# DRAFT Environmental Assessment For

Issuance of Four Scientific Research Permits for Cetacean Studies
October 2011

Lead Agency: USDC National Oceanic and Atmospheric Administration

National Marine Fisheries Service, Office of Protected

Resources

**Responsible Official:** James H. Lecky, Director, Office of Protected Resources

**For Further Information Contact**: Office of Protected Resources

National Marine Fisheries Service

1315 East West Highway Silver Spring, MD 20910

(301) 713-2289

**Location**: Pacific Ocean

Abstract: The National Marine Fisheries Service (NMFS) proposes to issue four five-year scientific research permits for takes of marine mammals in the wild, pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq.). Permit Nos. 16163, 16160, 16111, and 15569 would authorize varying combinations of research activities directed at cetacean species. Activities would include aerial surveys, vessel surveys for behavioral observations, photo-identification, underwater photography and videography, collection of sloughed skin and feces, sampling whale blows, passive acoustic recordings, export and re-import of parts, suction cup and implantable dart tagging, biopsy sample collection, and acoustic playbacks. Specific objectives for each permit vary, but all would continue long-term research on southern resident killer whales and other cetacean species.

# Contents

1.0	Purpose of and Need for Action	3
2.0	Alternatives Including the Proposed Action	4
3.0	Affected Environment	30
4.0	Environmental Consequences	48
5.0	Mitigation Measures	54
6.0	List of Preparers and Agencies Consulted	55
7.0	Literature Cited	55
	pendix A: Recent Environmental Assessments for Marine Mammal earch Permits	67
App	pendix B: Active Scientific Research Permits in the Action Area	71
Atta	achment 1: Proposed Action Take Tables	see attachment

#### 1.0 PURPOSE OF AND NEED FOR ACTION

# **Proposed Action**

In response to receipt of requests from applicants, NMFS proposes to issue Scientific Research Permits pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq.*), the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 *et seq.*), and the Fur Seal Act of 1966 (16 U.S.C. 1151 *et seq.*) for "takes" of marine mammals, including those listed as threatened or endangered. The applicants and their respective file numbers are:

Principal Investigator	File No.
Northwest Fisheries Science	16163
Center (NWFSC)/Brad Hanson,	
Ph.D.	
John Calambokidis	16111
The Center for Whale Research/	15569
Ken Balcomb	
The Whale Museum	16160

**Purpose of and Need for Action:** The MMPA and ESA prohibit "takes" of marine mammals and of threatened and endangered species, respectively, with only a few specific exceptions. The applicable exceptions in this case are an exemption for *bona fide* scientific research under Section 104 of the MMPA and for scientific purposes related to species recovery under Section 10(a)(1)(A) of the ESA.

The purpose of the permits is to provide the applicants with an exemption from the take prohibitions under the MMPA and ESA for harassment (including level A and B harassment as defined under the MMPA<sup>2</sup>) of marine mammals, including those listed as threatened or endangered, during conduct of research that is consistent with the MMPA and ESA issuance criteria.

The need for issuance of these permits is related to the purposes and policies of the MMPA and ESA. NMFS has a responsibility to implement both the MMPA and the ESA to protect, conserve, and recover marine mammals and threatened and endangered species under its jurisdiction. Facilitating research about species' basic biology and ecology or that identifies, evaluates, or resolves specific conservation problems informs NMFS management of protected species.

<sup>1</sup> Under the MMPA, "take" is defined as to "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

<sup>2 &</sup>quot;Harass" is defined under the MMPA as "Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but does not have the potential to injure a marine mammal or marine mammal stock in the wild (Level B harassment)."

Scope of Environmental Assessment: This EA focuses primarily on the effects on Southern Resident killer whales (*Orcinus orca*), humpback whales (*Megaptera novaeangliae*), blue whales (*Balaenoptera musculus*), fin whales (*B. physalus*), sei whales (*B. borealis*), sperm whales (*Physeter macrocephalus*), North Pacific right whales (*Eubalaena japonica*), Eastern and Western Steller sea lions (*Eumetopias jubatus*), Guadalupe fur seals (*Arctocephalus townsendi*), and Hawaiian Monk seals (*Monachus schauinslandi*) listed as threatened and endangered under the ESA, and one stock proposed for ESA listing, Hawaiian insular false killer whales (*Pseudorca crassidens*).

The National Oceanic and Atmospheric Administration (NOAA) has, in NOAA Administrative Order 216-6 (NAO 216-6; 1999), listed issuance of permits for research on marine mammals and threatened and endangered species as categories of actions that "do not individually or cumulatively have a significant effect on the human environment..." and which therefore do not require preparation of an environmental assessment (EA) or environmental impact statement (EIS). A possible exception to the use of these categorical exclusions is when the action may adversely affect species listed as threatened or endangered under the ESA (NAO 216-6 Section 5.05c).

There is no evidence from prior analyses<sup>3</sup> of the effects of permit issuance, or from monitoring reports submitted by permit holders<sup>4</sup>, that issuance of research permits for take of marine mammals listed under the ESA results in adverse effects on stocks or species. Nevertheless, NMFS has prepared this EA, with a more detailed analysis of the potential for adverse impacts on threatened or endangered species resulting from takes of a specified number of individual whales or pinnipeds, to assist in making the decision about permit issuance under the MMPA and ESA.

#### 2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

#### Alternative 1- No Action

Under the No Action alternative, Permit Nos. 16163, 16160, 16111, and 15569 would not be issued. This alternative would eliminate any potential risk to the environment from the proposed research activities, and the applicants would not receive an exemption from the MMPA and ESA prohibitions against take.

#### Alternative 2 – Proposed Permit:

Under the Proposed Action alternative, five-year research permits would be issued for activities proposed by the applicants for File Nos. 16163, 16160, 16111, and 15569 for takes of marine

<sup>3</sup> Since 2005, NMFS has prepared over 100 EAs for issuance of permits under the MMPA and ESA. In every case, the EA supported a finding of no significant impact regardless of the nature of the permitted take or the status of the species that were the subject of the permit or batched permits. These EAs were accompanied by Biological Opinions prepared pursuant to interagency consultation under section 7 of the ESA and further document that such permits are not likely to adversely affect listed species. A listing of recently completed EAs is provided in Appendix A.

<sup>4</sup> All NMFS permits for research on marine mammals require submission of annual reports, which include information on responses of animals to the permitted takes.

mammals during activities proposed by the applicants. These permits would include terms and conditions standard to such permits as issued by NMFS.

The types of research proposed by each applicant are summarized in Table 1; general descriptions of cetacean research activities and the specifics of each permit request follows. The activities listed for each permit in Table 1 would not all be conducted on all species targeted by that researcher. The focus of most research, and therefore the maximum types of research activities, varies between applicants. Specific species, take numbers, and activities for each application are listed in Attachment 1.

Table 1. Summary of locations and research activities requested in each application. All activities are not requested for all target species in each permit.

Location								Level B harassment						Level A harassment					
Applicant	California	Oregon	Washington	Alaska	Hawaii	High Seas	Aerial Surveys	Vessel Surveys	Close Vessel Approach, Behavioral Observations, and Photo- ID/Thermal imaging	Underwater photo/video	Passive Acoustic	Collect Breath Samples	Active Acoustic/Playback	Collect skin/fecal	Export/Re-import	Ultrasound	Suction Cup Tagging	Implantable Tagging	Biopsy
NWFSC No. 16163	X	X	X	X	X	X	X	X	X			X *	X **	X	X	X	X	X	X
Calambokid is No. 16111	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X
Balcomb No. 15569	X	X	X	X			X	X	X		X			X					
The Whale Museum No. 16160			X					X	X										

<sup>\*</sup> Breath Sampling includes sampling with a UAV.

#### **General Activities**

<sup>\*\*</sup> Playback includes activie acoustic playback and marine mammal imaging with an echosounder.

The research protocols are described in detail in each of the applications<sup>5</sup> on file for the action and are briefly summarized here. General descriptions of protocols are presented followed by more specific information for each applicant's request.

*Level B harassment* of large whales and small cetaceans would occur during aerial surveys, vessel surveys, ground surveys, behavioral observations, photo-identification activities, underwater photography and videography, passive acoustic recording, marine mammal breath sampling, acoustic playbacks, and marine mammal and prey field imaging with echosounders. Sloughed skin or feces would be collected from the water using a small net. This would only result in Level B harassment if a cetacean is within 100 yards of the vessel.

## **Aerial surveys**

Aerial surveys would be conducted using fixed-wing aircraft, rotary-wing aircraft, lighter than air craft and unmanned aircraft. Aerial surveys using fixed-wing aircraft would generally be conducted at an altitude of above 700 ft, with descents to a minimum of 300 ft for species identification and photo-identification. Helicopters would fly between altitudes of 750-1000 feet. Surveys would not be flown over pinniped haulout sites.

## Vessel surveys

Surveys may be conducted during any time of the year, but would be subject to vessel availability. Vessels would range in size up to ~150 ft (50m). Vessel surveys using random routes or line-transect sampling methods would be used to collect data for estimating abundance of cetaceans. During large vessel surveys, three to eight observers would rotate through at least three positions (port and starboard observers and a data recorder) during daylight hours, weather permitting (sea state of Beaufort 0-7 with minimal rain). The naked eye, 7x handheld, or 25x "bigeye" pedestal mounted binoculars would be used to locate marine mammals. The port observer would survey from 10° right to 90° left of the trackline and the starboard observer from 10° left to 90° right of the trackline. The recorder would scan the entire 180° area forward of the ship, focusing primarily on the trackline, using 7x reticled binoculars to confirm sightings.

The ship's global positioning system (GPS) unit or a handheld GPS would interface with a portable computer at the recorder's station. A standardized survey software program such as WinCruz would be used to collect standard line-transect information. The date, time, and position of the vessel would be automatically entered into the survey program every 5 min and whenever data are entered by the recorder. At the start of each trackline, observer positions and environmental conditions would be entered. Environmental conditions include sea state (Beaufort scale), swell height and direction, weather (rain, fog, no rain or fog, both rain and fog), horizontal and vertical positions of the sun, wind speed and visibility. Sighting information includes cue (blow, splash, animal), method (binocular type or naked eye), vertical distance (taken from reticles in the binoculars), angle relative to the ship's heading (from an angle ring on the binocular mount or an angle board), species, and group size (best, high, and low count). When appropriate, the survey effort would be temporarily suspended to approach a group to facilitate species identification or group-size estimation or to conduct other activities such as

\_

<sup>&</sup>lt;sup>5</sup> The scientific research permit applications will be available for review on the Applications and Permits for Protected Species (APPS) home page, <a href="https://apps.nmfs.noaa.gov">https://apps.nmfs.noaa.gov</a> and upon written request or by appointment in the respective NMFS Regional offices during the public comment period.

photo-identification, acoustic recording, or biopsy sampling before returning to the line transect point where the vessel disengaged and continuing the survey.

# Close vessel approach for photo-identification and behavioral observations

Vessels used for photo identification and behavioral observation would generally be less than 14 m in length. For large whales, boat approaches would be within a whale's length from an individual (ca. 10-15 m for an adult-sized whale), although a whale might approach the boat closer than this distance. For small cetaceans, boat approaches would be within 5 m.

Focal animal or group follows would be conducted, during which the behavior of the animal(s) would be recorded, pod composition determined, and behavioral roles identified when possible. Photographs of the tail flukes, dorsal fin shape, and distinctive scars and body markings of each member of a group would be taken. When feasible, behaviors would be videotaped. Observations and photography of the animal(s) would be of variable duration depending on circumstances, behaviors, social dynamics, and weather and water conditions.

During close vessel approaches for all activities (Level A and B harassment), disturbance to animals would be minimized by:

- ► Approaching at minimal speeds from behind or beside the group.
- ► Remaining parallel to the animals.
- ► Matching speed with the group.
- ▶ Minimizing changes in speed.
- ► Terminating activities if active avoidance is occurring.

## Underwater photography and videography

Blue, humpback, fin, and gray whales would be approached, observed and filmed underwater to observe behavior, document scarring, and examine presence of remoras and other parasites. Methods of observation would include pole mounted cameras and in-water divers.

#### Pole- or vessel-mounted camera

Underwater cameras would include devices ranging from a small pole mounted lipstick camera to larger vessel-mounted units that would be considered part of the vessel's superstructure. Very slow approaches or drifting in the vicinity of foraging animals would be conducted to within 5 m of animals to collect underwater video data.

#### Divers: Snorkel, Scuba, or Rebreathers

One to two divers would approach to within 5 meters of the whale and would remain less than 10 minutes in the water. Approaches would be terminated if repeated avoidance behavior was observed.

## Remote measuring/ Photogrammetry (aerial and laser techniques)

Photogrammetry is the technique of measuring objects (2D or 3D) from photo-grammes. These are commonly photographs but may also be imagery stored electronically on tape or disk taken by video cameras, charge-coupled device cameras or radiation sensors such as scanners. Images are generally taken from a high-speed aircraft flying at low altitudes. The camera is mounted in

the belly of the aircraft and takes large-format, motion-compensated photographs. For these research activities, altitudes between 750-1000 feet altitude are identified in the application for this technique. Photogrammetry techniques can also be used from vessels and most often in conjunction with photo-identification.

## Passive acoustic recording

Hydrophones or hydrophone arrays would be used for acoustic recordings of marine mammals. Generally, recordings would be of individuals already approached for behavioral observation and photo-identification or those encountered during line transect surveys. The vessel would not approach closer than 100 meters when towing an array.

## **Breath sampling**

Breath samples for health assessment would be collected using a pole system or Unmanned Aerial Vehicle (UAV).

## Pole system

The breath sampling device would be mounted on a long pole and would consist of a specially designed vacuum cylinder, a system previously used on several species (Rasmussen and Riddle 2004), algal culture plates, or nylon mesh. An algal culture plate inside the funnel would be used for bacterial cultures of the breath. Samples would be collected from free ranging whales by positioning a funnel at the end of a 6m pole (which is connected to the vacuum cylinder with plastic tubing) over the blowhole of the surfacing animal whose exhalation would manually open the cylinder valve for collection. The sampling equipment is not intended to touch the animal although in certain rare circumstances there could be brief (< 1 sec) contact.

#### UAV

The breath sampling device would be mounted on the remote controlled helicopter and consist of algal culture plates placed inside a funnel. The UAV would be maneuvered by an experienced operator and would be maneuvered to no less than 3 meters from the whale's blowhole and would remain above the dorsal fin height of a whale.

#### **Acoustic playbacks**

Playbacks would be conducted to determine whether particular classes of sounds evoke a mild alerting response in some large whale and small cetacean species. Sounds that cause mild alert responses could be used in the future to avoid vessel collisions, seismic exploration activities, and gear entanglements. A variety of sound types would be broadcast to tagged and untagged animals to determine their behavioral reactions. A ramping up procedure in which received levels are initially set to about 10 dB below the current generic acoustic thresholds would be increased in 5-10 dB steps until a behavioral response is observed or until the researchers reach a maximum level of 180 dB rms. Sound levels received by target species would not exceed 180 dB re:  $1\mu$ Pa, NMFS' and would meet the criteria for Level B harassment.

#### Playbacks would include:

- ► Simulated industrial sounds
- ► Control sounds including those naturally occurring, white noise, and other backgrounds signals.

#### Imaging marine mammals and prey with echosounders

Commercially available echosounders would be used to investigate the feasibility of using echosounder pulses for imaging and monitoring killer whales and other marine mammals. The operational range of echosounders used for imaging would likely be greater than 10m but shorter 500m.

Echosounders would also be used in the vicinity of marine mammals to investigate prey and prey resources.

## Collection of marine mammal parts and Export/Re-Import of samples

Parts of dead marine mammals associated with whale and dolphin predation events would be collected. Parts of marine mammals would be collected from the water using a skim net or sieve.

Sloughed skin and feces would be collected from large whales and small cetaceans following certain surface activities (e.g., breaching, tail slapping). Sloughed skin would be collected from the site of the surface activity only after the animals have moved greater than 100 yards from the location. Skin that remains attached to suction cups after tagging would also be collected.

The marine mammal parts and biopsy samples collected during research would be exported for analysis and remaining samples may be re-imported. The requested number of parts, specimens, or biological samples taken, salvaged and/or exported/re-imported is listed in Attachment 1.

*Level A harassment* would occur during ultrasound, genetic sampling, and suction cup and implant tagging activities. Level B harassment from vessel-based activities and underwater photography, as described above, would occur concurrently.

#### **Ultrasound**

Ultrasound would be used to examine blubber thickness of whales. A 12 meter cantilevered pole fitted at the end with a 0.5MHz ultrasound transducer would be used. The instrument would make contact with the back of a surfacing killer whale to obtain the blubber thickness measurement. Contact duration would last approximately one second. Stereo video cameras would be mounted on a 2m mast at the pivot point of the ultrasound apparatus to record the location of the ultrasound readings on the animals, allow time-coded video footage of the ultrasound take, and assist the researchers in estimating the length of the animals. (Moore et al. 2001). Individual animals may be approached within 100 m and calves less than 3 years old would not be approached.

## **Genetic sampling**

#### **Biopsy**

Skin and attached blubber tissue samples would be collected from large whales and small cetaceans using small, stainless steel biopsy darts ranging from 5-9 mm in diameter and 40-60 mm in length. Darts would be fitted with a flange or "stop" that regulates penetration depth of the bolt/dart and causes recoil after sampling. In no instance would the dart extend through the blubber to the muscle layer. Crossbows, most commonly with a draw of 68 kg (150 lbs), and

veterinary rifles using either compressed air or blank charges with adjustable pressure would be used for sample collection. Flotation material secured to the shaft of the bolt/dart would allow it to float and be retrieved after sampling.

Vessels would approach to within 10-30 m of the target animal. Darts would be aimed at the upper back just below the dorsal fin. Biopsy samples would be collected from both sexes and all age classes except neonates; species and take numbers are specified in the take tables for each permit (Attachment 1).

Bow-riding dolphins would be sampled using a handheld extendable pole (6 to 10 feet long) with rubber tubing attached to a trigger that allows the pole to spring forward 2 to 3 feet. Biopsy tips would be screwed to the tip of the pole and consist of sterilized bolts approximately 7 mm in diameter and 3 cm in length and sheathed in rubber tubing to prevent penetration of the skin beyond about 10 mm. The tip would contain three backward-pointing barbs to retain the sample. The resulting sample would consist of a plug of epidermal skin and blubber about 6 mm in diameter and 10 mm in length, taken from the dorsal surface of the animal.

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

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

Samples would be stored in 20% DMSO in saturated NaCl solution or 70% ethanol and/or stored at –20°C. Tissues remaining after analyses would be archived (by researchers or sent to NMFS' Southwest Fisheries Science Center for archival).

#### **Tagging**

Tags would be attached to large whales and small cetaceans via suction cup or implanted into the skin and blubber of animals, depending on the research objectives. Tags would contain a variety of components, depending on the objectives of the research, to record temperature, depth, sound, acceleration, position, pitch and roll, heading, heart rate, vocalizations and ambient noise, and video. Exact dimensions and weights would vary with the generation of tag and the specific components included; examples of current tags are provided in Table 2. Tags would be attached dorsally just in front of or beside the dorsal fin so that the antenna would be exposed when the animal surfaces. The tags would weigh less than 2500 grams (approximately 5.5 lbs) in air and maybe potted in syntactic foam, making them slightly buoyant in water. Most tags would weigh less than 500 g (approximately 1.1 lbs).

Advancements in technology have consistently led to smaller and more effective tags, and this trend is expected to continue in the future. Tagging equipment would be updated as newer models become available, and careful consideration of the primary research objective would be given before finalizing the tag package and deployment system to ensure that the smallest, lightest package is deployed.

Tagging would usually be conducted from small boats (less than 25 m in length), and only in relatively calm seas (i.e., Beaufort 0-2). Animals would be approached to within 2-30 m using

the methods described under *Close vessel approach for photo-identification and behavioral observations*. Tags would be attached using a hand-held or cantilevered pole or deployed with a crossbow or airgun. Behavioral responses of tagged individuals and of other animals in the group would be observed and recorded. In some instances, a hydrophone would be placed in the water to monitor acoustic response to tagging.

Tagged animals would be followed by boat at distances between 5 and 500 meters, depending on the species (larger species would be followed from a greater distance) and objectives, to monitor behavior and/or to obtain a trackline of movements. When possible, tags would be retrieved after they release from the animal. Photographs would be taken of the site of tag attachment to evaluate skin condition. In some instances, whales would be tagged twice annually or would receive multiple tags at the same time.

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

- ► Using sterilized tags for each tagging attempt.
- ▶ When possible, individuals would be identified prior to sampling to avoid duplication.
- ▶ Limiting tagging of age classes or specific individuals (*e.g.* Mothers and accompanied calves less than 6 months old. Conditions specific for each permit request).

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

Tag Type	Dimensions	Weight*	Attachment Method	Expected Attachment Duration
VHF/TDR tags	9.5 cm long 2.5 cm diameter	42 g, positively buoyant with floatation	Suction cup	6-8 hours; maximum 72 hours
DTAGs	12 cm x 5 cm	300 g in air	Suction cup	6-8 hours; maximum 72 hours
Bioacoustic probes	19.3 cm long 3.2 cm diameter	<1 kg	Suction cup	4-8 hours; maximum 48 hours
Crittercams	< 12 cm diameter < 35 cm long, including 15cm polyurethane flotation foam tail	< 2.4 kg	Suction cup	≤ 24 hours
Physiological tags	24cm x 8cm x 8cm	<400g	Suction cup/Dart electrode	<12 hours
Barnacle/Limpet/Dart type tags	Up to 6 cm x 5 cm x 2 cm	< 60 g	Two barbed titanium or stainless steel darts implant < 12 cm into blubber	Up to 25 weeks; with weak links to release within one year

<sup>\*</sup> Weight does not include floatation, housing, and attachments unless specified.

Suction cup tags would be attached to large whales and small cetaceans. Suction cups would be approximately 8-10 cm in diameter. Only the suction cups would be in prolonged contact with the animal's skin. Tags would release from the animal when the natural suction of the cup diminishes, or when a magnesium cap that corrodes in salt water causes the release of the tag. Tags would be retrieved by researchers upon release. The animal's behavior, including breaching, rolling, or rubbing, may cause the tag to shed prematurely. The amount of time that a tag would remain on an animal varies, but would generally be less than 96 hours. Attachments would likely last closer to six to eight hours (Lerczak et al. 2000, Croll et al. 2001, Calambokidis 2003, Witteveen et al. 2008).

## Examples of these tags include:

- ► VHF/TDRs
- ▶ DTAGs
- Bioacoustic probes
- Crittercams



Figure 1. Examples of various suction cup tags deployed off the US West Coast in past research by applicant. Top left is a Bprobe with floatation Top right is the MK10 Fastlock GPS tag, and at bottom is a National Geographic Crittercam (this is an older version, current V3 is smaller).

Satellite-linked transmitters would be used to quantify movement patterns and dive behavior of whales and dolphins. The transmitters send ultra-high frequency (UHF) radio signals to Argos receivers on five NOAA TIROS-N weather satellites. The signals are sent only when the whales come to the surface, and consist of a 750 ms phase-modulated transmission between 401.610 and 401.690 MHz.

Tags would be attached by implanting into blubber to varying degrees, depending on the species to be tagged and the desired duration of attachments. Attachment methods could include:

- ▶ Darts with backwards facing barbs (tag electronics external to animal).
- ► Implanted or partially-implanted electronics packages.

## Implantable Dart Tag

Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) tags with a dart attachment system would be used for satellite tagging effort. The tags provide location and depth information. These tags weight up to 59 grams and are approximately 6.3cm x 3cm x 2.2cm with a 17 cm long antennae. The dart portion is made from medical grade titanium and the lengths range up to 7cm with shorter lengths used to tag smaller species. The lower dorsal fin area or dorsal ridge is the target location for attachment. Tags would be expected to stay attached for up to 25 weeks and are designed to release after one year.

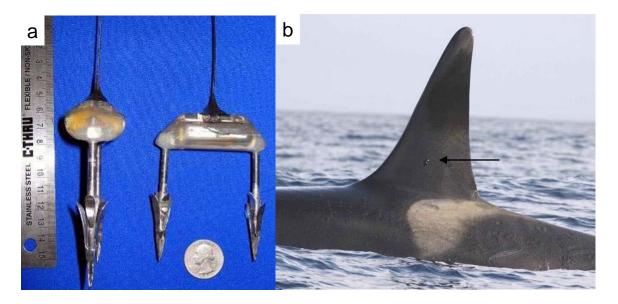


Figure 2: (a) Small satellite "dart" tag design (Unpublished data, Russ Andrews, Alaska SeaLife Center); (b) Tag successfully deployed on the dorsal fin of an adult male killer whale in the Aleutian Islands, Alaska (Unpublished data, NMML; Permit No. 782-1719).

# Physiological Tag [electrocardiogram (ECG) electrode]

The ECG tags (Figures 1 and 2) would be used to record data to study diving physiology. The tags measure both heart rate and body temperature. This tag package consists of two suction/electrode attachments connected by long thin wire (40cm) with an attached data logger. The electrodes are 4mm wide, made of steel or titanium, and penetrate up to 6.5 cm for larger

species and 3 cm for small species. These tags would attach to the side of the animal. The tag weighs up to 400 grams and can remain attached up to 2 days, detaching as the result of hydrodynamic drag.

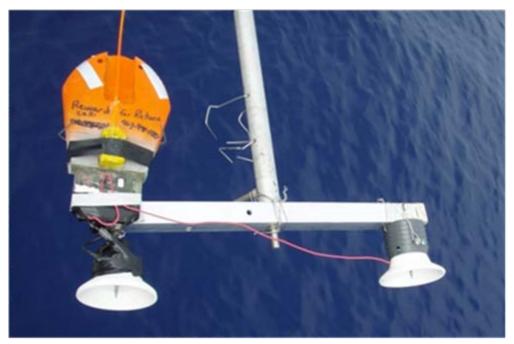


Figure 3. Modified cetacean ECG tag, with tag datalogger body tethered to the primary suction cup/dart electrode, attached to the deployment pole.



Figure 4. ECG tag attached to pilot whale off the Kona coast of Hawai'i.

# **Specific permit requests**

## NWFSC [Responsible Party: Brad Hanson] (File No. 16163)

This research would be a continuation of a long-term assessment of a variety of aspects of the biology and ecology of several cetacean species, with a particular focus on southern resident killer whales. The primary purpose is to obtain information relevant and critical to the management and conservation of species, populations and their key habitats. These activities include monitoring the abundance of cetacean stocks, determining stock structure and population dynamics, determining habitat relationships, and assessing the impact of human activities on these populations of the Pacific Northwest. These efforts support many of the actions of Tier I-III of NMFS stock assessment improvement plan (NMFS 2004).

The proposed activities would take place periodically throughout the year primarily in the inland and coastal waters of Washington and Oregon encompassing the U.S. EEZ. Additional effort would extend into inlands and coastal U.S. EEZ waters of California, Alaska and Hawaii; and the high seas of the North Pacific Ocean.

Directed research would involve a combination of activities, as described in *General Activities*, including:

- ► Vessel and aerial approach for behavioral observation and photo-identification
- Underwater photography/videography
- ► Passive acoustic recording
- ► Breath sampling
- ► Acoustic playbacks, as detailed below
- ► Collection of sloughed skin and feces
- ► Collection of prey parts
- ► Export of parts
- Ultrasound
- ▶ Biopsy sampling
- ► Suction cup tagging
- ► Blubber attachment tagging

Specific details or variations from activities described in *General Activities* are described here.

## Playback Activities

Various acoustic signals (Table 3) would be directed at southern resident killer whales in order to determine whether particular classes of sounds evoke a mild alerting response. Multiple species may be incidentally taken during the playback episodes. All playbacks would be deployed from an autonomous playback device with a self-contained power supply and electronics that permit it to be deployed without external connections to a power or signal source.

Playbacks and scoring of responses to playbacks would be conducted on small research vessels. The playback procedure would involve scoring of behaviors observed during baseline/pre-exposure, exposure (either experimental or control playback) and post-exposure observations to determine any effects of the playbacks on whale behavior. The duration of behavioral scoring for post-exposure conditions would be conducted until behaviors return to baseline after the exposure (~30-60 min). Ideally, playbacks would be conducted when at least one individual in a

group is tagged using a suction cup archival tag (DTAG), that has both acoustic and dive movement sensors.

In additional to the acoustic recordings obtained from the DTAG, researchers would monitor and record playbacks acoustically using a calibrated hydrophone in the same frequency ranges as the playback sounds as listed in Table 3.

Playbacks would be terminated if any animals in the playback area exhibit behaviors that fall into severity scores of 7 or higher as described in Southall et al. 2007. These include extensive or prolonged behaviors associated with aggression or aversion (jaw clapping/gnashing teeth, aggressive behavior displayed at and including physical contact with the loudspeaker or research vessel associated with the sound source), severe avoidance of the sound source/the research vessel associated with the sound source/area in which the playback occurred, and extensive and prolonged changes in group cohesion.

Groups that include calves less than 1 year in age would not be targeted for playback. Calves (individuals less than 1 year of age) would be determined from known age of SRKWs based on photo-ID records conducted by the Center for Whale Research (see Ford et al. 2000). The target sample size would be at least 10 tagged individuals/groups per playback sound type per year of the study. It is possible that the same individual (either tagged or not tagged) would be exposed to multiple playback series given the social structure of resident killer whales. A targeted individual would be intentionally exposed to a playback series only once per day and only five times total per year to avoid potential cumulative disturbance and also potential habituation affects to the playback exposures.

Table 3. Description of sound types for playbacks.

Sound type	Frog	Doggivad	Source	Duty ovolo	Playback	Pulse	Doct
Sound type	l Frea	Received	Source	Duty cycle	Flavback	I I uise	l Rest

	range	level	depth		Duration	length	duration
Simulated vibratory pile driving playback	500 Hz – 20 kHz	Up to 180 dB rms	5-20 m	continuous	Up to 3 min	Up to 3 min	NA
Simulated impact pile driving playback	500 Hz – 20 kHz	Up to 180 dB rms <sub>90%</sub>	5-20 m	Up to 20%	Up to 3 min	Up to 0.2 sec (length of 90% energy)	Between 0.8-0.9 sec
Control sounds such as white noise, recorded wave sounds, precipitation, background sounds also presence in experimental playback with the simulated pile driving sounds removed	500 Hz- 20 kHz	Up to 180 dB rms	5-20 m	Will be matched to simulated pile driving sound playback	Up to 3 min	Up to 3 min	Will be matched to simulated pile driving sound playback

## Marine mammal and prey imaging with echosounders

Marine mammals would be exposed to echosounder pulses as detailed in Table 4. Due to the width of the echosounder beam, at a 50 m distance, only marine mammals shorter than 5 m may be imaged. Killer whale females are around this length so the off axis energy at 100 kHz is approximately just at hearing threshold (Szymanski et al.1999) in low noise conditions at 50 m when spreading loss and absorption are taken into consideration. This is likely an overestimated assessment because echosounder pulses are directional so this exposure level would only occur when the marine mammal is within the beam of the pulse. Porpoises are the smallest marine mammals to be imaged so shorter ranges are possible and thus, they may be exposed to off-frequency energy but they would never be exposed to sound pressure levels above 180 dB rms. Baleen whales and pinnipeds would not be able to hear any off-frequency energy given their hearing ranges (Southall et al. 2007).

Echosounder pulses (Table 5) would be used to image prey fields in marine mammal habitat but only when marine mammals are likely to be absent, which would be determined by visually monitoring the area during data collection. The pulses would be much shorter (1 ms or less) than auditory temporal integration time constants of marine mammals. That is, marine mammal hearing thresholds increase (hearing sensitivity decreases) exponentially as sound duration decreases for all sounds shorter than the time constant. So, these signals would be weak from the perceptual perspective of the animal.

Only porpoises and smaller delphinids would be able to hear the echosounder. If any of these are sighted within visual range of 100 m, then the echosounder would be turned off and data

collection would cease until the animal(s) are outside this range so that potential exposure would always be equal or less than 180 dB.

Table 4. Description of Echosounder Pulses for imaging marine mammals.

Sound type	Freq	Received	Source	Duty	Duration	Pulse	Rest
	range	level	depth	cycle		length	duration
Echosounder	100-	Up to	1-50 m	Up to 3%	Up to 2	0.1-1	33 ms -
pulse	240	180 dB			hrs	ms	10 sec
	kHz	rms <sub>90%</sub>					
		(from					
		100-180					
		kHz)					

Table 5. Description of Echosounder Pulses for imaging prey fields.

Sound type	Freq	Received	Source	Duty	Duration	Pulse	Rest
	range	level	depth	cycle		length	duration
Echosounder pulses	34-462 kHz	Up to 180 dB rms <sub>90%</sub>	1-50 m	Up to 3%	Up to 8 hrs	0.1-1 ms	33 ms - 10 sec
		(from 100-180 kHz)					

## **Breath Sampling**

Individuals would be approached up to three times for breath sampling. The vessel would approach to within 5m for pole sampling, and the UAV would be maneuvered to no closer than 3m and would remain above the dorsal fin height.

#### Ultrasound

For the first year of the study, up to 10 adult Alaska resident killer whales would be approached to assess the utility of using this measurement to assess the health and nutritional status of individual killer whales. After the techniques are proven for this population of killer whales, up to 25 Alaskan resident killer whales may be approached annually for ultrasound measurements. Sampling would be conducted during discrete one month periods. Individual animals may be approached within 100 m up to three times per year to attempt ultrasound measurements, but no more than two measurements would be taken from each individual animal per year. No calves less than 3 years old would be approached for measurements.

## Biopsy sampling

Individuals would be approached up to three times in one encounter for biopsy attempts and up to ten attempts could be made annually. Multiple biopsies over time are necessary to assess persistent organic pollutants.

Measures described by the applicant to minimize effects to animals include:

- ► Coordination with other researchers to avoid harassing the same whales.
- ► If disturbance is evident (i.e., changes in behavior, stress vocalizations, abrupt shifts in direction of movement, apparent displacement) the approach would be terminated.
- ► Individuals known or estimated to be <3 years old would not be sampled.
- ► Encounter duration would be limited to 45 minutes.

# Tagging Activities

<u>Suction Cup:</u> No more than two tagging attempts per individual per encounter, or four tagging attempts per individual per year, would be made. Individuals would not be tagged more than once per year. No tagging attempts would be made on calves (i.e., whales in association with an adult female, or of a size that would be typical to be in association with an adult female); however, the NWFSC is requesting to tag animals accompanying calves.

<u>Implantable Tags:</u> Sex and age classes to be tagged include adult and juvenile males and females. No tagging attempts would be made on calves estimated to be less than one year of age or females accompanied by calves less than six months of age. Extra care would be taken when tagging females which have calves older than six months present to avoid any unnecessary risks. For Southern resident killer whales (SRKW) only specified adult males and post-reproductive females would be tagged (a list of whales determined eligible for tagging would be updated annually); no reproductive age females or juvenile whales would be tagged.

Individual whales may receive both a suction cup and implantable tag (refer to Attachment 1 for more information by species). Tagged whales would be tracked to monitor post tagging effects for as long as time, whales, and sea state permit. Monitoring would include photographing the attachment site to evaluate tag attachment to the body (skin condition) and tag movement and observing whale behavior.

## Calambokidis (File No. 16111)

The applicant requests authorization to continue long-term studies designed to examine marine mammal abundance, distribution, population structure, habitat use, social structure, movement patterns, diving behavior, and diet. The proposed research would also assess the impact of human activities such as ship strikes, noise exposure, contaminants, and fishery interactions on marine mammals. Focal species are endangered blue, fin, humpback, and sperm whales; and eastern gray and beaked whales. An additional 15 cetacean species and five pinniped species would also be studied, including the endangered sei and southern resident stock of killer whales; and the threatened eastern stock of Steller sea lions. The main objectives of the pinniped research are to 1) census harbor seals and other pinnipeds to examine occurrence and abundance primarily in the Puget Sound region; 2) determine mortality and contaminants in harbor seals and other pinnipeds in Washington State; and 3) examine food habits of harbor seals through collection of scat. See Attachment 1 for the proposed take table.

The proposed activities would take place throughout the year in international and U.S. waters of the eastern North Pacific from Central America to Alaska.

Directed research would involve a combination of activities, as described in *General Activities*, including:

- ▶ Vessel and aerial approaches for behavioral observation and photo-identification
- ► Ground surveys for pinniped population estimates and to collect scat
- ► Collection of sloughed skin and feces
- ► Collection of prey parts
- Underwater photography/videography
- ► Passive acoustic recording
- ▶ Imaging marine mammals and prey with echosounders
- ► Breath sampling
- ► Biopsy sampling
- ► Suction-cup tagging
- Dart tagging

Specific details or variations from activities described in *General Activities* are described below.

#### Aerial Surveys

Aerial surveys would be used to a limited degree to estimate the distribution and abundance of marine mammals in specific regions as well as to assist in locating concentrations of animals for more effective targeting of vessel-based effort and photo-ID. The applicant would also occasionally use aerial surveys to assist in locating VHF signals from tagged animals where the signal may be undetectable from the water's surface. Aerial surveys would be conducted in several aircraft types, depending on the target species and research objectives. For prolonged surveys in waters farther from shore, such as when conducting line-transect surveys for harbor porpoise or other cetaceans, the applicant would use high-wing twin-engine aircraft like the Partenavia Observer. Nearshore scouting surveys for animals would sometimes be conducted from single-engine aircraft. Biological data collected during aerial surveys include: species, number of animals, perpendicular distance from the transect line, direction of travel, and general behavior. Date, time, and position (using a GPS system) would be recorded each minute. Beaufort sea state, cloud cover, sighting conditions, and glare would be noted at the beginning and end of each transect and when significant changes occur. The data would be used to determine the distribution and abundance (and density) of marine animals within the study area.

Vessel operations (including surveys, photo-ID, behavioral sampling, and collection of feces) Field research would be undertaken from a variety of platforms, primarily small (5-11 m) power vessels, although on occasion larger vessels (10-40 m) may be chartered for offshore surveys. The primary vessels the applicant would employ would be 5.3-5.9 m rigid-hulled inflatable boats (RHIBs) with outboard engines. These vessels would be used to cover coastal waters out to 50 nm offshore during coast based surveys and farther offshore waters when deployed from larger vessels on multi-day surveys. The boats would be transported from one region to another by trailer so that the researchers can easily respond to changes in whale distribution along the entire US west coast. A number of opportunistic platforms may also be used to obtain additional

identification photographs. The applicant would place trained photo-identification personnel on several ship cruises conducted by National Marine Sanctuaries, Southwest Fisheries Science Center (SWFSC) and Scripps Institute of Oceanography.

All cetaceans observed would be approached close enough to identify the species and obtain photographs to confirm species for difficult-to-identify species. Depending on location and the specific survey purpose, more extensive work may be conducted. Photographs of bow-riding animals would also be taken on an opportunistic basis. Approaches would be conducted or supervised by experienced boat drivers. Vessel approaches would typically be done slowly and the vessel maneuvered to approach an animal or group of animals from behind or the side to minimize potential disturbance.

Photo-identification would be used to determine abundance, distribution, and movements of whales. This method would also be used by the applicant to examine aspects of reproduction and mortality rates in large cetaceans. Photo-identification approaches typically would last from a few minutes up to an hour, depending on the sea conditions, time of day, species encountered, behavior and research goals. The animals would be approached closely enough to optimize photographic quality, which varies by species. Generally, animals would be approached to an optimal distance of 50-100 m. Identification photographs would be taken with digital SLR cameras equipped with telephoto lenses (100-400mm). For humpback whales, photographs would be taken of the ventral surface of the flukes. For blue and gray whales, the right and left sides of the animals' backs the vicinity of the dorsal fin or hump would be photographed; flukes would be photographed when possible.

Behavioral work would involve focal follows (primarily undertaken at a distance from which the vessel would not disturb the individuals being followed) with continuous information recorded on group size, composition, distance between and orientation of individuals, directionality of travel.

location, interactions with other species, and the occurrence of specific behavioral events (e.g., breaches, spyhops, tailllobs, prey captures). The maximum duration for a focal follow would be eight hours.

During vessel surveys, fecal material may be visible in the wake of an animal. When possible, this material would be scooped up and preserved for analysis. Samples would be used to determine prey and would be sent to SWFSC, NWFSC, or Scripps Institution of Oceanography.

## *Ground surveys (including collection of scat)*

Ground surveys would consist of population counts and scat collection to study harbor seals and other pinnipeds at haul-out areas in Puget Sound and throughout Washington. Seal scat would primarily be collected during periods when animals are not present to avoid disturbance. In some cases low numbers of animals may be present and the collections may result in disturbance of animals. As reflected in the small number of takes requested, this would be kept to a minimum. Censuses of pinnipeds, primarily harbor seals, on haul-out areas would be conducted using a spotting scope from distances of 100m or more.

*Underwater photography/videography* 

For blue, humpback, fin, and gray whales, the applicant proposes to conduct limited underwater observations and filming (less than 100 approaches per year per species). The objectives of this research are to:

- examine underwater behavior of whales including feeding, vocal, and swimming behavior,
- allow documentation of rates of scarring from killer whale attacks, entanglement, or ship strikes and compare these rates with those determined from above water photography only, and
- examine the incidence and body position of remoras and other parasites.

Underwater filming would be conducted by several means including use of a pole-cam or camera held over the side of the boat as well as approaches made by 1-2 divers in the water equipped with snorkel, scuba, or rebreathers depending on the situation. Divers would approach whales only close enough to obtain good visibility of the whale. Visibility conditions vary quite a bit but the researchers do not anticipate approaches to closer than 5 m of the whales. Divers would not be in the water longer than 10 minutes at a time.

#### *Imaging marine mammal prey*

Prey occurrence around whales would be examined with hydroacoustics, especially in the region where suction-cup tags would be deployed on whales to examine diving and feeding behavior. All of the RHIBs are equipped with dual-frequency (50-200 Khz) compact commercial depth sounder units with a transom mounted transducers: Lowrance models HDS-5 (output levels are maximum 250W Peak to Peak, 31W RMS actual) and LCX 15 (output max of 8,000W Peak to Peak). Both of these units are designed for small boats and are below the power of typical of larger vessel units. The applicant's procedure is to have these units on during operations around baleen whales but off when operating around or surveying for beaked whales. Data from the depth sounders would be used to characterize type of prey (based on comparison of returns between 50 and 200 KHz signals). No special surveys would be conducted to systematically map prey fields but returns are examined from near the location of the whales incidental to the photo-ID and suction cup tag research.

#### Breath sampling

Microbial sampling would be undertaken from small boats. When conditions are appropriate (e.g., light winds, cooperative animals), samples may be collected from individual whales or dolphins otherwise approached for photo-identification. Collection material (e.g., media plates and/or a custom nylon mesh system for collecting exhaled mucous, or vacuum collection container) would be secured to a 3-6 m aluminum or carbon fiber pole. The sampling media would be passed through the exhaled plume over the blowhole after surfacing. There would be no contact with individual whales or dolphins during the procedure. Many samples can be collected from bowriding animals. No reaction is expected from these species (e.g., melonheaded whales, false killer whales, bottlenose dolphins, spinner dolphins, pantropical spotted dolphins, common dolphins, Dall's porpoise), although takes have been included in the case of inadvertent reactions. Reactions by other species are expected to be the same as from vessel approach, which already would be occurring during research activities (e.g., photoidentification). Most samples would be stored on ice or frozen in liquid nitrogen in the field, and frozen for shipping. Analysis of samples would be conducted by several labs including Hawaii

Pacific University, Woods Hole Oceanographic Institution, and IDEXX Laboratories, Grafton, MA.

Collection of skin (free floating and via biopsy)

Skin samples would be collected to examine genetic relatedness, population structure, and sex of individual whales. Samples would also be used for determination of pregnancy status based on hormone levels (Kellar et al. 2006) as well as other tests including contaminant levels (Krahn et al. 2001, Elfes et al. 2010).

Researchers would search the water column in the wake of humpback and blue whales for sloughed skin. This technique has been effective with several species of whales including blue whales off Mexico. Skin samples would be scooped out of the water and preserved for analysis.

Biopsy samples would be collected from whales using the crossbow method described in *General Activites*. An untethered free-floating bolt would generally be used. In some situations (for example when biopsying from a larger ship), a light breakable tether line would be used to aid dart retrieval. Samples would generally be shipped to SWFSC for archiving and long-term storage. Samples collected are would be archived and extracted at SWFSC prior to being provided to other collaborating researchers.

For the large whales that are the focus of the research (blue, fin, humpback, and gray whales), the applicant proposes to biopsy sample calves over four months of age and mothers associated with calves of that age. Calves of other species would not be sampled.

# **Tagging**

## Suction-cup tagging

Suction-cup tags would be attached using a long pole (4-7m) to make direct contact with the whale or by using a crossbow. During these types of close approaches, the boat driving would be closely supervised or conducted by personnel with extensive experience operating around whales. The vessel would approach the individual from behind and attempt to match the animal's speed, closing to the length of the pole. Many of the species that would be targeted for suction-cup tagging are small odontocetes which frequently bowride. These animals would be tagged while riding the bow wave of the vessel.

In an encounter to place a tag, each individual whale would be approached no more than three times. Researchers would attempt to place the tags high on the back of the whale mid-way between the blowhole and the dorsal fin. No attachments would be targeted forward of the pectoral fins.

Tags would consist of:

- suction cups to attach to the animal (typically one to four),
- syntactic foam (to float the package once it falls off),
- the instrument package, and
- a VHF transmitter.

Instrument packages would include a combination of the following instruments and devices:

- Hydrophone and recording system for underwater vocalizations
- Pressure sensor to record water depth
- Sensor to monitor and record water temperature
- 3-axis accelerometers to measure pitch and roll of animal
- 3-axis solid state magnetometers to measure heading
- Conductivity switch to control underwater instrument activation
- VHF tag to provide local positioning information
- Satellite tag to record long-range movements
- Underwater video camera to record behavior and prey

Tags would generally remain attached for a few hours to a few days, and simply fall off the individual when they lose suction. The tags float to the surface and can be recovered by tracking them down using the VHF signal emitted by the tag. Some systems like the Crittercam would have release mechanisms since the Hi-8 Crittercam system can only record continuously for 2-4 hours. The Burgess acoustic tag would not have a release because the goal is to deploy the tag for as long as possible and this system can gather and store information (depending on sampling rate) for many days (typically one to four days).

The heaviest tag proposed is the Hi-8 version of the Crittercam which weights 2.4 kg. All other systems weigh considerably less than that and an ongoing goal of the researcher would be to continue to shift towards smaller and lighter systems. The primary tag, the Burgess bio-acoustic probe, weighs under 1 kg and is currently packaged in resin in a cylindrical form measuring 19.3 cm long and 3.2 cm diameter. Flotation and VHF transmitter roughly double this length.

## Dart tagging

## **Satellite tags**

The applicant proposes to use the Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) tag (Andrews et al. 2008, Schorr et al. 2009), with a dart attachment system. This system is currently in use by other researchers working with killer whales in Alaska and in the Antarctic, as well as beaked whales and several other species in the Bahamas, and these tags have been successfully deployed by Cascadia Research (e.g., Schorr et al. 2009, Baird et al. 2010) on 14 different species: bottlenose dolphin, Risso's dolphin, killer whale, short-finned pilot whale, false killer whale, melon-headed whale, pygmy killer whale, Cuvier's beaked whale, Blainville's beaked whale, sperm whale, fin whale, blue whale, minke whale and humpback whale.

Dart length would vary by species, tags used on smaller species (e.g., bottlenose and Risso's dolphins) would have shorter dart lengths than those for large whales. These differences are based on the target location on the animal (dorsal fin vs. back) and blubber thickness. Currently, the longest darts in use for smaller cetaceans are 7cm in length. When the transmitter is deployed flush on the dorsal fin the backward facing petals would be located below the vertical sheath of the dorsal fin (the tissue layer with the greatest structural integrity) in order to provide the most secure anchoring. For large whales, the dorsal ridge/back is the primary target. The applicant is requesting a maximum depth of 12cm for the dart depth (maximum shaft length) for species like humpback, gray, and sperm whales with blubber depths typically larger than this.

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

## Physiological tags

The tag for recording physiological variables, including heart rate, is an archival tag where information is stored on-board the tag during the attachment, and then it must be retrieved for data downloading. The tag is buoyant and capable of releasing easily from the tagged whale. The tag weighs between 200 and 400 grams depending on battery configuration and in its largest configuration would measure approximately 24 cm by 8 cm by 8 cm.

The physiological tag would be attached to the dorsal surface of the target animal, near the dorsal fin. The tag would be deployed primarily using a pole (if smaller configurations are developed then delivery with a cross-bow or an air gun may become an option). The tag adheres to the whale with a combination of suction cup and dart electrodes. In order to pick up the biopotential of the ECG, the tag is connected to two electrodes that must be in contact with the body of the whale. The tag would be held to the tagged individual with two suction cups that include a small dart electrode and are attached to each other with a thin wire.

For larger species (short-finned pilot whales, killer whales, false killer whales, Blainville's beaked whales, Cuvier's beaked whales, Baird's beaked whales, Longman's beaked whales), the electrode darts would penetrate no more than 6 cm into the tagged individual (current darts used for satellite tagging of these species measure 6.5 cm). For small species (pygmy killer whale, melon-headed whale, bottlenose dolphin, rough-toothed dolphin, Risso's dolphin, dwarf sperm whale, pygmy sperm whale) the electrode darts would penetrate no more than 3 cm. The suction cup would hold the tag to the body for a limited time, but once the suction cup breaks free, then the drag of the tag would pull the dart electrodes out and the tag would float at the surface for retrieval.

#### *Multiple methods*

Some animals would experience a suite of research activities, including biopsy sampling and having multiple tags attached. Typically, animals would be photographed first and often the same approach would be used to attempt to tag or obtain a biopsy sample.

Generally animals may receive two tags, but in rare cases, the researcher may choose to attach three tags to the same animal. Some potential tagging configurations:

• Multiple complimentary suction-cup tags: if possible, attached on the same approach. This would usually consist of the deployment of an acoustic tag like the Bprobe in

combination with a Mk10 Fast-lock GPS tag (that does not have acoustics). While both tags records depth, they have other capabilities unique to each tag that complement each other. Deployment of these on the same approach using two taggers with two poles causes fewer disturbances than doing so on two separate approaches.

• Deployment of a suction cup tag and a dart tag on the same individual: this is unlikely to be deployed on the same approach due to differences in approach distances and angles ideal for the two deployments. No more than 20% of deployments of either tag type would be on individuals subjected to both procedures. The long-term dart tags would provide movement data and summarized depth information that would complement the high resolution but short-term information provided by the suction cup tags and would aid in tag calibration and testing. In cases where species are rarely encountered (e.g., Cuvier's beaked whales, Longman's beaked whales, false killer whales), tagging with both a dart/satellite tag and a suction-cup attached data logger would allow simultaneous collection of information on both movements and detailed diving/acoustic behavior.

# The Center for Whale Research (CWR)/Balcomb (File No. 15569)

The applicant requests authorization to continue long-term studies (most recently authorized under Permit No. 532-1822-02) with the goal of determining the population size and structure of the ESA listed SRKWs and other ecotypes of killer whales throughout their range. Other non-target species that may be opportunistically taken include 17 cetacean species and four pinnipeds species. Those species that are listed as endangered include the blue, fin, sei, humpback, and right whales; in addition to the threatened eastern stock of Steller sea lions. See Attachment 1 for the proposed take table.

The proposed activities would take place periodically throughout the year in the Eastern North Pacific Ocean primarily in the inland waters of Washington state with additional opportunistic effort from California to Alaska and out to 200nm offshore.

Directed research would involve a combination of activities, as described in *General Activities*, including:

- ▶ Vessel and aerial approaches for behavioral observation and photo-identification
- ► Remote measuring/ Photogrammetry (aerial and laser techniques)
- ▶ Passive acoustic recording
- ► Collection of feces
- ► Collection of prey parts

Specific details or variations from activities described in *General Activities* are described here.

## Vessel Approaches

(for behavioral observation, photo-identification; and collection of feces and prey parts)
CWR has an assortment of vessels available for research activities ranging from a 16' aluminum skiff to a 65' sailboat. Use of a particular vessel would be dependent on the weather conditions, geographic area, available personnel, and specific tasks to be conducted. Up to two vessels would be used in an encounter with the whales to maximize research effort. The vessels up to

25' are gas outboard powered, the trawlers are diesel inboard powered, and the sailboats are sail powered with auxiliary diesel power.

Target animals would be approached to within 100 yards and would be abandoned if approaches cause any response that rises to a level of biological significance (terror, abandonment of habitat, cease reproduction, etc.). The number of times an animal may be approached during an encounter is variable, and can often only be determined in post-analysis. The maximum duration of an approach encounter would be ten hours, but is dependent on the species. Attempts to approach an individual or a cohesive group of killer whales within 200 yards might typically include up to ten attempts within a maximum duration of four hours. Humpback whales could be approached within 100 yards during up to five approach attempts within a maximum duration of 30 minutes.

The vessels would operate at the most efficient hull speeds in survey mode, slow to approximately the whales' speed at a distance of approximately one-quarter mile, and gradually adjust slow speed to parallel (e.g., photo-identification KW mode – typically side view photography), or to be behind for photographing flukes (e.g., humpback mode), and fecal or prey collection.

# Aerial Approaches

(for remote measuring and photo-identification)

The following aircraft could be utilized depending upon weather conditions, geographic location, personnel available, and specific tasks to be accomplished: single engine amphibious aircraft, twin engine aircraft, helicopter, and lighter than air craft (eg. Zeppelin). These aircraft would fly at a survey altitude of 750-1000 feet.

# Photo-identification

Photo-identification is primarily accomplished using digital photography, either DX or full-frame 35mm digital, or HD and other high resolution video and telephoto lenses; however, 35mm film cameras, telephoto lenses, and archival curation would be employed. The images would be maintained and backed-up on computers on site and off site. The analysis of images would be done on site using CWR proprietary methods and experienced personnel for "matching."

## Remote Measuring/Photogrammetry

Photogrammetry morphometric measurements are based on photographing two laser dots that have been projected onto the body of a whale using two small laser-pointers (Durban et al. 2006). These laser-pointers are mounted in a parallel orientation to maintain a fixed and known separation distance. The dots provide a scale of known dimension on the image of the whale that can be used to calibrate morphometric measurements. This laser setup can be mounted on a camera lens and implemented in conjunction with photo-identification studies by a single photographer.

CWR has also utilized photogrammetry methods via an aerial platform to obtain precise estimates of full body size photogrammetric measurements of cetaceans (Fearnbach et al. 2011), due largely to the ability of helicopters to hover at a fixed (and known) altitude and make

relatively subtle adjustments in location to remain directly overhead of target animals. While directly overhead the target animal, the photographer would shoot photographs using a hand-held digital SLR camera with a bubble-level attached to the back of it to ensure that the camera was orientated vertically. Photographs would be taken when the whale was at the water surface and parallel to the water surface. The GPS and camera time would be synchronized so that each image can be linked to a specific altitude using a relational database.

#### Passive Acoustics

Passive acoustic sampling would be conducted using both fixed hydrophones and towed hydrophones or sonobuoys from near surface to 200' depth in the whales' habitat. The acoustic recordings are archived digitally and backed-up on computers on site and off site.

## The Whale Museum (File No. 16160)

The proposed research is to monitor and record vessel activities around marine mammal species routinely encountered by commercial and recreational vessels in the inland waters of Washington State. This research would contribute to a long term data set (Orca Master) that has provided critical information on characterizing annual vessel trends around Southern Resident killer whales. Through this research the effectiveness of federal, state and local marine wildlife guidelines and regulations through the Soundwatch program could be evaluated. Data collection would consist of: 1) counts of vessels near wildlife by type, location and activity; 2) wildlife/whale identification, location, travel direction and selected behaviors; 3) vessel information (port, number of passengers, knowledge of guidelines/regulations); 4) commercial and private vessel compliance with voluntary guidelines and/or regulations; and 5) vessel behaviors in designated Marine Protection Areas (MPAs). All Soundwatch data on marine wildlife/whale identification, location, travel direction and selected behaviors is incorporated into The Whale Museum's whale long-term sightings database and Orca master database. These efforts support the actions listed under B.6.2.1 and B.6.2.2 in the Southern Resident killer whale Recovery Plan (NMFS 2008). Research activities for this project would focus on Southern Resident killer whales and other species would also be targeted for research. Species and take numbers are specified in Attachment 1.

The researchers intend to conduct surveys year round but most surveys would occur every day from May – October. The proposed action area would include the Haro Strait region, Columbia River, and offshore waters of Washington State, and the southern waters of Vancouver Island, British Columbia, Canada.

Directed research would involve the following, as described in *General Activities*:

▶ Vessel approaches for behavioral observation, photo-identification, and monitoring

Specific details or variations from activities described in *General Activities* are described here.

Vessel Approaches (for behavioral observation, photo-identification, and monitoring) The Soundwatch program operates from a 19-foot S.A.F.E. (Safe All-around Flotation Equipped) boat with a 179 hp Volvo/Penta diesel inboard engine and a dual stainless steel

propeller. Vessel and whale monitoring would be conducted continuously using binoculars, laser range-finders and radar to determine whale locations, direction of travel, behaviors, and commercial and private vessel compliance to the voluntary guidelines and regulations. Vessel incidents are recorded opportunistically using Soundwatch Vessel Incidents data sheets as they are observed. Every time a vessel is seen, vessel information would be recorded on a Soundwatch Vessel Contact data sheet. Surveys of whales and a count of vessels within one half-mile of whales would be collected every half-hour (on-the-hour and half-hour) using a Soundwatch Vessel Count/Whale Survey data sheet.

Measures described by the applicant to minimize disturbance to animals include:

- ► Researchers immediately shut down the engine when the survey vessel is within 100 yards of marine mammals.
- Researchers would put the engine into neutral, and let the animal(s) pass beyond 100 yards before engaging the engine and moving to a greater distance away.

## Permit Duration:

The proposed permits would be valid for five years from the date of issuance, which is the maximum duration of an MMPA permit. A single one-year extension of these permits may be authorized and would be considered a modification, pursuant to NMFS regulations at 50 CFR §222.306.

If granted, a one-year extension of these permits would only allow "takes" of marine mammals that were not used in the last year of the permit; these remaining takes would be carried forward into a sixth permit year. The extensions would not change any other terms or conditions of the permits. NMFS does not consider a one-year extension of this nature to represent a substantial change to the proposed action that involves changes in environmental impacts. As such, NMFS would not prepare a supplemental EA for the one-year extension unless significant new information or circumstances relating to environmental impacts is available (e.g., a change in the status of the target species, listing of new threatened or endangered species in the project area).

#### Target Species or stocks:

The applicants' research is directed at 38 species of cetaceans (including their individually managed stocks) (Attachment 1). The requested actions involve Level A and B harassment that may indirectly affect seven pinniped species. The permits would exempt takes of all these marine mammals that could be potentially disturbed. This is consistent with the MMPA definition of harassment in which actions with a potential to injure a marine mammal or disturb a marine mammal in the wild by causing disruption of behavioral patterns including migration, breathing, nursing, breeding, feeding, or sheltering which are considered a take. The inclusion of "potential to" in this definition means that the take occurs regardless of whether there is an injury or a disruption in the behavioral patterns of marine mammals exposed to the action.

#### 3.0 AFFECTED ENVIRONMENT

#### Location

Research would occur in (sub-surface observation), on (vessel based surveys) or over (aerial based surveys) the waters of the North Pacific ocean including U.S. EEZ and state waters off of Alaska, Washington, Oregon, California, Hawaii, U.S. territories, and international waters.

## **Status of Species**

There are 38 species of cetaceans found in the study area that would be targeted for research (Attachment 1). Of these 38, six are listed as endangered, one (killer whales) has Distinct Population Segments (DPS's) that is listed as endangered, and one (false killer whale) has a DPS proposed for ESA listing. Gray whales have one listed DPS in the western Pacific; however, their range falls outside the action area and are not included. There are seven species of pinnipeds, including three that are ESA listed; that are non-target species that may be subject to Level B harassment (Table 6).

Table 6. ESA-listed species targeted for study in the proposed action by permit, location, and level of harassment.

Species		NWFSC File No. 16163	Calambokidis File No. 16111	Balcomb File No. 15569	The Whale Museum File No. 16160
Southern Resident Killer	Level A	X			
whale	Level B	X	X	X	X
	Level A	X	X		
Humpback whale	Level B	X	X	X	X
	Level A	X	X		
Blue whale	Level B	X	X	X	
	Level A	X	X		
Fin whale	Level B	X	X	X	
	Level A	X	X		
Sei whale	Level B	X	X	X	
	Level A	X	X		
Sperm whale	Level B	X	X	X	
	Level A				-
North Pacific right whale	Level B	X		X	
Hawaiian insular false	Level A	X			-
killer whale	Level B	X			
Stellers sea lion (Easter and Western)	Level B	X	X	X	
Guadalupe fur seal	Level B	X			
Hawaiian monk seal	Level B	X			

#### **ESA-Listed Species**

<u>Sei whale</u> (*Balaenoptera borealis*): Sei whales are widely distributed in all oceans, although this species is not found as far into polar waters as other rorquals (Gambell, 1985). Several stocks of

sei whales have been identified, but updated estimates of the number of sei whales worldwide are not available. Commercial whaling reduced sei whale numbers in the North Pacific from 42,000 whales to approximately 7,000 to 12,000 animals by 1974 (Tillman, 1977). For management purposes, sei whales within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) waters around Hawaii, and 2) California, Oregon and Washington waters.

Eastern North Pacific stock: The IWC recognizes only one stock of sei whales in the North Pacific, but some evidence exists for multiple populations (Horwood, 1987; Masaki, 1977; Mizroch et al., 1984a). Lacking additional information on sei whale population structure, sei whales in the eastern North Pacific (east of longitude 180°) are considered a separate stock for management purposes under the MMPA. The best abundance estimate for whales off the coasts of California, Oregon and Washington is 126 animals with an annual Potential Biological Removal (PBR) level of 0.17 (Caretta et al., 2010). No population trend is available for this stock. The offshore drift gillnet fishery may threaten this stock but no mortalities or serious injuries have been reported. No vessel collisions have been reported since 2003.

Hawaii stock: Little information is known about animals in Hawaii waters. The best abundance estimate for whales off Hawaii is 77 animals with an annual PBR level of 0.1 (Caretta et al., 2010). No population trend is available for this stock. There have been no reported fishery related mortality or serious injuries of sei whales in the Hawaiian Islands EEZ and is not considered to be a significant concern. The increasing levels of anthropogenic noise in the marine environment is a concern and may have habitat associated impacts.

Blue whale (Balaenoptera musculus): The blue whale is a cosmopolitan species of baleen whale. Blue whales are found in oceans worldwide and are separated into populations by ocean basin, including two stocks in the Pacific ocean. They follow a seasonal migration pattern between summering and wintering areas, but some evidence suggests that individuals remain in certain areas year-round. Poleward movements in the spring allow the whales to take advantage of high zooplankton production in the summer. Movement toward the subtropics in the fall allows blue whales to use less energy while fasting, avoid ice entrapment in some areas, and engage in reproductive activities in warmer waters of lower latitudes. Although the species is often found in coastal waters, generally blue whales are thought to occur more offshore than humpback whales. Although the extent of knowledge concerning distribution and movement varies by area, their migratory routes are not well known. In general, distribution is driven largely by food requirements.

The primary and preferred diet of blue whales is krill. Although other prey species, including fish and copepods, have been mentioned in the scientific literature, they likely do not contribute significantly to the diet of blue whales.

Scientists have yet to discern many details regarding the life history of the blue whale. The best available science suggests that the gestation period is approximately 10 to 12 months and that blue whale calves are nursed for about 6 to 7 months (NMFS, 1998). Most reproductive activity, including mating and birthing, takes place during the winter. Weaning probably occurs on, or en route to, summer feeding areas. The average calving interval is probably 2 to 3 years. The age

at sexual maturity is thought to be 5 to 15 years (Mizroch, et al., 1984) (Yochem and Leatherwood., 1985).

North Pacific stocks: The blue whale's range encompasses much of the North Pacific Ocean, from Kamchatka to southern Japan in the west, and from the Gulf of Alaska and California south, to at least Costa Rica in the east. The species is found primarily south of the Aleutian Islands and the Bering Sea. Whaling and sighting data suggest the existence of at least five subpopulations of blue whales, with an unknown degree of mixing among them.

For management purposes under the MMPA, blue whales inhabiting U.S. waters in the North Pacific are divided into two stocks: Western and Eastern. Based on acoustic and whaling data, it is believed that the Eastern stock winters in waters off Mexico to Costa Rica, and feeds during summer off the U.S. West Coast and to a lesser extent in the Gulf of Alaska and in central North Pacific waters. Blue whales accompanied by young calves have been observed often in the Gulf of California from December through March, indicating that at least some calves may be born in or near the Gulf (Sears, 1990). Therefore, this area is probably an important calving and nursing area for the species. The Western stock appears to feed in summer southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska (Stafford, 2003; Watkins et al., 2000); in winter they migrate to lower latitudes in the western Pacific and less frequently in the central Pacific, including Hawaii (Staffordet et al., 2001). Insufficient data are available to evaluate the current abundance or population trends of blue whale stocks in the western North Pacific.

The best estimate of blue whale abundance in the eastern North Pacific is 2,842 animals with an annual PBR of six whales per year in U.S. waters. Along the California coast blue whale abundance has been increasing during the past two decades (Barlow, 1994; Calambokidis and Barlow, 2004; Calambokidis et al., 1990). Because this apparent increase is too large to be accounted for by population growth alone, it is assumed that a shift in distribution has occurred and is discussed further below. Although the population in the North Pacific is expected to have grown since protection began in 1966, the possibility of continued unauthorized takes, incidental ship strikes and mortality, and serious injury in fishing gear makes this trend uncertain.

Blue whales were significantly depleted by commercial whaling activities worldwide. The reported take of North Pacific blue whales by commercial whalers totaled 9,500 between 1910 and 1965 (Ohsumi and Wada, 1972). Approximately 3,000 of these were taken from the west coast of North America from Baja California, Mexico to British Columbia, Canada (Clapham et al., 1997; Rice, 1974; Tonnessen and Johnsen, 1982). The primary threats currently facing blue whales are vessel strikes and fisheries interactions but also include anthropogenic noise, natural mortality, vessel disturbance, habitat degradation, and competition for prey resources. There were five deaths and eight injuries reported between 2004-2008 resulting from ship strikes. NOAA has implemented a mitigation plan in response to this growing threat.

#### Changes in distribution

Evidence suggests the distribution and migratory patterns of blue whales may have changed in eastern Aleutian Islands and northern California.

South of the eastern Aleutian Islands, relatively large concentrations of blue whales were documented in the 1970s but the species appears rare there today, suggesting that illegal and unreported whaling depleted the population (Stewart et al., 1987; Forney and Brownell Jr., 1996).

Off northern California (e.g., Farallon Islands, Moss Landing, and Trinidad), the recent appearance of numerous blue whales is noteworthy in light of their rarity in these regions prior to the late 1970s. Calambokidis (1995) concluded that such changes in distribution reflect a shift in feeding from the more offshore euphausiid, *Euphausia pacifica*, to the primarily neritic euphausiid, *Thysanoëssa spinifera*. More recently, some Californian animals have been observed returning to waters of southern Alaska and British Columbia to feed (Calambokidis et al., 2009).

**Fin whale** (*Balaenoptera physalus*): Fin whales are the second-largest species of whale and occur in all major oceans worldwide, primarily in temperate to polar latitudes, and less commonly in the tropics. They occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally.

Fin whales seasonally migrate between temperate and polar waters (Perry et al., 1999). In the North Pacific, the International Whaling Commission (IWC) recognizes two stocks of fin whales, the east China Sea stock and the rest of the North Pacific (Donovan, 1991). For management purposes under the MMPA, three stocks of fin whales are recognized in Pacific U.S. waters: the California/Oregon/Washington stock, the Northeast Pacific (Alaska) stock, and the Hawaii stock.

The primary and preferred diet of fin whales is krill and small schooling fish (e.g., herring, capelin, and sand lance). Fin whales fast in the winter while they migrate to warmer waters.

Little is known about the social and mating systems of fin whales. Similar to other baleen whales, long-term bonds between individuals are rare. Males become sexually mature at 6 to 10 years old and females at 7 to 12 years old. Physical maturity is attained at approximately 25 years for both sexes. After 11 to 12 months of gestation, females give birth to a single calf in tropical and subtropical areas during midwinter. Newborn calves are approximately 6 m long and weigh 2 tons. Fin whales can live 80 to 90 years.

California/Oregon/Washington stock: This stock is found along the U.S. west coast from California to Washington in waters out to 300 nmi. Because fin whale abundance appears lower in winter/spring in California (Dohl et al., 1983; Forney et al., 1995) and in Oregon (Green et al., 1992), it is likely that the distribution of this stock extends seasonally outside these coastal waters. The best available estimate of the stock's population size is 3,044 whales with a PBR of 16 whales (Carretta et al., 2010). Some data indicate that fin whales have increased in abundance in California coastal waters (Barlow, 1994, 1997), but these trends are not significant. Ship strikes average one serious injury or mortality each year. Fishery interactions may be approaching a zero mortality and serious injury rate.

Northeast Pacific (Alaska) stock: Whales in this stock are found from Canadian waters north to the Chukchi Sea. Reliable estimates of current and historical abundance of fin whales in the entire northeast Pacific are currently not available. Based on surveys which covered only a small portion of the range of this stock, a rough minimum estimate of the size of the population west of the Kenai Peninsula is 5,700 with a PBR level of 11.4 whales (Angliss and Allen, 2009). Data suggests that this stock may be increasing at an annual rate of 4.8 percent; however, this is based on uncertain population size and incomplete surveys of its range (Angliss and Allen, 2009). Fishery interactions may threaten this stock but fishery-related mortality levels can be determined to have met a zero mortality and serious injury rate.

*Hawaii stock:* The best available abundance estimate for this stock is 174 whales based on a 2002 survey of the entire Hawaiian Islands EEZ (Barlow, 2003) with a PBR of 0.2 whales per year (Carretta et al., 2010). Data is not available to determine a population trend for this stock. Insufficient information is available to determine whether the total fishery mortality and serious injury for fin whales is insignificant and approaching zero mortality and serious injury rate.

Commercial whaling for this species ended in the North Pacific Ocean in 1976. Other current threats not listed by stock include reduced prey abundance due to overfishing, habitat degradation, disturbance from low-frequency noise, and the possibility that illegal whaling or resumed legal whaling would cause removals at biologically unsustainable rates. Of all species of large whales, fin whales are most often reported as hit by vessels (Jensen and Silber, 2003).

North Pacific right whale (Eubalaena japonica): In April 2008, the North Pacific right whale was listed as a separate, endangered species. The same two areas that were designated as critical habitat for the northern right whale are now designated as critical habitat for the North Pacific right whale.

North Pacific right whales inhabit the Pacific Ocean, particularly between 20° and 60° latitude. Before commercial whalers heavily exploited right whales in the North Pacific, concentrations were found in the Gulf of Alaska, eastern Aleutian Islands, south central Bering Sea, Sea of Okhotsk, and Sea of Japan. Recently, there have been few sightings of right whales in the central North Pacific and Bering Sea. Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and sea of Okhotsk in the summer. Since 1996, right whales have been consistently observed in Bristol Bay, southeastern Bering Sea, during the summer months.

Migratory patterns of the North Pacific right whale are unknown, although it is thought the whales spend the summer on high-latitude feeding grounds and migrate to more temperate waters during the winter.

Females are larger than males, and give birth to their first calf at an average age of 9-10 years. Calves are 13-15 feet (3.9-4.6 m) long at birth. Gestation lasts approximately 1 year. Calves are usually weaned toward the end of their first year. It is believed that right whales live at least 50 years, but there are few data on their longevity.

There are no reliable estimates of current abundance or trends for right whales in the North Pacific. However, the pre-exploitation size of this stock exceeded 11,000 animals. In general, there are no data on trends in abundance for either the eastern or western population. For the western North Pacific, sighting survey estimates for the summer feeding ground indicate an abundance of around 900 in the Sea of Okhotsk. It is clear that this population is significantly larger than that in the eastern North Pacific. Over the past forty years, most sightings in the eastern North Pacific have been of single whales. However, during the last few years, small groups of right whales have been sighted (Wade et al., 2006, 2011). This is encouraging but there has been only one confirmed sighting of calves in the 20th century.

In the North Pacific, ship strikes and entanglements may pose a threat to right whales. However, because of the whales rare occurrence and scattered distribution, it is impossible to assess the impact of anthropogenic threats at this time. The reasons for the apparent lack of recovery for right whales in this region are unknown.

<u>Humpback whale</u> (*Megaptera novaeangliae*): The humpback whale is a mid-sized baleen whale with a humped dorsal, long pectoral flippers and a distinctive individually indentifiable ventral fluke pattern. They occur throughout the world's oceans, generally over continental shelves, shelf breaks, and around some oceanic islands (Balcomb and Nichols, 1978; Whitehead, 1987). Humpback whales exhibit seasonal migrations between warmer temperate and tropical waters in winter and cooler waters of high prey productivity in summer. They exhibit a wide range of foraging behaviors, and feed on many prey types including small schooling fishes, krill, and other large zooplankton.

Humpback whale reproductive activities occur primarily in winter. They become sexually mature at age four to six. Females are believed to become pregnant every two to three years and nurse their calves for up to 12 months. The age distribution of the humpback whale population is unknown, but the portion of calves in various populations has been estimated at about 4 to 12 percent (Chittleborough, 1965; Herman et al., 1980; Whitehead, 1982; Bauer, 1986; Clapham and Mayo, 1987). Sources and rates of natural mortality are generally unstudied, but may include parasites, disease, predation (killer whales, false killer whales, and sharks), biotoxins, and ice entrapment.

Their summer range includes coastal and inland waters from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Tomlin, 1967; Nemoto, 1957; Johnson and Wolman, 1984). Humpback whales also summer throughout the central and western portions of the Gulf of Alaska, including Prince William Sound, around Kodiak Island, and along the southern coastline of the Alaska Peninsula. Japanese scouting vessels continued to observe high densities of humpback whales near Kodiak Island during 1965–1974 (Wada, 1980). In Prince William Sound, humpback whales have congregated near Naked Islands, in Perry Passage, near Cheega Island, in Jackpot, Icy and Whale Bays, in Port Bainbridge and north of Montague Islands between Green Island and the Needle (Hall, 1979, 1982; von Ziegesar, 1984; von Ziegesar and Matkin, 1986). The few sightings of humpback whales in offshore waters of the central Gulf of

Alaska are usually attributed to animals migrating into coastal waters (Morris et al., 1983), although use of offshore banks for feeding is also suggested (Brueggeman et al., 1987).

Winter breeding areas are known to occur in Hawaii, Mexico, and south of Japan. Around the Hawaiian Islands, humpback whales are most concentrated around the larger islands of Maui, Molokai, Lanai, and Kahoolawe. Newborn and nursing calves with cows are seen throughout the winter and comprise 6 to 11 percent of all humpbacks sighted during aerial surveys. Humpbacks from the Mexican wintering grounds are found with greatest frequency on the central California summering ground (NMFS, 1991). In the western Pacific, humpbacks have been observed in the vicinity of Taiwan, Ogasawara Islands, and Northern Mariana Islands (NMFS, 1991).

Population estimates for the entire North Pacific increased from 1,200 in 1966 to 6,000-8,000 in 1992. More recently, photo-identification results from SPLASH, an international collaborative research program on the abundances, population structure, and potential human impacts on humpback whales in the North Pacific involving more than 50 research groups and 300 researchers, estimated the abundance of humpback whales in the North Pacific to be just under 20,000 animals (Calambokidis et al., 2008). The population is estimated to be growing 6 to 7 percent annually (Carretta et al., 2010). The SPLASH study collected data from all known wintering and feeding areas for humpback whales in the North Pacific, and the data suggests the likely existence of missing wintering areas that have not been previously described. Humpback whales that feed off the Aleutians and in the Bering Sea were not well represented on any of the sampled wintering areas and must be going to one or more unsampled winter locations (Calambokidis et al., 2008).

Three management units of humpback whales are recognized within the North Pacific: the eastern North Pacific, the central North Pacific stock, and the western North Pacific stock.

Eastern North Pacific stock: The eastern North Pacific stock is referred to as the winter/spring population in coastal Central America and Mexico which migrates to the coast of California to southern British Columbia in summer/fall (Steiger et al., 1991; Calambokidis et al., 1993). The best available abundance estimate for this stock is 2,043 whales and appears to be increasing in abundance (Carretta et al., 2010). The estimated annual mortality and injury due to entanglement (3.2 whales/yr), other anthropogenic sources (zero), plus ship strikes (0.4) in California is less than the PBR allocation of 11.3 whales annually for U.S. waters. Recent studies indicate humpbacks are sensitive to anthropogenic noise in the mid-frequency range but the long term effects of this on the stock have yet to be determined.

Central North Pacific stock: The central North Pacific humpback whale stock is referred to as the winter/spring population of the Hawaiian Islands which migrates to northern British Columbia/Southeast Alaska and Prince William Sound west to Kodiak (Baker et al., 1990; Perry et al., 1990; Calambokidis et al., 1997). Population estimates vary for this stock, but the most recent N<sub>min</sub> was calculated to be 5,833 (Allen and Angliss, 2010). The stock appears to be increasing, with a PBR of 61.2 animals. It is impacted by fishery interactions (3.8 whales seriously injured or killed annually) and ship strikes (1.6 animals/year).

Western North Pacific stock: The western North Pacific Stock is referred to as the winter/spring population of Japan and probably migrates to waters west of the Kodiak Archipelago (the Bering

Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin, 1966; Nishiwaki, 1966; Darling, 1991). This population is estimated to include 938 individuals and the PBR is calculated to be 2.6. Current data indicate the population size is trending upwards but no confidence limits are available. Fisheries interactions result in an annual mortality rate of 0.2 whales.

**Sperm whale** (*Physeter macrocephalus*): Sperm whales are the largest of the odontocetes and the most sexually dimorphic cetacean, with males considerably larger than females. Sperm whales inhabit all oceans of the world. They can be seen close to the edge of pack ice in both hemispheres and are also common along the equator, especially in the Pacific. Their distribution is dependent on their food source and suitable conditions for breeding and varies with the sex and age composition of the group. Their migrations are not as predictable or well understood as migrations of most baleen whales. In some mid-latitudes, there seems to be a general trend to migrate north and south depending on the seasons and moving poleward in summer. However, in tropical and temperate areas, there appears to be no obvious seasonal migration.

Sperm whales are deep divers and their principle prey is large squid, but they will also eat large demersal and mesopelagic sharks, skates, and fishes. The average dive lasts about 35 minutes and is usually down to 400 m, however dives may last over an hour and reach depths over 1,000 m.

Female sperm whales reach sexual maturity around 9 years of age when they are roughly 9 m long. At this point, growth slows and they produce a calf approximately once every 5 years. After a 14 to 16 month gestation period, a single calf about 4 m long is born. Although calves will eat solid food before one year of age, they continue to suckle for several years. Females are physically mature around 30 years and 10.6 m long, at which time they stop growing. Males reach physical maturity around 50 years and when they are approximately 16 m long. Males often do not actively participate in breeding until their late 20s.

Most females will form lasting bonds with other females of their family, and on average 12 females and their young will form a family unit. While females generally stay with the same unit all their lives in and around tropical waters, young males between 4 and 21 years old form "bachelor schools", comprised of other males that are about the same age and size. As males get older and larger, they begin to migrate to higher latitudes and slowly bachelor schools become smaller, until the largest males end up alone. Older, larger males are generally found near the edge of pack ice in both hemispheres. On occasion, however, these males will return to the warm water breeding area.

Sperm whales tend to inhabit areas with a water depth of 600 m or more, and are uncommon in waters less than 300 m deep. Female sperm whales are generally found in deep waters (at least 1,000 m) of low latitudes (less than 40°, except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land.

Currently, no good estimate is available for the total number of sperm whales in the Pacific. For management purposes, sperm whales inhabiting U.S. pacific waters have been divided into three stocks.

California-Oregon-Washington stock: Sperm whales are found year-round in California waters, but they reach peak abundance from April through mid-June and from the end of August through mid-November. They have been seen in every season except winter in Washington and Oregon. The most precise and recent estimate of sperm whale abundance for this stock is 971 animals from the ship surveys conducted in 2005 (Forney, 2007) and 2008 (Barlow, 2010). Survey data from the last few decades indicate that sperm whale abundance has been rather variable off California and does not show obvious trends. The offshore driftnet gillnet fishery is the main threat to this stock. The PBR for this stock is set at 1.5 whales per year.

North Pacific (Alaska) stock: The shallow continental shelf apparently bars the movement of sperm whales into the northeastern Bering Sea and Arctic Ocean. Males are thought to move north in the summer to feed in the Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands. Current and historic estimates for the abundance of sperm whales in the North Pacific are considered unreliable. The number of sperm whales of the North Pacific occurring within Alaska waters is unknown. Consequently, the PBR for this stock is unknown. Potential entanglement in fishing gear is a growing concern for this stock as whales have been observed depredating in several commercial Alaskan fisheries.

Hawaiian stock: Summer/fall surveys in the eastern tropical Pacific show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly westward towards the middle of the tropical Pacific and tapers off northward towards the tip of Baja California. The best estimate for sperm whales occurring in U.S. waters of Hawaii is 6,919 (Barlow, 2006); however, no population trend is available. The PBR for this stock is 7.6 animals per year. Commercial longline fisheries are a threat to this stock though no serious injuries or mortalities of sperm whales were reported from 1998 to 2002.

The greatest natural predators to sperm whales are killer whales, which have been documented killing at least one sperm whale in California waters. Typically, however, it is believed that most killer whale attacks are unsuccessful. Pilot whales have been observed harassing sperm whales, but it is unclear if they pose any real threat (Perry et al., 1999). Large sharks may also be a threat, especially for young sperm whales.

The greatest threat for sperm whales has been man, especially with the advent of whaling. By 1987, whalers took at least 345,000 sperm whales in the North Pacific and North Atlantic Oceans combined, with approximately 99 percent coming from North Pacific stocks (Perry et al., 1999). Hunting of sperm whales by commercial whalers declined in the 1970s and 1980s, and virtually ceased with the implementation of a moratorium against whaling by the IWC in 1988. Sperm whales are still being targeted in a few areas; there is a small catch by primitive methods in Lamalera, Indonesia, and Japan takes sperm whales for scientific purposes.

In addition to whaling, sperm whales may be impacted by shipping traffic, noise disturbance, and fishing operations. Sperm whales have the potential to be harmed by ship strikes and

entanglements in fishing gear, although these are not as great of a threat to sperm whales as they are to more coastal cetaceans. Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping activity is high. Another potential human-cased source of mortality is from accumulation of stable pollutants (e.g. polycholorobiphenyls, chlorinated pesticides, polycyclic aromatic hydrocarbons, and heavy metals). Stable pollutants might affect the health or behavior of sperm whales. The potential impact of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date. In efforts to recover this species, the NMFS' recovery plan for sperm whales noted that the potential effects of pollutants is poorly understood and should be determined (NMFS, 2006b). At present, because of their general offshore distribution, sperm whales are less likely to be impacted by humans, and those impacts that do occur are less likely to be recorded.

Eastern North Pacific Southern Resident Killer Whale stock (Orcinus orca): Killer whales show considerable size dimorphism. Adult males develop larger pectoral flippers, dorsal fins, tail flukes, and girths than females. Male adult killer whales reach up to 32 feet (9.8 m) in length and weigh nearly 22,000 pounds (10,000 kg); females reach 28 feet (8.5 m) in length and weigh up to 16,500 pounds (7,500 kg). Sexual maturity of female killer whales is achieved when the whales reach lengths of approximately 15-18 feet (4.6 m-5.4 m), depending on geographic region. The gestation period for killer whales varies from 15-18 months, and birth may take place in any month. Calves are nursed for at least one year, and may be weaned between one and two years of age. The birth rate for killer whales is not well understood, but is estimated as every five years for an average period of 25 years. Life expectancy for wild female killer whales is approximately 50 years, with maximum longevity estimated at 80-90 years. Male killer whales typically live for about 30 years, with maximum longevity estimated at 50-60 years.

Resident killer whales in the North Pacific consist of Southern, Northern, Southern Alaska, and Western Alaska North Pacific Residents. The Southern Resident killer whale (SRKW) stock contains three pods (or stable family-related groups): J, K, and L pods. Their range during the spring, summer, and fall includes the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Their occurrence in the coastal waters off Oregon, Washington, Vancouver Island, and more recently off the coast of central California in the south and off the Queen Charlotte Islands to the north has been documented. Little is known about the winter movements and range of the Southern Resident stock. Southern Residents have not been observed associating with other resident whales, and mitochondrial and nuclear genetic data suggest that Southern Residents rarely interbreed with other killer whale populations.

The population is currently estimated at about 88 whales, with a PBR of 0.17 animals per year. The estimated population shows a decline from its estimated historical level of about 200 during the mid- to late 1800s. Beginning in about 1967, the live-capture fishery for oceanarium display removed an estimated 47 whales and caused an immediate decline in SRKW numbers. The population fell an estimated 30% to about 67 whales by 1971. By 2003, the population increased to 83 whales.

<u>Hawaiian Insular stock of false killer whales</u> (*Pseudorca crassidens*): NMFS has determined that Hawaiian insular false killer whales are discrete from other false killer whales and are

significant to the taxon based on genetic discontinuity and behavioral factors (the uniqueness of their behavior related to habitat use patterns). NMFS has proposed that the Hawaiian Insular stock of false killer whales is a distinct population segment and should be listed as endangered under the ESA. Thus, for this analysis will be treated as if it is listed under the ESA.

Hawaiian insular false killer whales are behaviorally unique because they are the only population of the species known to have movements restricted to the vicinity of an oceanic island group. This behavioral separation is supported by their linkage through a tight social network, without any linkages to animals outside of the Hawaiian Islands. Their habitat differs as well from other false killer whale populations because they are found primarily in island-associated waters that are relatively shallow and productive compared to surrounding oligotrophic waters. False killer whales are highly social mammals with long interbirth intervals and reproductive senescence suggesting transfer of knowledge is important to successfully persist in this unique Hawaiian habitat.

Little is known about the breeding behavior of false killer whales in the wild, but some information is available from false killer whales held in oceanaria (Brown et al., 1966). Gestation has been estimated to last 11 to 16 months, (Kasuya, 1986; Odell and McClune, 1999). Females with calves lactate for 18 to 24 months (Perrin and Reilly, 1984).

Estimated age at sexual maturity is about 8 to 11 years for females, while males may mature 8 to 10 years later (Kasuya, 1986). The maximum reported age has been estimated as 63 years for females and 58 years for males (Kasuya, 1986). Both sexes grow 40 to 50 percent in body length during their first year of life. Growth ceases between 20 and 30 years of age (Ferreira, 2008).

False killer whales are top predators, eating primarily fish and squid, but also occasionally taking marine mammals (Oleson et al., 2010). False killer whales feed both during the day and night and they can dive over 230m looking for prey. (Baird et al., unpublished)

Within waters of the central Pacific, four Pacific Islands Region management stocks of false killer whales are currently recognized for management under U.S. MMPA: the Hawaii insular stock, the Hawaii pelagic stock, the Palmyra Atoll stock, and the American Samoa stock (Carretta et al., 2010)

Hawaiian insular false killer whales share a portion of their range with the genetically distinct pelagic population (Forney et al., 2010). Therefore, the draft 2010 Stock Assessment Report (SAR) for false killer whales recognizes an overlap zone between insular and pelagic false killer whales between 40 km and 140 km from the main Hawaiian Islands based on sighting, telemetry, and genetic data (Chivers et al., 2007 and 2010, Forney et al., 2010; Carretta et al., 2010). Individuals utilize habitat overlaying a broad range of water depths, varying from shallow (<50m) to very deep (>4,000m) (Baird et al., 2010).

The draft 2010 SAR for Hawaiian insular false killer whales (Carretta et al., 2010) gives the best estimate of current population size as 123 individuals (coefficient of variation, or CV = 0.72), citing Baird et al. (2005). The current best estimates of population size for Hawaiian insular false killer whales are 151 individuals (CV = 0.20) without the animals photographed at Kauai,

or 170 individuals (CV = 0.21) with them. The calculated PBR for the insular stock is .61 animals per year (Caretta et al., 2010). The large groups sizes observed in 1989, together with the declining encounter rates from 1993 through 2003 suggest that Hawaiian insular false killer whales have declined substantially in recent decades. The primary threat to insular false killer whales is deep and shallow set long line fishing with an estimated mortality or serious injury of  $0.6 \ (CV=1.3)$  animals per year. Additional anthropogenic threats include habitat degradation and bioaccumulation of toxins.

## <u>**Hawaiian Monk Seal**</u> (*Monachus schauinslandi*):

Hawaiian monk seals are distributed predominantly in six Northwestern Hawaiian Islands (NWHI) subpopulations at French Frigate Shoals, Laysan and Lisianski Islands, Pearl and Hermes Reef, and Midway and Kure Atoll. Small numbers also occur at Necker, Nihoa, and the main Hawaiian Islands (MHI). On average, 10-15% of the seals migrate among the NWHI subpopulations (Johnson and Kridler, 1983; Harting, 2002). Thus, the NWHI subpopulations are not isolated, though the different island subpopulations have exhibited considerable demographic independence. Observed interchange of individuals among the NWHI and MHI regions is rare, yet preliminary genetic stock structure analysis (Schultz et al., 2011) suggests the species is appropriately managed as a single stock.

The best estimate of the total population size is 1,161. (Caretta et al., 2010). This estimate is the sum of estimated abundance at the six main Northwest Hawaiian Islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands, and an estimate of minimum abundance in the main Hawaiian Islands.

The total of mean non-pup beach counts at the six main reproductive NWHI subpopulations in 2007 is 68% lower than in 1958. A log-linear regression of estimated abundance on year from 1999 (the first year for which a reliable total abundance estimate has been obtained) to 2008 estimates that abundance has declined -4.5% yr-1 (95% CI= -5.0% to -3.9% yr-1). There are multiple sources of mortality and serious injury impending recovery of the species and include fisheries interactions (entanglement in active and ghost gear), food limitation, male aggression, shark predation, and disease/parasitism.

<u>Guadalupe fur seal</u> (*Arctocephalus townsendi*): The Guadalupe fur seal is listed as threatened under the ESA and depleted under the MMPA. They are distributed along the west coast, centered around Guadalupe Island off the west central Baja California coast. Their population has expanded in recent years and small colonies have formed in the Channel and Farallon Islands off of California.

The best estimate of the total population size is from 1993 and is 7,408. (Caretta et al., 2009), with an estimated growth rate of 13.7% and a PBR of 91 animals per year.

There is limited data on anthropogenic impacts to the species, but may include fisheries interactions (e.g., gear entanglement). U.S. fisheries observer data indicate that the impact is neglible in U.S. waters, however the level of impact in Mexican waters is unknown.

<u>Steller sea lions</u> (*Eumetopias jubatus*): Steller sea lions (SSLs) prefer the colder temperate to sub-arctic waters of the North Pacific Ocean. Haul outs and rookeries usually consist of beaches (gravel, rocky or sand), ledges, rocky reefs. In the Bering Sea and Okhotsk Sea, sea lions may also haul out on sea ice, but this is considered atypical behavior. Critical habitat has been defined for Steller sea lions as a 20 nautical mile buffer around all major haul-outs and rookeries, as well as associated terrestrial, air and aquatic zones, and three large offshore foraging areas.

SSLs are distributed mainly from the coast to the outer continental shelf along the North Pacific Ocean rim from northern Hokkaiddo, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to California. For management purposes, Steller sea lions inhabiting U.S. waters have been divided into two Distinct Population Segments (DPSs) at 144° West longitude (Cape Suckling, Alaska). The differentiation is based primarily on genetic and physical differences, but also on differing population trends in the two regions. The Western DPS includes SSLs that reside in the central and western Gulf of Alaska, Aleutian Islands, as well as those that inhabit the coastal waters of Asia (e.g., Japan and Russia). The Eastern DPS includes sea lions living in southeast Alaska, British Columbia, California, and Oregon.

Currents population estimates are a minimum of 42,366 SSLs in the Western DPS and 58,334-72,223 in the Eastern DPS (Allen and Angliss, 2010). Since the 1970s, the most significant drop in numbers occurred in the eastern Aleutian Islands and the western Gulf of Alaska. The Western DPS declined by 75% between 1976 and 1990, and decreased another 40% between 1991 and 2000 (the average annual decline during this period was 5.4%). The extent of this decline led NMFS to list the Steller sea lion as threatened range-wide under the ESA in April 1990. In the 1990s, the decline continued in the Western portions of the range leading NMFS to divide the species into two DPSs, Eastern and Western, and list the Western DPS as endangered in 1997. Population surveys suggest that the Eastern DPS is stable or increasing in the northern part of its range (Southeast Alaskan and British Columbia), while the remainder of the Eastern DPS and all the Western DPS is declining. NMFS recently received two petitions to delist the Eastern DPS and is soliciting comments on these requests.

SSLs in southeast Alaska are not an isolated population, as demonstrated by the movement of branded and tagged animals from southeast Alaska to British Columbia and Washington (Raum-Suryan et al., 2002). In addition, recent mitochondrial deoxyribonucleic acid studies with large samples of pups from newly established rookeries in the Eastern DPS have shown that some females born in the western DPS are pupping in the Eastern DPS (NMFS, unpublished data).

Overall, the Eastern DPS has increased over 3 percent per year since the 1970s, more than doubling in southeast Alaska, British Columbia, and Oregon. The Eastern DPS contained only about 10 percent of the total number of SSLs in the United States in the 1970s. However, large declines in the Western DPS coupled with notable increases in the east resulted in a shift such that over half of the SSLs in the U.S. now belong to the Eastern DPS (NMFS, 2006a).

Anthropogenic threats to SSLs include boat strikes, contaminants/pollutants, habitat degradation, illegal hunting/shooting, offshore oil and gas exploration, direct and indirect interactions with fisheries, and subsistence harvests by natives in Alaska and Canada (150-300 taken a year). In

the 1800s, they were targeted by hunters for their meat (food), fur hides (clothing), oil, and various other products. In the early 1900s, fishermen killed and placed bounties on this species, which they blamed for fish losses. Some SSLs were killed to limit their predation on fish in aquaculture facilities (fish farms), but intentional killing of SSLs has not been permitted since they were protected under the MMPA and listed under the ESA, with the exception of subsistence hunting.

Steller sea lions' direct and indirect interactions with fisheries are currently receiving significant attention and may possibly be an important factor in their decline. Direct fishing impacts are largely due to fishing gear (drift and set gillnets, longlines, trawls, etc.) that has the potential to entangle, hook, injure, or kill sea lions. These pinnipeds have been seen entangled in fishing equipment with what are considered "serious injuries." SSLs are also indirectly threatened by fisheries because they have to compete for food resources and critical habitat may be modified by fishing activities.

## **Non-ESA Listed Species**

Of the 32 non-listed cetacean and 4 pinniped species, two (AT1 killer whales and northern fur seals) have stocks considered depleted under the MMPA and five have stocks that are data deficient with no population estimate available (minke, Bairds beaked, Cuviers beaked, and dwarf sperm whales; and harbor seal). The remaining non-listed species marine mammals are from populations that are considered either stable or increasing in size.

Table seven lists the non-ESA species for each proposed action. More information about each stock may be found in the respective Stock Assessment Reports, which are available online at <a href="http://www.nmfs.noaa.gov/pr/sars/species.htm">http://www.nmfs.noaa.gov/pr/sars/species.htm</a>.

## **Non-Target Marine Animals**

In addition to the non-target marine mammal stocks and species that are listed in Table 7, an assortment of mammals, sea birds, sea turtles, fish and invertebrates may be found in the action area during the proposed research including sea otter (*Enhydra lutis*), leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) sea turtles; canary rockfish (*Sebastes pinniger*); Chinook salmon (*Oncorhynchus tshawytscha*), and its designated critical habitat; steelhead trout (*O. mykiss*); chum salmon (*O. keta*) and its designated critical habitat; coho salmon (*O. kisutch*); bocaccio (*Sebastes paucispinis*); Pacific eulachon (smelt) (*Thaleichthys pacificus*); yelloweye rockfish (*Sebastes ruberrimus*); green sturgeon (*Acipenser medirostris*); and protected birds such as marbled murrlets (*Brachyramphus marmoratus*). However, merely being present does not mean a marine organism would be affected by the proposed action. Research would be directed only at marine mammals, and thus is not expected to affect non-target marine animals. For these reasons, the effects on non-target species are not considered further.

Table 7: Other species targeted for study in the proposed action, by permit and level of harassment.

Species		NWFSC File No. 16163	Calambokidis File No. 16111	Balcomb File No. 15569	The Whale Museum File No. 16160
Dolphin,	Level A	X	X		
bottlenose	Level B	X	X		
Dolphin, common,	Level A	X			
short-beaked	Level B	X	X		
Dolphin, common,	Level A	X			
long-beaked	Level B	X	X		
Dolphin, Fraser's	Level A				
	Level B	X			
Dolphin, northern	Level A	X	X		
right whale	Level B	X	X		
Dolphin, Pacific	Level A	X	X		
white-sided	Level B	X	X	X	X
Dolphin, pantropical	Level A				
spotted	Level B	X			
Dolphin, Risso's	Level A	X	X		
Bolphin, Risso's	Level B	X	X	X	
Dolphin, rough-	Level A	X			
toothed	Level B	X			
Dolphin, spinner	Level A				
	Level B	X			
Dolphin, striped	Level A	X			
	Level B	X	X		
Whale, Baird's	Level A	X	X		
beaked	Level B	X	X	X	
Whale,	Level A	X	X		
mesoplodont, beaked	Level B	X	X	X	
Whale,	Level A	X			
Blainville's beaked	Level B	X			

Whole Davide's	Level A	X	X		
Whale, Bryde's	Level B	X	X	X	
Whale, Cuvier's	Level A	X	X		
beaked	Level B	X	X	X	
Whale, dwarf	Level A	X			
sperm	Level B	X	X		
Whale, false killer	Level A	X			
whate, faise killer	Level B	X			
Whale, gray	Level A	X	X		
whate, gray	Level B	X	X	X	X
Whale, Hubbs'	Level A				
beaked	Level B	X			
Whale, killer	Level A	X	X		
whate, kiner	Level B	X	X	X	X
Whale, Longman's	Level A	X			
beaked	Level B	X		X	
Whale, melon-	Level A	X			
headed	Level B	X			
Whale, minke	Level A	X	X		
w naie, ninke	Level B	X	X	X	X
Whale, Perrin's	Level A				
beaked	Level B	X			
Whale, pilot,	Level A	X	X		
short-finned	Level B	X	X		
Whale, pygmy	Level A				
beaked	Level B	X			
Whale, pygmy	Level A	X			
killer	Level B	X			
Whale, pygmy	Level A	X			
sperm	Level B	X	X		
Whale, Stejneger's	Level A	X			
beaked	Level B	X			
Porpoise, harbor	Level A	X	X		
1 orpoise, narbor	Level B	X	X	X	X
Porpoise, Dall's	Level A	X	X		
	Level B	X	X	X	X

Seal, northern elephant	Level A	X			
	Level B	X	X		
Sea lion,	Level A	X			
California	Level B	X	X	X	
Cool howbon	Level A	X			
Seal, harbor	Level B	X	X	X	
Seal, northern fur	Level A				·
	Level B	X	X	X	

## **Biodiversity and Ecosystem Function**

The proposed action is directed at marine mammals and does not interfere with benthic productivity, predator-prey interactions or other biodiversity or ecosystem functions. Marine mammals would not be removed from the ecosystem or displaced from habitat, nor would the permitted takes affect their diet or foraging patterns. Further, the proposed action does not involve activities known or likely to result in the introduction or spread of non-indigenous species, such as ballast water exchange or movement of vessels among water bodies. Thus, effects on biodiversity and ecosystem function would not be considered further.

## **Ocean and Coastal Habitats**

The action area includes designated critical habitat for SSLs, North Pacific right whales, southern resident killer whales, northern sea otters, marbled murrelets; and proposed critical habitat for Cook Inlet beluga whales and leatherback turtles. The proposed action is directed at marine mammals and does not affect habitat. It does not involve alteration of substrate, movement of water or air masses, or other interactions with physical features of ocean and coastal habitat. Thus, effects on habitat would not be considered further.

### **Unique Areas**

Research may be conducted in the marine portion of several sanctuaries, monuments, and marine protected areas located within the action area and include:

- Olympic Coast National Marine Sanctuary
- Hawaiian Islands Humpback Whale National Marine Sanctuary
- Papahanaumokuakea Marine National Monument
- Palmyra Atoll National Wildlife Refuge
- Cordell Bank National Marine Sanctuary
- Gulf of the Farallones National Marine Sanctuary
- Channel Islands National Marine Sanctuary
- Monterey Bay National Marine Sanctuary
- San Juan Islands National Wildlife Refuge
- Protection Island National Wildlife Refuge

Essential fish habitat (EFH) designated for various species of fish, which includes hard and soft bottom substrates is also located throughout the action area. The proposed action is directed at marine mammals and does not alter or affect unique areas, including any components of EFH.

The Office of National Marine Sanctuaries (ONMS) was consulted regarding the proposed action:

[ONMS comments here]

# Historic Places, Scientific, Cultural, and Historical Resources

There are no districts, sites, highways or structures listed in or eligible for listing in the National Register of Historic Places in the action area. The proposed action represents non-consumptive use of marine mammals and does not preclude their availability for other scientific, cultural, or historic uses, including subsistence harvest by Alaskan Natives. Thus, effects on such resources will not be considered further.

#### **Social and Economic Resources**

The proposed action does not affect distribution of environmental burdens, access to natural or depletable resources or other social or economic concerns. It does not affect traffic and transportation patterns, risk of exposure to hazardous materials or wastes, risk of contracting disease, risk of damages from natural disasters, food safety, or other aspects of public health and safety. Thus, effects on such resources will not be considered further.

# 4.0 ENVIRONMENTAL CONSEQUENCES

### **Effects of the No Action Alternative**

There are no direct or indirect effects on the environment of not issuing the permits. The takes of marine mammals, including those listed as threatened or endangered, resulting from the applicants' research would not be exempted. It is unlikely the applicants' would conduct the research in the absence of a permit, because to do so would risk sanctions and enforcement actions.

## **Effects of the Proposed Permit Alternative**

Effects would occur at the time when the applicants' research results in takes of marine mammals, including those listed as threatened or endangered.

The NWFSC, J. Calambokidis, and the Whale Center are current (Permit Nos. 781-1824-02, 540-1811-04, and 532-1822-02) and prior holders of multiple research permits. These requests would allow continuation of ongoing long term research for another 5 years, and authorize the Whale Museum to conduct Level B research activities. The number of animals proposed to be taken annually would be slightly higher than is currently authorized for some species, however the level of effort would not be substantially different. The overall effects of issuing the permits would be similar to the effects of issuing Permit Nos. 781-1824, 540-1811, and 532-1822, and these have all been amended multiple times. An EA of the initial permits and of subsequent major amendments resulted in a FONSI each time. Research activities may result in short-term behavioral responses by individuals, but would not be expected to result in stock- or species-level effects.

Most relevant to this analysis is the potential for negative impacts on the target species. It is important to recognize that an adverse effect on a single individual or a small group of animals

does not translate into an adverse effect on the population or species unless it results in reduced reproduction or survival of the individual(s) that causes an appreciable reduction in the likelihood of survival or recovery for the species. In order for the proposed actions to have an adverse effect on a species, the exposure of individual animals to the research activities would first have to result in:

- direct mortality,
- serious injury that would lead to mortality, or
- disruption of essential behaviors such as feeding, mating, or nursing, to a degree that the individual's likelihood of successful reproduction or survival was substantially reduced.

Subsequently, mortality or reduction in an individual's likelihood of successful reproduction or survival would then have to result in a net reduction in the number of individuals of the species. In other words, the loss of the individual or its future offspring would not be offset by the addition, through birth or emigration, of other individuals into the population. That net loss to the species would have to be reasonably expected, directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of the listed species in the wild.

**Level B harassment**, as defined by the MMPA, would occur during vessel surveys, photo-identification activities, sub-surface observation, breath sampling, acoustic playback, and aerial surveys. The differences in close approach activities requested in the proposed action from what was previously authorized are limited to small increases in the number of animals that would be taken, and would not be expected to have any additional effects that were not analyzed in previous EAs.

Level B harassment from large and small vessel surveys and photo-identification, as described above, would occur concurrently with Level A harassment activities.

**Level A harassment**, as defined by the MMPA, would occur during tagging activities, biopsy sampling, or ultrasound measurement during which physical contact has the potential to injure animals. Actual injury would be minimized by conditions of the permit limiting how sampling and attachment of tags may occur, such as avoiding sensitive areas of the body. The applicants would also minimize potential disturbance or physical risk by:

- Limiting time spent in the vicinity of target animals and the number of attempts made to obtain breath, biopsy samples, or deploy tags in order to minimize incidental harassment or disturbance from the presence of the small boat or the activities; and
- Sterilizing biopsy tips and dart tags in a multi-step process to minimize the risk of infection.

All tag types to be used for this action were fully analyzed in the EAs for the SWFSC and Robin Baird, Ph.D. (Permit Nos. 14097 and 15330) (NMFS, 2010a; NMFS, 2011a), a supplemental EA for Brad Hanson, Ph.D. (Permit No. 781-1824-02) (NMFS, 2011b) and two Categorical

Exclusion (CE) memos for amendments to Permit No. 731-1774. Findings of No Significant Impact (FONSIs) were issued for the two EA's and one SEA (refer to Appendix A for further details).

Playback activities have previously been analyzed in the EAs for Southall (Permit No. 14534) and a batched group of humpback research permits (Nos. 14682, 10018-01, 13846, 14451, 14585, 14599, 14122, 14296, and 14353) (NMFS, 2010b,c). These analyses resulted in FONSIs for these EAs (refer to Appendix A for further details).

### **Controversy**

Federal agencies are required to consider "the degree to which effects on the quality of the human environment are likely to be highly controversial" when evaluating potential impacts of a proposed action. [40 CFR §1508.27] The applications for the proposed permits will be made available for public review and comment.

## [INSERT PUBLIC COMMENTS HERE]

The applications were sent to the Marine Mammal Commission for review at the same time during the comment period, pursuant to 50 CFR §216.33 (d)(2). Comments received on the application were considered as part of the scoping for this EA.

The Marine Mammal Commission (MMC) recommended that NMFS:

# [INSERT MMC COMMENTS HERE]

### **Cumulative Effects**

Cumulative effects are defined as those that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency (federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time.

In general, takes of marine mammals by harassment during permitted research have not been shown to result in long-term or permanent adverse effects on individuals regardless of the number of times the harassment occurs. The frequency and duration of the disturbance under the proposed permit would allow adequate time for animals to recover from adverse effects such that additive or cumulative effects of the action on its own are not expected.

No measurable effects on population demographics are anticipated because any sub-lethal (disturbance) effects are expected to be short-term, and the proposed action is not expected to result in mortality of any animals. There exists the possibility that adverse effects on a species could accrue from the cumulative effects of a large number of permitted takes by harassment relative to the size of a population. However, there is no evidence that current or past levels of permitted takes have resulted in such species level effects.

# **Summary of Other Actions**

The stocks and populations of marine mammals that are the subject of the permit are exposed to a variety of human activities including subsistence harvest (gray whales in Washington; Steller sea lions and northern fur seals in Alaska); entanglement in fishing gear; vessel activity including whale watching; and anthropogenic noise from vessels, military and industrial activities. Anthropogenic activities and ecosystem shifts result from climate and oceanographic changes also alter the marine habitat in the action area.

<u>Subsistence</u>: The levels of harvest are managed under various federal and international laws and treaties and are not believed to have an adverse impact on the status of the species.

A gray whale harvest by the Makah Tribe in Washington has not occurred since 2000, and future harvests are subject to obtaining a waiver to the MMPA's take moratorium. Harvest quota levels are set by the International Whaling Commission.

Steller sea lions are the target of a co-managed subsistence harvest in Alaska. The average number of animals harvested and struck but lost is 24 animals/year. An unknown number of SSLs from this stock are harvested by subsistence hunters in Canada. The magnitude of the Canadian subsistence harvest is believed to be small.

Northern fur seals are also subject to an annual subsistence harvest in the Pribilof Islands, with an average annual harvest of 562 animals between 2004-2008 (Allen and Angliss, 2010). Illegal intentional killing of northern fur seals by commercial and sport fishers may also occur, but no estimates of the level of mortality exist.

**Entanglement:** Entanglement in fishing gear and ghost gear is a concern for multiple species in the action area; however, steps taken by NMFS has significantly reduced bycatch and entanglement rates thru use of pingers and gear modifications (Caretta et al., 2010).

<u>Vessel Activity:</u> Many marine mammal populations may be experiencing increased exposure to vessels and associated sounds. Commercial shipping, whale watching, ferry operations, and recreational boating traffic have expanded throughout the action area in recent decades. Commercial fishing boats are also a prominent part of the vessel traffic in many areas. Vessels have the potential to affect marine mammals through their physical presence and activity and the increased underwater sound levels generated by boat engines. Vessel strikes are rare, but do occur and can result in injury or death.

Harassment from whale-watching is not regulated by permits, nor are the effects monitored. The growth of whale watching during the past two decades has meant that whales in some areas (Hawaii, Puget Sound, Monterey Bay) are experiencing increased exposure to vessel traffic and sound. This brings added risk for vessel strikes, displacement from habitat and interference with social interaction and communication (Kovacs and Innes, 1990; Kruse, 1991; Wells and Scott, 1997; Samuels and Bejder, 1998; Bejder et al., 1999; Colborn, 1999; Cope et al., 1999; Mann et al., 2000; Samuels et al., 2000; Boren et al., 2001; Constantine, 2001; Nowacek et al., 2001). Not only do greater numbers of boats accompany the whales for longer periods of the day, but there has also been a gradual lengthening of the viewing season in some areas. For example, the

mean number of vessels following groups of southern resident killer whales at any one time during the peak summer months increased from five boats in 1990 to an average of 20 boats from 1998-2009, and individual whales sometimes attract much larger numbers of vessels (Koski, 2010). There is documentation of a whale-boat collision in Haro Strait in 2005 which resulted in a minor injury to a killer whale and in 2006, killer whale L98 was killed during a vessel interaction. NMFS has issued a final rule to prohibit vessels from approaching killer whales within 200 yards new viewing guidelines to address this issue for SRKW in particular (76 FR 20870). Federal approach regulations are already in place in Hawaii and Alaska for humpback whales, and viewing guidelines for all marine mammal species are established for the Alaska, Northwest, Southwest, and Pacific Islands regions.

There is evidence that anthropogenic noise has substantially increased the ambient level of sound in the ocean over the last 50 years (Andrew et.al., 2002, McDonald et.al., 2006). Much of this increase is due to increased shipping activity, industrial activity and military operations. Some individuals or populations are regularly exposed to natural and anthropogenic sounds and may tolerate, or have become habituated to, certain levels of noise exposure (Richardson, 1995). The net effect of disturbance is dependent on the size and percentage of the population affected, the ecological importance of the disturbed area to the animals, and their behavioral plasticity (Geraci and St. Aubin, 1980).

The military uses acoustics to test the construction of new vessels as well as for naval operations, and has recently requested MMPA 101(a)(5)(A) authorization for activities in the Gulf of Alaska Temporary Maritime Activities Area and Northwest Training Range Complex; as well as being issued Incidental Harassment Authorizations (IHAs) for training activities in their Hawaii Range Complex, Southern California Range Complex, and Mariana Islands Range Complex.

In some areas where industrial and commercial activity takes place, noise originates from the construction, operation, and vessel and aircraft support. Many researchers have described the behavioral responses of marine mammals to sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, and geological explorations (Richardson, 1995; Nowacek et.al., 2007). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated the short-term effects of disturbance on humpback whale behavior (Hall, 1982; Baker et al., 1983; Krieger and Wing, 1984; Bauer and Herman, 1986, Miller et.al., 2000), but the long-term effects, if any, are unclear or not detectable. Actions such as repair of bridges and ports, as well as explosive removal of structures have been analyzed previously and been found to have a negligible impact on the marine mammal stocks.

Contaminants: Human actions, such as emitting discharge from wastewater facilities, dredging, ocean dumping and disposal, aquaculture, and coastal development are known to have deleterious impacts on marine mammals and their prey's habitat, ultimately affecting the animals themselves as contaminants are bioaccumulated. Point source pollutants from coastal runoff, at sea disposal of dredged material and sewage effluents, oil spills, as well as substantial commercial and recreational vessel traffic and impacts of fishing operations continue to negatively affect marine mammals in the proposed action areas.

Climate Change: The extent to which climate and/or ecosystem changes impact the target cetacean species is largely unknown. However, NMFS recognizes that such impacts may occur based on the biology, diet, and foraging behavior of dolphins and whales. Inter-annual, decadal, and longer time-scale variability in climate can alter the distribution and biomass of prey available to large whales. The effects of climate-induced shifts in productivity, biomass, and species composition of zooplankton on the foraging success of planktivorous whales have received little attention. Such shifts in community structure and productivity may alter the distribution and occurrence of foraging whales in coastal habitats and affect their reproductive potential as well. Similar shifts in prey resources could likewise impact large whales if climate change alters the density, distribution, or range of prey.

<u>Incidental Harassment Authorizations (IHAs)</u>: In addition to scientific research permits, NMFS issues Letters of Authorization (LOAs) and IHAs under the MMPA for the incidental take of marine mammals. NMFS has issued eight IHAs, seven rulemakings, and ten LOAs for the take of multiple target species in the action area.

Other Scientific Research Permits and Authorizations: The number of permits and associated takes by harassment indicate a high level of research effort of some endangered marine mammal species in the proposed action area. This is due, in part, to intense interest in developing appropriate management and conservation measures to recover these species. Given the number of permits, associated takes and research vessels and personnel present in the environment, repeated disturbance of individual large whales is likely to occur in some instances, particularly in coastal areas (due to the proximity to shore). It is difficult to assess the effects of such disturbance. However, NMFS has taken steps to limit repeated harassment and avoid unnecessary duplication of effort through permit conditions requiring coordination among permit holders. NMFS expects that the temporary harassment of individuals would dissipate within minutes, and therefore animals would recover before being targeted for research by another Permit Holder. NMFS would continue to monitor the effectiveness of these conditions in avoiding unnecessary repeated disturbances.

A total of XX permits and Letters of Confirmation (LOC) authorize the harassment of one or more of the cetacean or pinniped species targeted or incidentally taken in the proposed action area (Appendix B). Nearly all the permits authorize a smaller study area or region within the Pacific Ocean basin, reducing the chance of repeated harassment of individual whales by researchers. Most of this research does not overlap in area or timing. Some spatial overlap exists for research on species with known feeding or breeding grounds, such as humpback whales. The majority of the takes authorized by these permits are for Level B harassment that would result in no more than disturbance to the target species. LOCs are issued under the General Authorization and confirm that the research would result in no more than Level B harassment of non-ESA marine mammals.

A few of the permits are currently operating under a one-year extension (Appendix B); which do not authorize additional takes of the target species but allows researchers to use authorized takes remaining from the last year of the permit for an additional 12 months or until the remaining takes have been exhausted, whichever occurs first. A few of the active permits will expire before these permits can be issued. NMFS expects that some researchers, such as NMFS Science Centers, which are mandated to assess the status of U.S. marine mammal stocks, will request

new permits, or renewals, to continue their work once the current permit expires. NMFS cannot predict with certainty the level of take of each species that may be requested in the future but, conservatively, expects the amount of future research to be similar to or slightly greater than current levels as interest in marine conservation, biology, and management of these species grows.

None of the active research permits authorize activities likely to result in the serious injury or mortality of any animal. Further, no such incidences have been reported by permitted cetacean researchers. Therefore, the number of takes proposed by the applicants are not expected to result in a significant adverse impact on the target species, especially considering the majority of the takes are already authorized in three of the applicants' current permits. In addition, all permits issued by NMFS for research on protected species, including the proposed permits, contain conditions requiring the Permit Holders to coordinate their activities with the NMFS regional offices and other Permit Holders conducting research on the same species in the same areas, and, to the extent possible, share data to avoid unnecessary duplication of research and disturbance of animals.

It is also important to note that many of the target whales are migratory and may transit in and out of U.S. waters and the high seas. NMFS does not have jurisdiction over the activities of individuals conducting field studies in other nations' waters, and cumulative effects from all scientific research on these species across the Proposed Action area cannot be fully assessed. However, where possible, NMFS attempts to collaborate with foreign governments to address management and conservation of these trans-boundary ESA-listed species.

## **Summary of Cumulative Effects**

There may already be significant adverse impacts on marine mammals from the existing levels of human activities. However, the relative incremental effect of the proposed action would not be significant. The proposed takes of specified numbers of marine mammals by harassment during the life of the permits are not likely to contribute to collectively significant adverse impacts on marine mammal stocks or species, including those listed as threatened or endangered. The effects of the takes would be transitory and recoverable, associated with only minor and short-term changes in the behavior of a limited number of individual marine mammals.

Although the effects of repeated or chronic disturbance from scientific research activities should not be dismissed, the potential long-term benefits and value of information gained on these species also must be considered. The proposed research would provide valuable information on these species' biology and ecology that in turn may be used to improve their management and reduce the effects of human activities on these populations.

### 5.0 MITIGATION MEASURES

There are no additional mitigation measures beyond those that are part of the applicant's protocols or conditions that would be required by permit, as discussed in the description of the Proposed Permit Alternative. The applicants' protocols are incorporated into the permits by reference.

In summary, the permit conditions limit the level of take as described in the take tables and require notification, coordination, monitoring, and reporting. Although injury and mortality are not expected, if they occur due to the authorized actions, the permits contains measures requiring researchers to cease activities until protocols have been reviewed and revised with NMFS. Upon review NMFS may also revoke the permit.

Review of monitoring reports of previous permits for the same or similar research protocols indicate that these types of mitigation measures are effective at minimizing stress, pain, injury, and mortality associated with takes.

#### 6.0 LIST OF PREPARERS AND AGENCIES CONSULTED

### **Agencies Consulted**

Marine Mammal Commission NOS National Marine Sanctuaries Program US Fish and Wildlife Service

## **Prepared By**

This document was prepared by the Permits, Conservation and Education Division of NMFS' Office of Protected Resources in Silver Spring, Maryland.

### 7.0 LITERATURE CITED

- Allen, B.M. and R.P. Angliss. 2010. Alaska marine mammal stock assessments, 2009. U.S. Dep. Commer., NOAA Tech. Memo. NMFS AFSC-206, 287 pp.
- Andrew, R. K., B. M. Howe, and J. A. Mercer. 2002. Ocean ambient sound: comparing the 1960s with the 1990s for a receiver off the California coast. Acoustics Research Letters Online 3(2):65-70.
- Andrews, R.D.,R.L. Pitman, and L.T. Balance. 2008. Satellite tracking reveals distinct movement patterns for Type B and Type C killer whales in the southern Ross Sea, Antarctica. Polar Biol. 31:1461-1468.
- Angliss, R.P. and B. M. Allen. 2009. Alaska marine mammal stock assessments, 2008. NOAA Tech. Memo. NMFS-AFSC-193. 252 pp.
- Baird, R.W., and A.M. Gorgone. 2005. False killer whale dorsal fin disfigurements as a possible indicator of long-line fishery interactions in Hawaiian waters. Pacific Science 59:593-601
- Baird, R.W., A.M. Gorgone, D.L. Webster, D.J. McSweeney, J.W. Durban, A.D. Lignon, D.R. Salden, and N.H. Deakos. 2005. False killer whales around the main Hawaiian Islands: An assessment of inter-island movements and population size using individual photo-identification. (Pseudorca crassidens). Report prepared under Order No.

- JJ133F04SE0120 from the Pacific Islands Fisheries Science Center, National Marine Fisheries Service, 2570 Dole Street, Honolulu, HI 96822. 24pgs. 2005.
- Baird, R.W., G.S. Schorr, D.L. Webster, D.J. McSweeney, M.B. Hanson and R.D. Andrews. 2010. Movements and habitat use of satellite-tagged false killer whales around the main Hawaiian Islands. Endangered Species Research 10:107-121.
- Baker, C.S., L.M. Herman, B.G. Bays and G.B. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in southeast Alaska: 1982 season. Report submitted to the National Marine Mammal Laboratory, Seattle, WA. 78 pp.
- Baker, C.S., S.R. Palumbi, R.H. Lambertsen, M.T. Weinrich, J. Calambokidis, and S.J. O'Brien. 1990. Influence of seasonal migration on geographic distribution of mitochondrial DNA haplotypes in humpback whales. Nature 344:238-240.
- Balcomb, K.C., and G. Nichols. 1978. Western north Atlantic humpback whales. Rep. Int. Whal. Comm. 28:159-164.
- Barlow, J. 1994. Abundance of large whales in California coastal waters: a comparison of ship surveys in 1979/80 and in 1991. Rep. Int. Whal. Comm. 44:399-406.
- Barlow, J. 1997. Preliminary estimates of cetacean abundance off California, Oregon and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Admin. Rep. LJ-97-11. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 25p.
- Barlow, J. 2003. Cetacean abundance in Hawaiian waters during summer/fall 2002. Administrative Report. La Jolla, CA, Southwest Fisheries Science Center. 22 pp.
- Barlow, J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. Mar. Mamm. Sci. 22(2):446-464.
- Barlow, J. 2010. Cetacean abundance in the California Current from a 2008 ship-based line-transect survey. NOAA Technical Memorandum, NMFS, NOAA-TM-NMFS-SWFSC-456.
- Bauer, G.B. 1986. The behavior of humpback whales in Hawaii and modifications of behavior induced by human interventions. (Megaptera novaeangliae), University of Hawaii. 314p. Ph.D. dissertation.
- Bauer, G.B. and L.M. Herman. 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. Report Submitted to NMFS Southwest Region, Western Pacific Program Office, Honolulu, HI. 151 pp.
- Bejder, L., S.M. Dawson, and J.A. Harraway. 1999. Responses by Hector's dolphins to boats and swimmers in Porpoise bay, New Zealand. Mar. Mamm. Sci., 15(32):738-750.

- Berzin, A. A., and A. A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi and Bering seas. Pages 103-136 in K.1. Panin, ed. Soviet research on marine mammals in the far east.
- Boren, L.J., N.J. Gemmell, and K. Barton. 2001. Controlled approaches as an indicator of tourist disturbance on New Zealand Fur Seals (Arctocephalus forsteri). Page 23 in Abstracts of the Southern Hemisphere Marine Mammal Conference 2001, Victoria, Australia, May 29-June 1, 2001.
- Brown, D. H., D.K. Caldwell, and M.C. Caldwell.1966. Observations on the behavior of wild and captive false killer whales, with notes on associated behavior of other genera of captive delphinids. (Pseudorca crassidens). Contributions in Science, Natural History Museum of Los Angeles County 95:2-3
- Brueggeman, J., G.A. Green, RA Grotefendt, and D.G. Chapman. 1987. Aerial surveys of endangered cetaceans and other marine mammals in the northwestern Gulf of Alaska and southeastern Bering Sea. Final Report, Outer Continental Shelf Environmental Assessment Program. 124pp.
- Calambokidis, J., G.H Steiger, J.C. Cubbage, K.C. Balcomb, C. Ewald, S. Kruse, R. Wells, R. Sears. 1990. Sightings and movements of blue whales off central California 1986-88 from photo-identification of individuals. Rep. Int. Whal. Comm. Special Issue (12):343-348.
- Calambokidis, J., G.H. Steiger, and J.R. Evenson. 1993. Photo-id and abundance estimates of humpback and blue whales off California in 1991-92. Final Contract Report 50ABNFI00137 to Southwest Fisheries Science Center, P.O. Box 271, LaJolla, CA 92038. 67pp.
- Calambokidis, J. 1995. Blue whales off California. Whalewatcher 29(1):3-7.
- Calambokidis, 1., G.H. Steiger, J.M. Straley, T.J. Quinn II, L.M. Herman, S. Cerchio, D.R. Salden, M. Yamaguchi, F. Sato, 1. Urban R., J. Jacobsen, O. von Ziegesar, K.C. Balcomb, C.M. Gabriele, M.E. Dahlheim, M. Higashi, S. Uchida, J.K.B. Ford, Y. Miyamura, P. Ladron de Guevara P., S.A Mizroch, L. Schlender and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific Basin. Report to Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, California. 71pp.
- Calambokidis, J. 2003. Underwater behavior of blue whales examined with suction-cup attached tags. Annual Report to Office of Naval Research for Grant Number: N00014-02-1-0849. 6pp.

- Calambokidis, J. and J. Barlow. 2004. Abundance of blue and humpback whales in the eastern North Pacific estimated by capture-recapture and line-transect methods. Mar. Mamm. Sci. 20(1):63-85.
- Calambokidis, J., E.A. Falcone, T.J. Quinn, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. LeDuc, D. Matilla, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, J. Urbán, D. Weller, B.H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. Flynn, A. Havron, J. Huggins, and N. Maloney. 2008. SPLASH: Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific. Final report for Contract AB133F-03-RP-00078. 57 pp.
- Calambokidis, J., J. Barlow, J.KB. Ford, T.E. Chandler, and A.B. Douglas. 2009. Insights into the population structure of blue whales in the Eastern North Pacific from recent sightings and photographic identification. Marine Mammal Science 25(4): 816-832.
- Carretta, 1.V. K.A Forney, M.S. Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, R.L. Brownell Jr., J. Robbins, D.K. Matilla, K. Ralls, M.M. Muto, D. Lynch, and L. Carswell. 2009. U.S. Pacific Marine Mammal Stock Assessments: 2009. NOAA-TM-NMFSSWFSC-453. 341 pp.
- Carretta, J.V. K.A. Forney, E. Oleson, K. Martien, M.M. Muto, M.S. Lowry, J. Barlow, J. Baker, B. Hanson, D. Lynch, L. Carlswell, R.L. Brownell Jr., J. Robbins, D.K. Matilla, K. Ralls, M.C. Hill. 2010. Draft U.S. Pacific Marine Mammal Stock Assessments: 2010. NOAA-TM-NMFS-SWFSC-xxx. 307 pp.
- Chittleborough, RG. 1965. Dynamics of two populations of the humpback whale, Megaptera novaeangliae (Borowski). Australian Journal of Marine and Freshwater Research 16(1):33-128.
- Chivers, S. J., R. W. Baird, D. J. McSweeney, D. L. Webster, N. M. Hedrick and J. C. Salias. 2007. Genetic variation and evidence for population structure in eastern North pacific false killer whales (Pseudorca crassidens). Can. J. Zool. 85: 783-794.
- Chivers, S. J., R. W. Baird, K. M. Martien, B. Taylor, L., E. Archer, A. M. Gorgone, B.
  L. Hancock, N. Hedrick, M., D. K. Mattila, D. J. McSweeney, E. M. Oleson, C. L.
  Palmer, V. Pease, K. M. Robertson, J. Robbins, J. C. Salinas, G. S. Schorr, M.
  Schultz, J. L. Theileking and D. L. Webster. 2010. Evidence of genetic differentiation for Hawai'i insular false killer whales (Pseudorca crassidens). NOAA-TM-NMFS-SWFSC-458. 44pp.
- Clapham, PJ., and C.A Mayo. 1987. Reproduction and recruitment of individually identified humpback whales, Megaptera novaeangliae, observed in Massachusetts Bay, 1979-1985. Can. J. Zoo1. 65(12):2853-2863.

- Clapham, P. J., S. Leatherwood, I. Szczepaniak, and R.L. Brownell. 1997. Catches of humpback and other whales from shore stations at Moss Landing and Trinidad, California, 1919-1926. Mar. Mamm. Sci. 13(3):368-394.
- Colborn, K. 1999. Interactions between humans and bottlenose dolphins, *Tursiops truncates*, near Panama City, Florida. Master's Thesis, Duke University, Durham, NC. 45pp.
- Constantine, R. 2001. Increased avoidance of swimmers by wild bottlenose dolphins (Tursiops truncates) due to long-term exposure to swim-with-dolphin tourism. Mar. Mamm. Sci., 17(4):689-702.
- Croll, D. A., C.W. Clark, J. Calambokidis, W.T. Ellison, and B.R. Tershy. 2001. Effect of anthropogenic low-frequency noise on the foraging ecology of Balaenoptera whales. Animal Conservation 4: 13-27.
- Cope, M., D. St. Aubain, and J. Thomas. 1999. The effect of boat activity on the behavior of bottlenose dolphins (*Tursiops truncates*) in the nearshore waters of Hilton Head, South Carolina. Page 37 in Abstracts of the 13<sup>th</sup> Biennial Conference on the Biology of Marine Mammals, Wailea, Hawaii, November 38-December 3, 1999.
- Darling, J.D. 1991. Humpback whales in Japanese waters. Ogasawara and Okinawa. Fluke identification catalog 1987-1990. Final Contract Report, World Wide Fund for Nature, Japan. 22pp.
- Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-83: Status, abundance, and distribution. Final Report to the Minerals Management Service, Contract No. 14-12-0001-29090. 284pp.
- Donovan, G.P. 1991. A review of IWC stock boundaries. Rept. Int. Whal. Commn., Special Issue 13:39-68.
- Durban, J. W., Parsons, K. M. 2006 Laser-metrics of free-ranging killer whales. Marine Mammal Science. 22, 735-743.
- Elfes, C.E., G.R. VanBlaricom, D. Boyd, J. Calambokidis, P.J. Clapham, R.W. Pearce, J. Robbins, J.C. Salinas, J.M. Straley, P.R. Wade and M.M. Krahn. 2010. Geographic variation of persistent organic pollutants levels in humpback whale (Megaptera novaeangliae) feeding areas of the North Pacific and North Atlantic. Environmental Toxicology and Chemistry 29(4):824-834.
- Fearnbach, H., Durban, J. W., Ellifrit, D. K., Balcomb, K. C. I. 2011. Size and long-term growth trends of Endangered fish-eating killer whales. Endangered Species Research. 13, 173-180.
- Ferreira, I.M. 2008. Growth and reproduction in false killer whales (Pseudorca crassidens Owens, 1846). Ph.D. Thesis, University of Pretoria.

- Ford, J. K. B., G. M. Ellis, and K. C. Balcomb. 2000. Killer whales: The natural history and genealogy of Orcinus orca in British Columbia and Washington State, 2nd Edition. Vancouver, British Columbia: UBC Press.
- Forney, K.A., J. Barlow, and J. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fish. Bull. 93:1526.
- Forney, K.A., and R.L. Brownell, Jr. 1996. Preliminary report of the 1994 Aleutian Island marine mammal survey. Paper SC/48/011 presented to the International Whaling Commission Scientific Committee, June 1996 (unpublished).
- Forney, K.A. 2007. Preliminary estimates of cetacean abundance along the U.S. west coast and within four National Marine Sanctuaries during 2005. U.S. Department of Commerce NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-406. 27p.
- Forney, K. A., R. W. Baird and E. M. Oleson. 2010. Rationale for the 2010 revision of stock boundaries for the Hawaii insular and pelagic stocks of false killer whales, Pseudorca crassidens. PSRG-2009-11. 5.
- Gambell, R. 1985. Sei whale, Balaenoptera borealis Lesson, 1828. In Handbook of Marine Mammals. Volume 3: the Sirenians and Baleen Whales. Sam H. Ridway and Sir Richard Harrison, eds. p.155-170.
- Geraci, J.R. and D.J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Mar. Fish. Rev. 42:11: 1-12.
- Green, G.A., J.J. Brueggeman, R.A. Grotefendt, C.E. Bowlby, M.L. Bonnell, K.C. Balcomb, III. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Ch. 1 In: J.J. Brueggeman (ed.). Oregon and Washington Marine Mammal and Seabird Surveys. Minerals Management Service Contract Report 14-12-0001-30426.
- Hall, J.D. 1979. A survey of cetaceans of Prince William Sound and adjacent vicinity-their numbers and seasonal movements. Environmental Assessment of the Alaska Continental Shelf; final Reports of the Principal Investigators. Biological Studies, Vol. 6: 631-726 Boulder, NOAA-OCCSEAP.
- Hall, J.D. 1982. Prince William Sound, Alaska: Humpback whale population and vessel traffic study. Final Report, Contract No. 81-ABG-00265. NMFS, Juneau Management Office, Juneau, Alaska. 14 pp.
- Harting, A. L. 2002. Stochastic simulation model for the Hawaiian monk seal. Ph.D. thesis, Montana State University, Bozeman, MT. 328 pp.
- Herman, L.M., P.H. Forestell, and RC. Antinoja. 1980. The 1976/1977 migration of humpback whales into Hawaiian waters: composite description. Marine Mammal Commission Report No. MMC 77-19. Washington, D.C.

- Horwood, J. 1987. The Sei Whale: Population Biology, Ecology and Management. Croom Helm, London, U.K. 375 pp.
- Jensen, A.S. and G.K. Silber. 2003. Large Whale Ship Strike Database. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-OPR-25, 37 pp.
- Johnson, A. M., and E. Kridler. 1983. Interisland movement of Hawaiian monk seals. (Monachus schauinslandi). Elepaio-Journal of the Hawaii Audubon Society 44:5.
- Johnson, J. H., and A. A. Wolman. 1984. The humpback whale, Megaptera novaeangliae. Mar. Fish. Rev. 46(4):30-37.
- Lerczak, James A., K.E.W. Shelden, and R.C. Hobbs. 2000. Application of suction-cup-attached VHF transmitters to the study of beluga, Delphinapterus leucas, surfacing behavior in Cook Inlet, Alaska. Marine Fisheries Review 62(3):99-111.
- Kasuya, T. 1986. False killer whales. In T. Tamura, S. Ohsumi, & S. Arai (Eds.), Report of investigation in search of solution for dolphin-fishery conflict in the Iki Island area (pp. 178-187). Tokyo: Japan Fisheries Agency. 285 pp.
- Kellar, N.M., M.L. Trego, C.I. Marks, and A.E. Dizon. 2006, Determining pregnancy rates from blubber in three species of delphinids. Marine Mammal Science, 22: 1–16.
- Krahn, M.M., G.M. Ylitalo, D.G. Burrows, J. Calambokidis, S.E. Moore, M. Gosho, P. Gearin,
  P.D. Plesha, R.L. Brownell, Jr., S.A. Blokhin, K.L. Tilbury, T. Rowles and J.E. Stein.
  2001. Organochlorine contaminant concentrations and lipid profiles in eastern North
  Pacific gray whales (Eschrichtius robustus). Journal of Cetacean Research and
  Management 3:19-29.
- Koski, K. 2010. 2010 Soundwatch Program Annual Report: Soundwatch Public Outreach/Boater Education Project. The Whale Museum, Friday Harbor, Washington. 75 pp.
- Kovacs, K.M. and S. Innes. 1990. The impact of tourism on harp seals (*Phoca groenlandica*) in the gulf of St. Lawrence, Canada. Applied Animal Behaviour Science, 26:15-26.
- Krieger, K. and B.L. Wing. 1984. Hydroacoustic surveys and identifications of humpback whale forage in Glacier Bay, Stephens Passage, and Frederick Sound, southeastern Alaska, Summer 1983. NOAA Tech. Memo. NMFS/NWC-66. 60 pp.
- Kruse, S. 1991. The interactions between killer whales and boats in Johnstone Strait, RC. pages 149-159 in K. Pryor and K.S. Norris, eds. Dolphin Societies -Discoveries and Puzzles. University of California Press, Berkeley, CA.

- Mann, J., R.C. Connor, L.M. Barre, and M.R. Heithaus. 2000. Female reproductive success in wild bottlenose dolphins (*Tursiops sp.*): Life history, habitat, provisioning, and group size effects. Behavioral Ecology, 11:210-219.
- Masaki, Y. 1977. The separation of the stock units of sei whales in the North Pacific. Rept. Int. Whal. Commn., Special Issue 1:71-77.
- McDonald, M.A., J.A. Hildebrand, and S.E. Wiggins. 2006. Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. J. Acoust. Soc. Am. 120(2):711-718.
- Miller, P. J.O., N. Biassoni, A. Samuels, and P.L. Tyack. 2000. Whale songs lengthen in response to sonar. Nature 405(6789):903-904.
- Mizroch, S.A., D.W. Rice, and J.M. Breiwick. 1984a. The sei whale, Balaenoptera borealis. Mar. Fish. Rev. 46(4):25-29.
- Mizroch, S. A., D.W. Rice, and J.M. Breiwick. 1984b. The blue whale, Balaenoptera musculus. Mar. Fish. Rev. 46(4):15-19.
- Moore, M.J., C. A. Miller, M. S. Morss, R. Arthur, W. A. Lange, K. G. Prada, M. K. Marx, and E. A. Frey. 2001. Ultrasonic measurement of blubber thickness in right whales. Journal of Cetacean Research and Management. 2:301-309.
- Morris, B.F., M.S. Alton, and H.W. Braham. 1983. Living marine resources of the Gulf of Alaska: a resource assessment of the Gulf of Alaska/Cook Inlet proposed oil and gas lease sale 88. U.S. Dep. Commer., NOM, Natl. Mar. Fish. Serv., Anchorage, AK. 232 pp.
- Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. Scientific Reports of the Whales Research Institute, Tokyo 12: 33-89.
- Nishiwaki, M. 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Whales, Dolphins and Porpoises. Berkeley, University of California Press: 171-191.
- NMFS. 1991. Recovery Plan for the Humpback Whale (Megaptera novaeangliae). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 105 pp.
- NMFS 1998. Recovery plan for the blue whale (Balaenoptera musculus). Prepared by Reeves, R.L., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the National Marine Fisheries Service.
- NMFS. 2004. A requirements plan for improving the understanding of the status of U.S. Protected Marine Species. Report of the NOAA Fisheries National Task Force for

- Improving Marine Mammal and Turtle Stock Assessments. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/SPO-63, 112 p.
- NMFS. 2006a. Draft Revised Recovery Plan for the Steller sea lion (Eumetopias jubatus). National Marine Fisheries Service Alaska Region. Juneau, AK. 285.
- NMFS. 2006b. Draft recovery plan for the sperm whale (Physeter Macrocephalus). National Marine Fisheries Service, Silver Spring, MD.
- NMFS, 2010a. Environmental Assessment on the Effects of the Issuance of a Scientific Research Permit [File No. 14097] for Pinniped, Cetacean, and Sea Turtle Studies. Silver Spring, MD.
- NMFS, 2010b. Environmental Assessment on the Effects of Scientific Research Activities Associated with Behavioral Response Studies of Pacific Marine Mammals Using Controlled Sound Exposure. [File No. 14534]. Silver Spring, MD.
- NMFS, 2010c. Environmental Assessment for The Issuance of Scientific Research Permits for Research on Humpback Whales and Other Cetaceans. July 2010. Silver Spring, MD.
- NMFS, 2011a. Environmental Assessment for Issuance of a Scientific Research Permit for Cetacean Studies. [File No. 15330]. Silver Spring, MD.
- NMFS, 2011b. Supplemental Environmental Assessment On The Effects Of Issuance Of A Scientific Research Permit Amendment For Research On The Eastern North Pacific Southern Resident Killer Whale (Orcinus Orca) Permit No. 781-1824-02. Silver Spring, MD.
- Nowacek, S.M., R.S. Wells, and A.R. Solow. 2001. Short-term effects of boat traffic on bottlenose dolphins, *Tursiops truncatus*, in Sarasota Bay, FL. Mar. Mamm. Sci., 17(4):673-688.
- Nowacek, D.P., L.H. Thorne, D.W. Johnston, and P.L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2):81-115.
- Odell, D. K., and K.M. McClune.1999. False killer whale, Pseudorca crassidens (Owen, 1846). In Handbook of Marine Mammals. Volume 6: the Second Book of Dolphins and the Porpoises. p.213-243. Sam H. Ridway and Sir Richard Harrison, eds.
- Ohsumi, S. and S. Wada. 1972. Stock assessment of blue whales in the North Pacific. Working Paper for the 24<sup>th</sup> Meeting of the International Whaling Commission. 20 pp.
- Oleson, E. M., C. H. Boggs, K. A. Forney, M. B. Hanson, D. R. Kobayashi, B. L. Taylor, P. R. Wade, and G. M. Ylitalo. 2010. Status review of Hawaiian insular false killer whales (Pseudorca crassidens) under the Endangered Species Act. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-22, 140 p. + Appendices.

- Perrin, W.F., and S.B. Reilly. 1984. Reproductive parameters of dolphins and small whales of the family Delphinidae. Report of the International Whaling Commission Special Issue 6:97-133.
- Perry, A, C.S. Baker, and L.M. Herman.1990. Population characteristics of individually identified humpback whales in the central and eastern North Pacific: A summary and critique. (Megaptera novaeangliae). Report of the International Whaling Commission Special Issue 12:307-317.
- Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. Mar. Fish. Rev. 6:1-74.
- Rasmussen, L.E.L. and S.W. Riddle. 2004. Development and initial testing of pheromone-enhanced mechanical devices for deterring crop raiding elephants: a positive conservation step. J. Eleph. Manage. Assoc. 15:30–37.
- Raum-Suryan, K.L., K.W. Pitcher, D.G. Calkins, J.L. Sease, and T.R. Loughlin. 2002. Dispersal, Rookery Fidelity, and Metapopulation Structure of Steller Sea Lions (*Eumetopias jubatus*) in an Increasing and Declining Population in Alaska. Mar. Mamm. Sci. 18, (3) 746-764.
- Richardson, W. J., C.R. Greene Jr., C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. San Diego, CA: Academic Press, Inc.
- Rice, D. W. 1974. Whales and whale research in the eastern North Pacific. In The Whale Problem: A Status Report. W.E. Schevill, ed. Pp. 170-195. Cambridge, MA: Harvard University Press.
- Samuels, A. and L. Bejder. 1998. Habitual interactions between humans and wild bottlenose dolphins (*Tursiops truncatus*) near Panama City Beach, Florida. Report to the Marine Mammal Commission, Silver Spring, MD. 13 pp.
- Samuels, A., L. Bejder, and S. Heinrich. 2000. A Review of the Literature Pertaining to Swimming with Wild Dolphins. Report to the Marine Mammal Commission. 57 pp.
- Schultz, J.K., J.D. Baker, R.J. Toonen, A.L. Harting, and B.W. Bowen. 2011. Range-wide genetic connectivity of the Hawaiian monk seal and implications for translocation. Conservation Biology 25(1):124-132.
- Schorr, G.S., R.W. Baird, M.B. Hanson, D.L. Webster, D.J. McSweeney and R.D. Andrews. 2009. Movements of satellite-tagged Blainville's beaked whales off the island of Hawai'i. Endangered Species Research 10:203-213.
- Sears, R.1990. The Cortez blues. Whalewatcher 24(2):12-15.

- Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Green Jr., D. Kastak, D.R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33, 414-521.
- Szymanski, M. D., D. E. Bain, K. Kiehl, S. Pennington, S. Wong, and K. R. Henry. 1999. Killer whale (Orcinus orca) hearing: Auditory brainstem response and behavioral audiograms. J. Acoust. Soc. Am. 106, 1134-1141.
- Stafford, K. M., S.L. Nieukirk, and C.G. Fox. 2001. Geographic and seasonal variation of blue whale calls in the North Pacific. (Balaenoptera musculus). Journal of Cetacean Research And Management 3(1):65-76.
- Stafford, K. M.2003. Two types of blue whale calls recorded in the Gulf of Alaska. Mar. Mamm. Sci. 19(4):12.
- Stewart, B. S., S.A. Karl, P.K. Yochem, S.Leatherwood, J.L. Laake. 1987. Aerial surveys for cetaceans in the former Akutan, Alaska, whaling grounds. Arctic 40(1):33-42.
- Steiger, G.H., J. Calambokidis, R. Sears, K.C. Balcomb, and IC. Cubbage. 1991. Movement of humpback whales between California and Costa Rica. Mar. Mammal Sci. 7:306-310.
- Tillman, M.F. 1977. Estimates of population size for the North Pacific sei whale. Rep. Int. Whal. Comm. Spec. Iss. 1:98-106.
- Tomlin, A G. 1967. Mammals of the USSR and adjacent countries. Vol 9, Cetacea. Israel Program Sci. Trans. No. 1124, Natl. Tech. Info. Servo TT 65-50086. Springfield, VA 717 pp. (Translation of Russian text published in 1957).
- Tonnessen, J. N., and A. O. Johnsen. 1982. The history of modern whaling. Translated by: R. I. Christophersen. University of California Press, Berkeley, CA. 798pp.
- Von Saunder, A. and J. Barlow. 1999. A report of the Oregon, California and Washington Line-transect Experiment (ORCAWALE) conducted in west coast waters during summer/fall 1996. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-SWFSC-264. 40 pp.
- Von Ziegesar, O. 1984. A survey of the humpback whales in southeastern Prince William Sound, Alaska: 1980, 1981, and 1983. Report to the state of Alaska, Alaska Council on Science and Technology, 34 pp.
- Von Ziegesar, O. and C.O. Matkin. 1986. Humpback whales in Prince William Sound in 1985: a contract report. Contract No. 41 USC 252, NMFS, National Marine Mammal Laboratory, Seattle, WA

- Wada, S. 1980. Japanese whaling and whale sighting in the North Pacific 1978 season. Rep. Intl. Whal. Comm. 30:415-424.
- Wade, P. R., A. Kennedy, R. Leduc, J. Barlow, J. Carretta, K. Shelden, W. Perryman, R. Pitman, K. Robertson, B. Rone, J.C. Salinas, A. Zerbini, R.L. Brownell Jr., and P.J. Clapham. 2011. The world's smallest whale population? Biology Letters 7(1):83-85.
- Wade, P., M.P. Heide-Jorgensen, K. Shelden, J. Barlow, 1. Carretta, J. Durban, R. LeDuc, L. Munger, S. Rankin, A. Sauter and C. Stinchcomb. 2006. Acoustic detection and satellite-tracking leads to discovery of rare concentration of endangered North Pacific right whales. Biology Letters 2: 417-419.
- Walker, W.A., and M.B. Hanson. 1999. Biological observations on Stejneger's beaked whale, Mesoplodon stejnegeri, from strandings on Adak Island, Alaska. Mar. Mamm. Sci. 15:1314-1329.
- Watkins, William A., A.D. Daher, J.E. George, and S. Haga. 2000. Distribution of calling blue, fin, and humpback whales in the North Pacific. WHOI Technical Report. WHOI-00-12. 46pp.
- Weinrich, M.T., R.H. Lambertsen, C.R. Belt, M.R. Schilling, H.J. Iken and S.E. Syrjala. 1992. Behavioural reactions of humpback whales *Megaptera novaeangliae* to biopsy procedures. Fish. Bull. 90(3): 588-598.
- Wells, R.S. and M.D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci., 13(3):475-480.
- Whitehead, H. 1982. Population of humpback whales in the northwest Atlantic. Rep. Int. Whal. Comm. 32:345-353.
- Whitehead, H. 1987. Updated status of the humpback whale, Megaptera novaeangliae in Canada. Canadian Field-Naturalist 101(2): 284-294.
- Witteveen, B.H., R.J. Foy, K.M. Wynne, and Y. Tremblay.2008. Investigation of foraging habits and prey selection by humpback whales (Megaptera novaeangliae) using acoustic tags and concurrent fish surveys. Marine Mammal Science 24(3):516-534.
- Yochem, P.K., and S. Leatherwood. 1985. Blue whale Balaenoptera musculus (Linnaeus, 1758). In Handbook of Marine Mammals, vol. 3: The Sirenians and Baleen Whales. S.H. Ridgway and R. Harrison, eds. Pp. 193-240. London: Academic Press.

### Appendix A: Recent Environmental Assessments for Marine Mammal Research Permits

NMFS Permits Division has prepared EAs with Findings of No Significant Impact (FONSI) for issuance of permits to conduct research on the listed and proposed for listing species, as well as for issuance of permits to conduct biopsy, tagging, and playback studies on numerous species of marine mammals. Those EAs were prepared to take a closer look at the potential environmental impacts of permitted research on marine mammals listed as threatened or endangered, and not because the Permits Division determined that significant adverse environmental impacts were expected or that a categorical exclusion was not applicable. As each EA demonstrates, and each FONSI has documented, research on marine mammals generally does not have a potential for significant adverse impacts on marine mammal populations or any other component of the environment.

- NWFSC (Dr. Hanson) has been authorized to conduct similar research under Permit No. 781-1824-02, which expires April 14, 2012.
- Mr. Calambokidis has been authorized to conduct similar research since 1984 and most recently under Permit No. 540-1811-04, which expires April 14, 2012.
- The Center for Whale Research (Mr. Balcomb) has been authorized to conduct similar research since 1974 and most recently under Permit No. 532-1822-04, which expires April 14, 2012.
- This is the first permit for The Whale Museum and their activities are limited to Level B Harassment by vessel approach.

The issuance of these permits and subsequent amendments have been analyzed under numerous NEPA documents.

The NEPA documents that contain analyses relevant to the proposed action include:

• Environmental Assessment on the Effects of the Issuance of Eleven National Marine Fisheries Service Permitted Scientific Research Activities on Marine Mammal and Sea Turtle Species in the U.S. Territorial Waters and High Seas of the North Pacific Ocean (including the Gulf of Alaska and Bering Sea), Arctic Ocean (including the Chukchi Sea and Beaufort Sea), Southern Ocean (including waters off Antarctica), and Foreign Territorial Waters of Mexico (Gulf of California only), Canada, Russia, Japan and the Philippines (NMFS, 2004).

This was a batched EA which analyzed the issuance of 11 research permits. The objective of the various permits was to collect information on the biology, foraging ecology, behavior, and communication of a variety of marine mammal and sea turtle species in the action area, with a focus on humpback whales in the North Pacific. This EA described and analyzed the effects of research activities ranging from close approaches during aerial and vessel surveys for photo-identification to biopsy sampling and acoustic playbacks. Four alternatives were proposed: 1) no action; 2) authorizing the proposed activities except invasive sampling; 3) authorize all the proposed activities; and 4) retraction of all permits and no further issuance of permit requests. All but alternative 3 were found to be unsuitable because they would fail to provide critical information on

the ecology and biology of marine mammals that would help conserve, manage, and recover these species. A FONSI was signed June 30, 2004 based on the best available information suggesting that careful approaches to cetaceans, even repeated approaches, elicit only moderate to minimal reactions, and that most animals show no observable change in behavior in response to biopsy sampling or tagging.

• Supplemental Environmental Assessment on the Effects of the Issuance of Nine National Marine Fisheries Service Permit Actions for Scientific Research Activities on Marine Mammal Species in the U.S. Territorial Waters and High Seas of the Eastern, Central, and Western North Pacific Ocean, with a Primary Focus on the Waters Off Hawaii and from California Northward to Southeast Alaska (Including Gulf of Alaska and Aleutian Islands), and Including Foreign Territorial Waters of Japan (NMFS, 2005).

For issuance of File No. 731-1774 and 8 other permits, an SEA was prepared that analyzed the effects of increased action and cumulative impacts of research on primarily humpbacks, blue, sei, and fin whales in the Pacific basin. These requests cover a subset of the same research methodologies, target species and action area analyzed under the original EA as detailed above. Therefore, the original EA was supplemented to address the direct impacts of the newly requested permit actions as well as the cumulative impacts of the amendment and the initially permitted activities. It concluded that no significant cumulative effect of the requests were expected. A FONSI was signed September 16, 2005.

• Environmental Assessment on the Effects of the Issuance of Four National Marine Fisheries Service Scientific Research Permits and Three Permit Amendments on the Eastern North Pacific Southern Resident Killer Whale (Orcinus orca) and Other Marine Mammals in the U.S. Territorial Waters, Exclusive Economic Zones, and High Seas of the Eastern North Pacific Ocean along the Coast of the U.S. from Southeastern Alaska to Central California, and Coastal Inlets and Estuaries of These States (NMFS, 2006c)

The EA was prepared for issuance of several permits and amendments for research directed at Southern Resident killer whales, and including research on non-ESA listed killer whales and various other marine mammals. The research protocols analyzed included tagging of listed species. A FONSI was signed on March 30, 2006.

• Environmental Assessment on the Effects of Scientific Research Activities Associated with Behavioral Response Studies of Pacific Marine Mammals Using Controlled Sound Exposure (NMFS, 2010)

For issuance of File No. 14534, an EA was prepared. The objectives of the study includes support of conservation management by providing empirical measurements of behavior in marine mammals and behavioral changes as a function of sound exposure. The action area for the proposed study includes the U.S. Navy's existing Southern California (SOCAL) Range Complex, other US locations including offshore waters, and international waters throughout the Pacific basin. Research involves documenting the behavioral responses in several marine mammal species exposed to controlled underwater

sound exposures and quantifying exposure conditions associated with various effects and would be conducted through vessel surveys which include active acoustic playback, photo-identification, biological sampling, radio tagging, and satellite tagging. This EA described and analyzed the effects of research activities ranging from close approaches during vessel surveys for tagging, photo-identification, biopsy sampling and acoustic playbacks. Two alternatives were proposed: 1) no action and 2) authorize all the proposed activities; one was found to be unsuitable because it would fail to provide critical information on the ecology and biology of marine mammals that would help conserve, manage, and recover these species. A FONSI was signed July 29, 2010 based on the best available information suggesting that the proposed permit result only in transitory and recoverable changes in behavior and physiological parameters of the affected animals, including those listed as threatened or endangered, but are not expected to result in measurable effects on populations, stocks, or species. It was also determined that the sound propagation in the water column will not result in impacts on unique or ecologically critical areas.

• Environmental Assessment on the Effects of the Issuance of a Scientific Research Permit [File No. 14097] for Pinniped, Cetacean, and Sea Turtle Studies (NMFS, 2010)

For issuance of File No. 14097, an EA was prepared. The objectives of the study are to conduct population assessments to determine abundance, distribution patterns, foraging ecology, behavior, and communication for most marine mammal and sea turtle species in U.S. territorial and international waters. Research would be conducted through vessel surveys, aerial surveys, photogrammetry, photo-identification, biological sampling, radio tagging, and satellite tagging. Cetacean, pinniped, and sea turtle parts, specimens, and biological samples would also be salvaged and imported/exported. This EA described and analyzed the effects of research activities ranging from close approaches during aerial and vessel surveys for photo-identification to biopsy sampling and acoustic playbacks. Two alternatives were proposed: 1) no action and 2) authorize all the proposed activities; one was found to be unsuitable because it would fail to provide critical information on the ecology and biology of marine mammals that would help conserve, manage, and recover these species. A FONSI was signed July 01, 2010 based on the best available information suggesting that the proposed permit elicit only moderate to minimal reactions, that most animals show no observable change in behavior in response to biopsy sampling or tagging and no long term impact or reduction in fecundity are expected.

• Environmental Assessment for The Issuance of Scientific Research Permits for Research on Humpback Whales and Other Cetaceans (NMFS, 2010)

The objective of the eight permits is to collect information on the biology, foraging ecology, behavior, and communication of a variety of marine mammal species in the Pacific Ocean, with a focus on humpback whales. This EA described and analyzed the effects of aerial surveys, vessel surveys for behavioral observations, photo-identification, underwater photography and videography, collection of sloughed skin and feces, sampling whale blows, passive acoustic recordings, export and re-import of parts, tags

attached by suction cup or by implanting darts, barbs, or a portion of the tag into the skin and blubber, biopsy sample collection, and acoustic playbacks. A FONSI was signed July 14, 2010 based on the best available information suggesting that the proposed permit actions elicit only moderate to minimal reactions, that most animals show no observable change in behavior in response to biopsy sampling or tagging and no long term impact or reduction in fecundity are expected.

• Environmental Assessment for Issuance of a Scientific Research Permit [File No. 15330] for Cetacean Studies (NMFS, 2011)

The objective of the research is to determine the abundance, distribution, stock structure of cetaceans, movement patterns, habitat use, and diving behavior of cetaceans in U.S. territorial and international waters of seven species of pinnipeds, 40 species of cetaceans, and unidentified mesoplodon species. This EA described and analyzed the effects of vessel surveys, aerial surveys, photo-identification, acoustic recording, biological sample collection, and dart and suction cup tagging as well as salvage and import/export of cetacean parts, specimens, and biological samples. A FONSI was signed July 26, 2011 based on the best available information suggesting that the proposed permit elicit only moderate to minimal reactions, that most animals show no observable change in behavior in response to approach and tagging and no long term impact or reduction in fecundity are expected.

• Supplemental Environmental Assessment On The Effects Of Issuance Of A Scientific Research Permit Amendment For Research On The Eastern North Pacific Southern Resident Killer Whale (Orcinus Orca) Permit No. 781-1824-02 (NMFS, 2011)

This amendment authorizes satellite tagging of up to 6 Southern resident killer whales and increases the number of suction cup tags deployed on this species from 10 to 20. A FONSI was signed October XX, 2011 based on the best available information suggesting that the proposed permit elicit only moderate to minimal reactions, that most animals show no observable change in behavior in response to approach and tagging and no long term impact or reduction in fecundity are expected.

NMFS also prepared an Environmental Impact Statement (EIS) on the Steller Sea Lion and Northern Fur Seal Research Program (NMFS, 2007). The EIS describes the suite of research activities historically and currently permitted on Steller sea lions throughout their range in the U.S.

**Appendix B : Active Scientific Research Permits In the Action Area** 

Permit No.	Permit Holder	Expiration date	Location	Harassment
Cetaceans Perm	nits			
369-1757-01*	Mate	Until new Permit Issued	AK, WA,OR, CA	Level A & B
587-1767-01*	Salden	9/30/2011	HI, AK	Level B only
727-1915	Scripps Institute of Oceanography	2/1/2013	WA, OR, CA, HI	Level A & B
781-1824-01*	NMFS, NWFSC	4/14/2012	AK, WA, OR, CA	Level A & B
945-1776*	Glacier Bay National Park and Preserve	11/30/2011	AK	Level B only
1058-1733-01	Baumgartner	5/31/2012	AK	Level A & B
1071-1770-02*	The Dolphin Institute	6/30/2011	AK, WA, OR, CA , HI	Level A & B
1120-1898	Eye of the Whale	7/31/2012	AK	Level B only
1127-1921	Hawaii Marine Mammal Consortium	6/30/2013	HI	Level A & B
10018	Cartwright	6/30/2013	HI	Level B only
10045	Wasser	7/15/2013	WA	Level B only
13392	Jefferson	8/1/2013	CA	Level A & B
13430	NMFS NMML	1/31/2015	OR, WA	Level A & B

Permit No.	Permit Holder	Expiration date	Location	Harassment
13846	Whale Trust/Darling	7/31/2015	AK, WA, HI	Level A & B
14097	NMFS, SWFSC	6/30/2015	AK, WA, OR, CA , HI	Level A & B
14122	Straley	7/31/2015	AK	Level A & B
14245	NMFS, NMML	5/1/2016	AK, WA, OR, CA	Level A & B
14296	Witteveen	7/31/2015	AK	Level A & B
14353	Zoidis	7/31/2015	HI	Level A & B
14451	University of Hawaii at Manoa	7/31/2015	AK, WA, OR, CA , HI, CNMI	Level B only
14534	NOAA S&T	7/31/2015	CA	Level A & B
14585	Pack	7/31/2015	AK, HI	Level A & B
14599	Sharpe	7/31/2015	AK	Level A & B
14682	Au	11/15/2015	н	Level A & B
15271	Harvey	3/31/2016	WA, OR, CA	Level A & B
15330	Baird	8/1/2016	AK, WA, OR, CA , HI, CNMI	Level A & B
15483	Mate	12/31/2015	OR	Level B only
15616	Matkin	2/28/2016	AK	Level A & B
16183	Maldini	2/29/2016	CA	Level B only

Permit No.	Permit Holder	Expiration date	Location	Harassment
Pinniped Perm	its			
87-1851	Costa	1/31/2012	CA	Level A & B
373-1868	Point Reyes Bird Observatory	4/15/2012	CA	Level A & B
486-1790	Stewart	10/1/2011	CA	Level A & B
555-1870	Harvey	4/15/2012	AK, WA, OR, CA	Level A & B
10137	PIFSC	6/30/2014	HI	Level A & B
14197	Vandenberg Airforce Base	6/30/2014	CA	Level A & B
14324	Alaska SeaLife Center	8/31/2014	AK	Level A & B
14325	Alaska DFG	8/31/2014	AK	Level A & B
14326	NMFS NMML	8/31/2014	AK, WA, OR, CA	Level A & B
14327	NMFS National Marine Mammal Laboratory (NMML)	8/31/2014	AK, CA	Level A & B
14328	Alaska SeaLife Center	8/31/2014	AK	Level A & B
14329	North Pacific Universities Marine Mammal Research Consortium	8/31/2014	AK	Level A & B
14330	Aleut Community of St. Paul Island	8/31/2014	AK	Level A & B
14331	Aleut Community of St. George Island	8/31/2014	AK	Level A & B
14335	Alaska SeaLife Center	8/31/2014	AK	Level A & B

Permit No.	Permit Holder	Expiration date	Location	Harassment
14336	Markus Horning	8/31/2014	AK	Level A & B
14337	Andrew Trites, Ph.d.	8/31/2014	AK	Level A & B
14636	Costa	6/30/2015	CA	Level A & B
14676	Ponganis	2/01/2015	CA	Level A & B
16087	NMFS NMML	6/30/2016	WA, OR, CA	Level A & B

<sup>\*</sup> indicates that there is a one-year extension on the permit