NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title: Biological Opinion on the Issuance of Permit No. 932-1905 to the Marine Mammal Health and Stranding Response Program

Action Agency: Permits, Conservation and Education Division, and the Marine Mammal Health and Stranding Response Program, Office of Protected Resources, National Marine Fisheries Service

Consultation Conducted By: Endangered Species Division, Office of Protected Resources, National Marine Fisheries Services

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National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological Opinion

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

Activities Considered: Issuance of research and enhancement permits to the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program

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

Approved by: ______________________

Date: FEB 26 2009

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" a protected species, that agency is required to consult formally with the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR 402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS or the U.S. Fish and Wildlife Service concur with that conclusion (50 CFR 402.14(b)). For the actions described in this document, the action agencies are NMFS' Office of Protected Resources - Permits, Conservation and Education Division and NMFS' Office of Protected Resources – Marine Mammal Health and Stranding Response Program. The consulting agency is NMFS' Office of Protected Resources - Endangered Species Division.

This Opinion is based on our review of the Environmental Impact Statement NMFS' Marine Mammal Health and Stranding Response Program prepared on their program, final and draft recovery plans that are available for the species considered in this Opinion, NMFS' Marine Mammal Stock Assessment Reports for marine mammals, past and current research and population dynamics modeling efforts, published and unpublished scientific information on the biology and ecology of threatened and endangered whales and sea turtles in the action area, and other sources of information gathered and evaluated during the consultation on the proposed exercises. This Opinion has been prepared in accordance with section 7 of the ESA and associated implementing regulations.

Consultation History
On 16 March 2007, NMFS' Marine Mammal Health and Stranding Response Program published a Draft Environmental Impact Statement and Overseas Environmental Impact Statement on enhancement and research activities the program planned to fund or undertake on marine mammals globally.

On 17 March 2008, NMFS published a proposed rule in the Federal Register on the Marine Mammal Health and Stranding Response Program's request for a permit to conduct enhancement and research activities on marine mammals, including endangered and threatened marine mammals (73 Federal Register 14228).

On 3 December 2008, NMFS' Permits Division provided NMFS' Endangered Species Division with a copy of its final estimates of the number of marine mammals that might be "taken" as a result of the enhancement and research activities the Marine Mammal Health and Stranding Response Program planned to fund or carry out.

During informal consultation on these proposed actions, the Permits Division and Endangered Species Division initially agreed to address these actions in a single biological opinion because they all would target the same species.

BIOLOGICAL OPINION

Description of the Proposed Action
The National Marine Fisheries Services' Permits, Conservation and Education Division (Permits Division) proposes to issue a permit to the National Marine Fisheries Services' Marine Mammal Health and Stranding Response Program (hereafter, the "Health and Response Program") that authorizes representatives of that program to (1) carry out activities pursuant to section 109(h), 112(c), and Title IV of the Marine Mammal Protection Act of 1972, that involve threatened and endangered marine mammal species under the jurisdiction of the National Marine Fisheries Service; (2) harass marine mammals incidental to all activities of the Stranding Response Program in the U.S.; (3) conduct intrusive research activities on marine mammals in the U.S.; and (4) collect, receive, transfer, import, export, analyze, and curate marine mammal specimens. The Permits Division proposes to take this action pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq.*), and the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et seq.*).

The purpose of the proposed permit is to allow the Health and Response Program to fulfill its statutory mandates under Title IV of the MMPA to collect and disseminate reference data on the health and health trends of marine mammals in the wild; correlate the health of marine mammals with available data on physical, chemical, and biological environmental parameters; and coordinate effective responses to unusual mortality events. The Health and Response Program, pursuant to section 109(h) of the MMPA, also responds to health emergencies involving marine mammals including, but is not limited to, animals that are stranded, trapped out of habitat, or otherwise in peril. The Health and Response Program also rehabilitates and releases endangered and threatened marine mammals, temporarily holds endangered or threatened individuals that cannot be released into the wild until those individuals can be placed in permanent holding facilities, and is responsible for disentangling all endangered or threatened marine mammal species. Under section 109(h) of the MMPA, the Health and Response Program may also "take" marine mammals to protect public health and welfare and may conduct non-lethal removals of nuisance animals.

To fulfill their mandate, the Health and Response Program also might conduct research projects on any marine mammal species under the jurisdiction of NMFS, including endangered and threatened marine mammals. The Health and Response Program might also receive, possess, analyze, transfer, import and export samples or parts from all marine mammal species under the jurisdiction of NMFS or the U.S. Fish and Wildlife Service. They also might collect samples from any endangered or threatened marine mammals under NMFS' jurisdiction. The purpose of the proposed research is to allow the Health and Response Program to develop baseline health parameters for marine mammals, undertake health surveillance programs, and collect morbidity and mortality information.

The proposed permit would authorize the Health and Stranding Response program to continue the following categories of activities (that is, activities that were authorized in the program's pre-existing permit; also see Tables 1 and 2):

Aerial Surveys

The Health and Stranding Response Program uses aerial surveys to (1) locate imperiled marine mammals; (2) monitor behavior or disease in a given population or individual; and (3) survey the extent of disease outbreaks or die-offs. The type of aircraft used to respond to health emergencies depends upon the aircraft available at the time of the response and the logistics of the response. The frequency of surveys is depends on the circumstances of stranded or entangled animals, the disease, or the occurrence of a unusual mortality event.

Aerial surveys are flown along predetermined transect lines at a set altitude and air speed while observers scan the water for signs of marine mammals. When participants in aerial surveys sight a marine animal or group of marine mammals, the survey aircraft descends and circles over the animal or animals while photographs are taken. The time and altitude of the aircraft depends on the aircraft and the response or research situation.

Vessel Surveys

The Health and Stranding Response Program may conduct vessel surveys to: collect data on animal abundance, to assess animals; locate animals for research activities; and collect research samples. The program also uses vessel surveys to monitor animals subsequent to their release, to assess their health, for photo-identification, and tracking. The program also uses vessels as a platform for conducting animal sampling.

For small cetaceans, inshore monitoring surveys are conducted using small (5-7 m) outboard motor powered boats. Animals are located by having crew members visually search waters as the boat proceeds along a specified route at slow speeds (8-16 km/hr). Animals outfitted with Very High Frequency (VHF) radio tags are located by listening for the appropriate frequency and, after detecting a signal, maneuvering the boat towards the animal using a combination of signal strength and directional bearings. Frequencies and remote sensors may also be monitored. Once

Table 1. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
Project 1: Emergency Response Activities								
All ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	All (no restriction on age class)	Male or Female	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Close approach, aerial and vessel surveys, disentanglement, capture, restraint, handling, tagging, marking (excluding hot branding), sample collection (including biopsy), sample analysis, anesthesia, sedation, treatment, import/export of animals, transport, relocation, rehabilitation, release, hazing away from harmful situations; and acoustic sampling, recording, and playbacks	Live animals may be transported to rehabilitation facilities and release sites. Live animals may be relocated	Beaches, coastal waters of the US, waters within the US EEZ, and international waters (for export	All/continuous
All ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	All	Male or Female	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Euthanasia, necropsy, carcass disposal	Carcasses may be transported to disposal sites or laboratories	Beaches, coastal waters of the US, and waters within the US EEZ	All/continuous
All ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	All	Male or Female	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Accidental mortality, necropsy, carcass disposal	Carcasses may be transported to disposal sites or laboratories	Beaches, coastal waters of the US, and waters within the US EEZ	All/continuous
All Cetacea, all Pinnipedia (including walrus), dugongs, manatee, polar bear, and sea otter[2]	All	Male or Female	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Incidental harassment	N/A	Beaches, coastal waters of the US, and waters within the US EEZ	All/continuous
All Cetacea, all Pinnipedia (including walrus), dugongs, manatee, polar bear, and sea otter[2]	All	Male or Female	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Receipt, import/export of samples	Analytical and diagnostic samples may be transported, imported or exported as needed to laboratories	Beaches, coastal waters of the US, waters within the US EEZ, and international waters	All/continuous

Table 1. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
Project 2: Prospective Health Assessment Research Activities								
Pinnipedia (except Guadalupe fur seal, Hawaiian monk, seal and Steller sea lion)	All	Male or Female	Unlimited	5	Close approach, aerial and vessel surveys	None	Coastal waters of the US, US EEZ, international waters	All
Pinnipedia (except Guadalupe fur seal, Hawaiian monk, seal and Steller sea lion)	All	Male or Female	Up to 300 annually (total)	5	Capture (net or hand), restraint, handling, tagging, marking (excluding hot branding), sample collection (including biopsy), release; and acoustic sampling, recording, and playbacks	None	Coastal waters of the US, US EEZ, international waters	All
Pinnipedia (except Guadalupe fur seal, Hawaiian monk seal and Steller sea lion)	All	Male or Female	3 annually (total)	1	Accidental mortality during capture activities	None	Coastal waters of the US, US EEZ, international waters	All
Pinnipedia (except Guadalupe fur seal, Hawaiian monk seal and Steller sea lion)	All	Male or Female	Up to 400 annually (total)	5	Collection of samples during other legal takes/permitted activities (subsistence harvest, by-catch, live capture/release)	None	Coastal waters of the US, US EEZ, international waters	All
Hawaiian monk seals, Guadalupe fur seals, and Steller sea lions (eastern and western population) that are held in captivity and are not releasable back into the wild and those undergoing rehabilitation	All	M//F	As warranted to satisfy the requirements of study design	As warranted to satisfy the requirements of study design	Capture (net or hand), restraint, handling, tagging, marking (tagging and marking excludes hot branding and would only occur in an animal is not already marked or is not otherwise identifiable), sample collection (including biopsy samples,) release, and acoustic sampling, recording, and playbacks	None	Captive holding facilities (including rehabilitation centers)	All
Small Cetacea (*Tursiops, Stenella, Steno, Delphinus, Lagenorhynchus Lagenodelphis, Lissodelphis, Grampus,*	All	Male or Female	Unlimited	5	Close approach, aerial and vessel surveys	None	Coastal waters of the US, US EEZ, international waters	All

Table 1. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Phocoena, Phocoenoides, Kogia, Delphinaterus, all beaked whales)								
Small Cetacea (see above)	All except young-of-the-year	Male or Female	Up to 200 annually (total)	5	Capture (net or hand), restraint, handling, tagging, marking (including freeze branding), sample collection, release; and acoustic sampling, recording, and playbacks	None	Coastal waters of the US, US EEZ, international waters	All
Small Cetacea (see above)	All except YOY	Male or Female	3 annually (total)	1	Accidental mortality during capture activities	None	Coastal waters of the US, US EEZ, international waters	All
Small Cetacea (see above)	All except YOY	Male or Female	Up to 400 annually (total)	5	Collection of samples during other legal takes/permitted activities (subsistence harvest, by-catch, live capture/release)	None	Coastal waters of the US, US EEZ, international waters	All
Large Whales (gray, right, humpback, fin, blue, sei, Bryde's, minke, bowhead, and sperm whales)	All except calves ≤ 6 months in age and cows with calves	M/F	Up to 4,900 annually (total)	5	Close approach, aerial and vessel surveys	None	Coastal waters of the US, US EEZ, international waters	All
Large Whales (same species as the previous entry)	All except calves ≤ 6 months in age and cows with calves (for tagging and health sampling)	M/F	Up to 100 annually (total)	5	Close approach, aerial and vessel surveys, tagging and sample collection (including biopsy and respiratory gases), acoustic sampling (including recording and playback experiments), collection of feces, photo-identification (for visual health assessment and identification)	None	Coastal waters of the US, US EEZ, international waters	All
Large Whales (same	All except for	M/F	Up to 400	5	Collection of samples from	None	Coastal waters	All

Table 1. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
species as the previous entry)	live calves ≤ 6 months in age and cows with calves		annually (total)		dead animals in conjunction with the activities of other investigators who are operating under other permits or legal authority, subsistence harvest, or by-catch; collection of respiratory gasses and blood samples from live animals in conjunction with the activities of other investigators who are operating under other permits or legal authority, or during emergency response activities covered under the proposed permit		of the US, US EEZ, international waters	
All Cetacea, all Pinnipedia (including walrus), dugongs, manatee, polar bear, and sea otter[2]	All	Male or Female	As warranted to satisfy the requirements of the study design	As warranted to satisfy the requirements of the study design	Receipt, important, and export of samples	Analytical and diagnostic samples may be transported, imported, or exported to laboratories as needed	Beaches, coastal waters of the U.S., waters within the U.S. EEZ, and international waters; world-wide import or export	All/ continuous
Project 3: Cognitive Assessment of Sea Lions in Rehabilitation with Domoic Acid Intoxication								
Zalophus californianus	All	M/F	Up to 50 domoic acid exposed animals and up to 50 controls (total)	30 (up to 1/day)	Restraint, handling, and sample collection	Animals may be transported to Long Marine Laboratory.	Animals in rehabilitation at The Marine Mammal Center	Period for each animal- up to 30 days. Entire study- Over 5 years
Zalophus californianus	All	M/F	Up to 50 domoic acid exposed animals (total)	1	Accidental mortality during research activities	None	Animals in rehabilitation at The Marine Mammal Center	Entire study- Over 5 years

1 The term "emergencies" generally refers to health emergencies involving marine mammals and include, but are not limited to stranding events, entanglements, disease outbreaks, and exposure to biotoxins. Due to their nature, the number of individuals that might be "taken" during responses to these health emergencies cannot be determined in advance

2 Dugongs, manatees, polar bears, sea otters, and walruses are under the jurisdiction of the U.S. fish and wildlife Service and are not addressed in this biological opinion

Table 2. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct on endangered or threatened species under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
Project 1: Emergency Response Activities								
All ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	All (no restriction on age class)	M/F	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Close approach, aerial and vessel surveys, disentanglement, capture, restraint, handling, tagging, marking (excluding hot branding), sample collection (including biopsy), sample analysis, anesthesia, sedation, treatment, import/export of animals, transport, relocation, rehabilitation, release; hazing away from harmful situations; and acoustic sampling, recording, and playbacks	Live animals may be transported to rehabilitation facilities and release sites. Live animals may be relocated	Beaches, coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters; world-wide important or export of animals	All/continuous
All ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	All	M/F	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Euthanasia, necropsy, carcass disposal	Carcasses may be transported to disposal sites or laboratories	Beaches, coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters	All/continuous
All ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	All	M/F	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Accidental mortality, necropsy, carcass disposal	Carcasses may be transported to disposal sites or laboratories	Beaches, coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters	All/continuous
All Cetacea, all Pinnipedia (including walrus), dugong, manatee, polar bear, and sea otter[3]	All	M/F	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Incidental harassment	N/A	Beaches, coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters	All/continuous

Table 2. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct on endangered or threatened species under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
All Cetacea, all Pinnipedia (including walrus), dugongs, manatee, polar bear, and sea otter[2]	All	M/F	As warranted to respond to emergencies[1]	As warranted to respond to emergencies[1]	Receipt, import/export of samples	Analytical and diagnostic samples may be transported, imported or exported as needed to laboratories	Beaches, coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters	All/continuous
Project 2: Prospective Health Assessment Research Activities								
Hawaiian monk seals, Guadalupe fur seals, and Steller sea lions (eastern and western population) that are held in captivity and are not releasable back into the wild and those undergoing rehabilitation	All	M//F	As warranted to satisfy the requirements of study design	As warranted to satisfy the requirements of study design	Capture (net or hand), restraint, handling, tagging, marking (tagging and marking excludes hot branding and would only occur in an animal is not already marked or is not otherwise identifiable), sample collection (including biopsy samples,) release, and acoustic sampling, recording, and playbacks	None	Captive holding facilities (including rehabilitation centers)	All
Large Whales (gray, right, humpback, fin, blue, sei, Bryde's, minke, bowhead, and sperm whales)	All except calves ≤ 6 months in age and cows with calves	M/F	Up to 4,900 annually (total)	5	Close approach, aerial and vessel surveys, collection of feces, photo-identification for visual health assessment and identification	None	Coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters	All
Large Whales (see above)	All except calves ≤ 6 months in age and cows with calves (for tagging and health sampling)	M/F	Up to 100 annually (total)	5	Close approach, aerial and vessel surveys, tagging and sample collection (including biopsy and respiratory gases), acoustic sampling (including recording and playback experiments), collection of feces, photo-identification (for visual health assessment and identification)	None	Coastal waters and EEZ of the United States, its territories, and possessions, and adjacent marine waters	All
Large Whales (see above)	All except for live calves ≤ 6	M/F	Up to 400 annually (total)	5	Collection of samples from dead animals in conjunction with the activities of other investigators who	None	Coastal waters and EEZ of the United States, its	All

Table 2. Activities representatives of the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program would be authorized to conduct on endangered or threatened species under the proposed permit

Species	Life Stage	Gender	Expected Number of Individuals "Taken"	Number of Times an Individual Might be "Taken"	Proposed Action	Transport	Location	Dates/Time Period
	months in age and cows with calves				are operating under other permits or legal authority, subsistence harvest, or by-catch; collection of respiratory gasses and blood samples from live animals in conjunction with the activities of other investigators who are operating under other permits or legal authority, or during emergency response activities covered under the proposed permit		territories, and possessions, and adjacent marine waters	
All Cetacea, all Pinnipedia (including walrus), dugongs, manatee, polar bear, and sea otter[2]	All	Male or Female	As warranted to satisfy the requirements of the study design	As warranted to satisfy the requirements of the study design	Receipt, important, and export of samples	Analytical and diagnostic samples may be transported, imported, or exported to laboratories as needed		

1 The term "emergencies" generally refers to health emergencies involving marine mammals and include, but are not limited to stranding events, entanglements, disease outbreaks, and exposure to biotoxins. Due to their nature, the number of individuals that might be "taken" during responses to these health emergencies cannot be determined in advance

2 Dugongs, manatees, polar bears, sea otters, and walruses are under the jurisdiction of the U.S. fish and wildlife Service and are not addressed in this biological opinion

a group of animals is located, the boat approaches the group so that crew members can assess their physical and medical condition. Photographs of the dorsal fins of individual animals are taken for later identification and matching to existing dorsal fin catalogs. When an animal is located that has been recently caught for a health evaluation, an attempt is made to photograph the dorsal fin and body to confirm identification, health, position, and behavior. A photograph of the dorsal fin would also be used to assess would healing from tag attachment. The area behind and below the posterior aspect of the dorsal fin may also be photographed to assess biopsy wound healing. A telephoto lens would be used for photographs, so vessels would not need to be too close to animals.

Multiple approaches may be required to obtain appropriate quality photographs, particularly if there are multiple individuals within a group. A close approach will be terminated and the boat will move away from a group of marine mammals if members of the group begin to display behavior that suggests they are experiencing undue stress (e.g., significant avoidance behavior such as "chuffing" or forced exhalation, tail slapping, or erratic surfacing).

Capture, Handling, and Restraint

The Health and Stranding Response Program may need to capture marine mammals to collect samples, perform an examination, or attach tags or scientific instruments. Capture methods include, but are not limited to, nets, traps, conditioning, anesthesia, and immobilization. Net types used to capture pinnipeds on land may include, but are not limited to, circle, hoop, dip, stretcher, and throw nets. Net guns and pole nooses may be used for capture.

Investigators typically capture seals that are resting onshore by stalking them and placing them in individual hoop nets. As an alternative, investigators might inject an immobilizing agent, administered remotely by a dart, to subdue older animals. Young pups may be caught, picked up, and handled by researchers during their investigations.

Herding boards may be used to maneuver animals into cages. For water captures of pinnipeds, dip nets, large nets, modified gill nets, floating or water nets, and platform traps may be used. Purse seine nets may be used offshore of haul-out sites to capture pinnipeds when they stampede into the water (Jeffries *et al.* 1993). Animals become entangled in these nets when the nets are pulled ashore. Once removed from the net, adult or juvenile pinnipeds are usually placed head first into individual hoop nets. Older animals may be restrained using gas anesthesia (administered through an endotracheal tube), a fabric restraining wrap, a restraining net, or through sedation. Pups may be restrained by hand, in a hoop net, or with the inhalation of a gas anesthesia (administered through a mask over their nose).

For health assessment studies of small cetaceans, small schools of animals are approached for identification. If the school contains animals desired for capture, the school is followed until it is in waters that facilitate safe captures (waters outside of boating channels, equal to or less than 1.5 m deep, where currents are minimal).Typically no more than three animals are captured at one time. The animals are encircled with a 600 m long by 4 m deep seine net, deployed at high speed from an 8 m long commercial fishing motor boat. Small (5-7 m) outboard-powered vessels are used to help contain the animals until the net circle is complete. These boats make small, high-speed circles, creating acoustic barriers.

Once the net is completed, about 15-25 handlers are deployed around the outside of the corral to correct net overlays and aid any animals that may become entangled in the net. The remaining 10-20 or more team members prepare for sampling and data collection and begin the process of isolating the first individual. Isolation is accomplished by pinching the net corral into several smaller corrals.

Handlers are usually able to put their arms around the selected animal as it bobs in place or swims slowly around the restricted enclosure. However, a few animals may strike the net and become entangled. After animals are restrained by handlers, an initial evaluation is performed by a trained veterinarian. Once cleared by the veterinarian, the animal is transported to the processing boat via a navy mat and/or a sling. A sling is also used to place an animal back in the water for release.

In some cases, animals may need to be captured in deep waters. A break-away hoop-net is used to capture individuals as they ride at the bow of the boat. When they surface to breathe, the hoop is placed over their head and they move through the hoop, releasing the net. The additional drag of the net slows the animals substantially, but the design allows the animal to still use its flukes to reach the surface to breathe. The net is attached to a tether and large float, and the animal is retrieved, maneuvered into a sling and brought onboard the capture boat. All other procedures are the same for animals capture using either technique.

With both capture techniques, following restraint, animals are generally placed on foam pads on the deck of a boat, either solid hulled or inflatable, or another safe platform. The animal is shaded by a canvas top. The animal's respirations and behavior are monitored and recorded by one researcher. Another team member is responsible for ensuring that the animal's eyes are shaded from direct sunlight. Two to four personnel are positioned around the animal for restraint, as necessary, and to keep the animal wet and cool using buckets of water and sponges.

Some animals do not acclimate well to being on the platform; for these individuals the assessment is conducted in the water. Animals that appear to be pregnant (but not in the late 2nd or 3rd trimester) and young animals may also be worked up in the water when this is considered to be in the dolphin's best interest. In addition, for animals that have been caught in previous years a reduced sampling protocol may be employed, reducing the need for the animal to be removed from the water.

During responses to emergency situations, investigators may capture small cetaceans in shallow water using a net deployed from a boat with methods similar to those described previously. In rivers and canals, investigators may use their bodies to herd animals then catch them with their hands. In deep water, hoop net may be used to capture animals.

To disentangle large whales, whales may be either physically or chemically restrained. Physical restraint of the animal is accomplished by attaching control lines, floats, and buoys to the entangling gear with a grappling hook or by attaching new gear to the animal to hold it.

Responders use control lines to pull themselves up to the whale. Floats and buoys are used to slow the animal down by increasing drag. Response to entangled small cetaceans typically requires in-water capture of free-swimming animals. Entangled pinnipeds are typically captured on land when they are hauled out. These capture methods are described above.

Transport

The Health and Stranding Response Program has historically used vehicles, boats, or aircraft to transport marine mammals to rehabilitation facilities or release sites. Cetaceans may be transported on stretchers, foam pads, or air mattresses. For short-term transport, closed-cell foam pads are preferred because they are rigid and do not absorb water. Open cell foam is typically used for long-term transport of cetaceans because it can contour to the animal's form. Boxes may be constructed to transport the animal upright in a stretcher. Cetaceans must be protected from exhaust fumes, sun, heat, cold, and wind, as transport often occurs on the flatbed of a truck. Animals are kept moist and cool, to avoid overheating (Geraci and Lounsbury 2005).

Small pinnipeds are typically transported in plastic kennel cages. Cages are large enough for animals to turn around, stretch out, and raise their heads. Cages should prevent animal contact with waste and allow proper air circulation. As with cetaceans, pinnipeds traveling by vehicle must be protected from the sun, heat, cold, wind, and exhaust fumes. Pinnipeds may overheat during transit and wetting the animal helps to prevent hyperthermia (Geraci and Lounsbury 2005). Large pinnipeds may need to be sedated during transport.

Commercial vehicle transport procedures for marine mammals under U.S. jurisdiction should comply with the Animal and Plant Health Inspection Service's "Specifications for the Humane Handling, Care, Treatment, and Transportation of Marine Mammals" (9 CFR Ch 1, Subpart E). The "Live Animal Regulations" published by the International Air Transport Association (IATA), and accepted by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, are followed for the air transport of animals under foreign jurisdiction (IATA 2006). Both sets of standards have specifications for containers, food and water requirements, methods of handling, and care during transit.

Close Approach

The Health and Stranding Response Program closely approaches marine mammals by aircraft, surface vessel, and on foot for disentanglement, photo-identification, behavioral observation, hazing (during emergency response), capture, tagging, marking, biopsy sampling, skin scrapes, swabs, collection of sloughed skin and feces, breath sampling, blood sampling, administration of drugs, video recording, and incidental harassment. These close approaches have involved more than one vessel and will continue to do so.

Tagging and Attachment of Scientific Instruments

The Health and Stranding Response Program might tag marine mammals to monitor an animal's movements after it has been released from a stranding site, after rehabilitation, or after samples have been taken during research activities. The Program uses a variety tags and other scientific instruments, including, but not limited to, roto-tags (cattle tags), button tags, VHF radio tags, satellite tags, Passive Integrated Transponder (PIT) tags, D-tags, code division multiple access tags, pill, time-depth recorders (TDRS), life history transmitters (LHX tags), and CRITTERCAMS (video cameras).

The specific instrument representatives of the Health and Stranding Response Program employ will depend on the species being tagged and the research or question being addressed. The methods used to attach tags and other instruments depends on the type of tags, the species involved, and the circumstances. Tags have traditionally been attached to cetaceans using bolt, buoy, punch, harness, suction cup, implant, or ingestion. Tags have traditionally been attached to pinnipeds using glue, bolt, punch, harness, suction cup, surgical implant, or ingestion.

Tags are generally attached to free-swimming cetaceans by crossbow, compound bow, rifles, spear guns, slingshot (or throwing device), pole or jab spears. Attachments are temporary and occur via a suction cup device or implant. Scientific instruments attached to suction cups include, but are not limited to D-tags, TDRs, VHF tags, satellite tags, and CRITTERCAMS.

Large, slow moving whales have traditionally been tagged using suction cups and a pole delivery system that is cantilevered on the bow of a boat. Bow-riding animals have been tagged using a hand-held poles. Fast-swimming toothed whales have traditionally been tagged using crossbows. Tags are attached on the dorsal surface of the animal behind the blowhole, closer to the dorsal fin. Tag placement ensures that the tag will not cover or obstruct the whale's blowhole, even if the cup migrates after placement (movement would be toward the tail).

Implantable tags may be attached in free-swimming animals by mounting the instrument on an arrow tip or other device designed to penetrate the skin of the animal. Tags would typically be attached by crossbow and may include, but not limited to satellite tags, VHF tags, and temperature-depth recorders. Buoys are used to attach VHF or satellite tags to gear on entangled whales. Buoys may also be attached to increase drag in an attempt to slow the whale for disentanglement.

For animals in hand, tags may be attached for longer deployments. Roto-tags may be attached to cetaceans with a plastic pin to the trailing edge of the dorsal fin. Button tags are plastic disks attached with a bolt through the dorsal fin. VHF tags (roto-radio tags) may also be bolted through the trailing edge of the dorsal fin. The bolts on each type of tag are held in place by corrodible nuts, so that the tag will eventually be released.

Satellite or VHF tags can be mounted on a molded plastic or fabric saddle that would be bolted through the dorsal fin (Geraci and Lounsbury 2005) or dorsal ridge. Plastic saddles would be padded on the inside to reduce skin irritation. Saddles would be attached to the dorsal fin with two or three Delrin pins secured with magnesium nuts. The nuts would corrode in seawater, allowing the package to be released within a few days or weeks.

Dorsal ridge "spider tags" are currently used on beluga whales (NMFS Permit No. 782-1719) (Litzky et al. 2001). Up to four holes are bored in the region of the anterior terminus of the dorsal ridge using a coring device (trochar) with a diameter of no more than 1 cm. Each insertion and exit point for the trochars would be prepared by cleaning with an antiseptic wipe, or equivalent. Rods of nylon or other non-reactive material, not greater than 1 cm in diameter and 50 cm in length, would then be pushed through the holes and attached to the wire cables or fabric flange or straps of the satellite tags or through bolt holes in the tag. The wire cables would be tightened to hold the tag against the back of the animal to minimize tag movement and drag, but would not be put under significant tension to avoid pressure necrosis around the pin insertion points. The other attachment systems would be manipulated to achieve the best possible fit depending on their design. Excess rod would then be cut off. All equipment would be sterilized in cold sterile solution, alcohol, or equivalent, and kept in air- and water-tight containers prior to use. Trochars and rods would be coated with antiseptic gel prior to insertion and each trochar would only be used for one hole before it is cleaned, sharpened, and resterilized. Where more than one instrument is to be attached, the number of pins would be limited to four.

A fast drying epoxy adhesive is used to glue scientific instruments to pinnipeds. Instruments may be attached to the dorsal surface, head, or flippers and will release when the animal molts. A harness can be used to attach scientific instruments. Roto-tags can be attached to flippers using a single plastic pin. Tags can also be surgically implanted into the body cavity or muscle of pinnipeds. Implanted tags include PIT and LHX tags.

A PIT tag is a glass-encapsulated microchip, which is programmed with a unique identification code. When scanned with an appropriate device, the microchip transmits the code to the scanner, enabling the used to determine the exact identity of the tagged animal. PIT tags are biologically inert and are designed for subcutaneous injection using a syringe or similar injecting device. The technology is well established for use in fish and is being used successfully on sea otters (Thomas *et al*. 1987), manatees (Wright et al. 1997), and southern elephant seals (Galimberti *et al*. 2000). PIT tags are also commonly used to identify domestic animals. PIT tags may be injected just below the blubber in the lumbar area, approximately 5 inches lateral to the dorsal midline and approximately 5 inches anterior to the base of the tail. Tags may also be injected at alternative sites on a pinniped's posterior, but only after veterinary consultation. The injection area would be cleansed with Betadine (or equivalent) and alcohol prior to PIT tag injection. PIT tags are currently being used in Hawaiian monk seals (NMFS Permit No. 848-1695).

LHX tags are satellite linked, delayed transmission life history transmitters. The tag allows continuous monitoring from up to five built in sensors. The tag is implanted into the abdominal cavity of a pinniped. When the animal dies, the tag is released from the body and transmits the data to a satellite. The battery life of an LHX tag is well over five years. LHX tags are being evaluated under current NMFS PR1 research permits (Permit No.1034-1685 [for California sea lions] and No. 881-1668 [for Steller sea lions]).

Marking

Marking methods for marine mammals during research activities include, but are not limited to: bleach, crayon, zinc oxide, paint ball, notching, and freeze branding. Hot branding will not be used as a marking method. Crayons, zinc oxide, and paint balls can be used on cetaceans and pinnipeds for temporary, short-term marking. Bleach or dye (human hair dye) markings can be used on pinnipeds. The marks are temporary, with the length of time dependent on molting. Notching can be used to permanently mark cetaceans by cutting a piece from the trailing edge of the dorsal fin. Notching in pinnipeds removes a piece of skin from the hind flipper of phocids (true or earless seals) and the foreflipper of otariids (sea lions and fur seals).

Cetaceans can be marked using freeze branding, typically on both sides of the dorsal fin or just below the dorsal fin. Freeze branding is used during health assessment studies to mark all animals for post-release monitoring. Freeze branding uses liquid nitrogen to destroy the pigment producing cells in skin. Each brand (typically 2" numerals) is super-cooled in liquid nitrogen and applied to the dorsal fin for 15-20 seconds. After the brand is removed, the area is wetted to return the skin temperature to normal. Brands will eventually re-pigment, but may remain readable for five years or more.

Freeze brands provide long-term markings that may be important during subsequent observations for distinguishing between two animals with similar fin shapes of natural markings. Freeze branding may be used to produce two types of marks on pinnipeds. Short contact by the branding iron destroys pigment producing cells, leaving an unpigmented brand. Longer contact with the brand destroys these cells and the hair, leaving a bald brand (Merrick *et al.* 1996). During health assessments, each animal is photographed and videotaped to record the locations of freeze brands. Freeze bands are photographed as they are applied, as they rapidly disappear following application.

Biopsy Sampling

Biopsy sampling would be conducted to collect skin, blubber, or other tissue samples. Sampling may occur on free ranging animals, animals captured for health assessment studies, and animals in rehabilitation. Skin and blubber biopsy sampling from a vessel may be conducted using crossbows, compound bows, dart guns, or pole spears. A crossbow would be used to collect a sample from animals within approximately 5 to 30 m of the bow of the vessel. The depth of the biopsy tip penetration would vary depending on the species being sampled and the depth of their blubber layer. For small cetaceans, such as bottlenose dolphins, the biopsy tip used to collect blubber for contaminant analysis penetrates to a depth of approximately 1.0-2.5 cm. Shorter tips may be used when only skin sampling is required. Sloughed skin can aggregate in the wake behind a moving animal, the slick "footprint" after a whale submerges, or in the water following surface active behaviors, such as breaching. This skin may be collected for analyses. Skin may also be collected from the suction cup used to temporarily attach scientific instruments to cetaceans.

Blubber biopsy samples may be taken during health assessment studies. These samples are necessary for the analyses of environmental contaminants, biotoxins, and fatty acids. An elliptical wedge biopsy is obtained from each animal. For small cetaceans, the sampling site is located on the left side of the dolphin, just below the posterior insertion of the dorsal fin. Local anesthetic (typically Lidocaine) is injected in an L-block at the biopsy site. A veterinarian then uses a clean scalpel to obtain a sample that is approximately 5 cm long and 3 cm wide, through nearly the full depth of blubber (approximately 1.5- 2.0 cm). A cotton plug soaked with ferric subsulfate is inserted into the site once the sample is removed in order to stop bleeding. The sample is then partitioned into separate containers for each project. Skin obtained with the blubber biopsy is used for genetic analyses. Skin scrapings, biopsy samples, or needle aspirates will be collected for clinical diagnoses from sites of suspected lesion These samples are processed by various diagnostic laboratories and a sub-sample is sent to the National Marine Mammal Tissue Bank (NMMTB). Blubber and muscle biopsies may be collected from pinnipeds. Prior to sampling, investigators would inject animals with local anesthetics (using subcutaneous and intramuscular injections), clean the site with a topical antiseptic, make small incisions with a sterile scalpel blade, and push a sterile biopsy punch through the blubber and into the muscle layer to obtain ~ a 50 mg tissue sample. Investigators would apply pressure and irrigate the wound but would not close the wound with sutures.

The proposed permit is not proposing to authorize investigators associated with the Health and Response Program to take biopsy samples of large whale calves that are less than 6 months in age or mothers attending such calves.

Blood Sampling

With cetaceans, the Health and Response Program collects blood samples from the dorsal fin, caudal peduncle, pectoral flipper, or flukes. At any of these sites, blood would be sampled using an 18- gauge 4-cm needle, with a scaled down needle bore for calves, Dall's porpoise, and harbor porpoise. With phocid seals and otariids , blood samples may be collected through the bilaterally divided extradural vein, which overlies the spinal cord. Otariids may also be sampled using the caudal gluteal vein. Sampling would be done with a 20-gauge, 4-cm needle for small animals and an 18-gauge, 4-cm needle for larger animals. Phocids may be sampled by inserting a needle into the metatarsal region of the hind flipper (Geraci and Lounsbury 2005).

Blood sampling small cetaceans during health assessment studies may occur in the water before an animal is brought aboard a research vessel or once the animal has been brought aboard the vessel. Typically, blood samples are drawn from blood vessels on the ventral side of the fluke, using an 18-20 gauge catheter. About 200-350 cubic centimeters (cc) of blood are removed from each individual.

Samples are placed in a variety of Vacutainers or other containers if analyses require different storage. Samples are generally stored in coolers until they are transported to a laboratory, although some samples may be processed on deck with a portable centrifuge system. Samples are separated and prepared for: standard chemistry, hematology, and hormonal analysis; contaminant analyses; immune function studies; aliquots for culturing for assessment of pathogens; and other preparations as necessary. All sample analyses occur at various diagnostic laboratories.

Breath Sampling

The Health and Response Program samples the breath of cetaceans or pinnipeds to assess their nutritional status and health. A specially designed vacuum cylinder would be used to collect breath samples. Samples would be collected from free ranging cetaceans by positioning a funnel at the end of a pole (which is connected to the vacuum cylinder via plastic tubing) over the blowhole of the surfacing animal. The cylinder valve would be manually opened during exhalation. An algal culture plate inside the funnel would be used for bacterial cultures of the breath. The culture plate would be sealed and transported to a laboratory for analysis. The equipment typically would not touch the animal, although in some instances there may be brief (less than 10 seconds) contact. An individual animal may be approached up to three times to obtain a sample. Samples may also be collected during health assessments or on any live captured animal. The samples will then be examined using gas chromatography-mass spectrometry for volatile compounds to evaluate respiratory disease, nutritional status, and physical condition.

Ultrasound Sampling

The Health and Response Program may use ultrasound to sample free-ranging animals and animals captured during emergency response or research studies. Ultrasound may be used to evaluate blubber thickness, wounds, lesions, the presence of lesions, pregnancy, reproductive organs, and blood vessels. During health assessment studies, a diagnostic ultrasound is used to examine the condition of the internal organs and to measure testis length and diameter to assess male maturity. Females are also examined by a veterinarian during the initial evaluation for pregnancy and the presence of developing follicles. Females determined to be in late-term pregnancy (late 2nd and 3rd trimester) are tagged with a roto-tag so they can be avoided in subsequent sets, and then immediately released. The ultrasound operates at a frequency of about 2.5-5.0 MHz, well above the dolphin's hearing. The examinations are recorded on video and audio tape, and thermal prints are made of features of interest. In addition, digital video thermography is used to measure skin temperature.

Other Sampling

Other sampling includes tooth extraction, urine, blowhole, fecal, milk, and sperm. Colonic temperature measurements may also be conducted. Most of these samples are collected during health assessment studies. During health assessment studies, the age determination of animals is conducted using the deposition of growth layer groups in teeth. A tooth is extracted from the animal by a veterinarian trained in this procedure. The tissue surrounding the tooth (usually #15 in the lower left jaw) is infiltrated with Lidocaine without epinephrine (or equivalent local anesthetic), applied through a standard, high-pressure, 30 gauge needle dental injection system. Once the area is anesthetized, the tooth is elevated and extracted using dental extraction tools. A cotton plug soaked in Betadine, or equivalent, solution is inserted into the alveolus (pit where the tooth was) as a local antibiotic and to stop bleeding. This plug is removed prior to release. This procedure is modified from that described by Ridgway *et al.*(1975), wherein the entire mandible was anesthetized. The revised procedure has been used in captivity and in live capture and release sampling for many years. Extracted teeth are sectioned, stained, and growth layer groups are counted.

Urine analyses are diagnostically useful to evaluate the urinary system (kidneys, ureters, bladder, and urethra). Important diagnoses can be made by determining the color, pH, turbidity, chemical constituents, presence or absence of blood, and by identifying any bacteria or yeast present in the urine. These diagnoses would likely be missed without such an examination. During health assessment studies, urine may be collected opportunistically, by holding an open sterile container in the urine stream. Samples may also be collected using urinary catheterization. A veterinarian experienced with cetaceans and a qualified veterinary technician perform the catheterization procedure. The dolphin would be lying on its side on the foam-covered deck of the boat serving as the veterinary laboratory. Wearing sterile surgical gloves, the assistant gently retracts the folds of the genital slit to allow visualization of the urethral orifice. The veterinarian (wearing sterile gloves) carefully inserts a sterile urinary catheter, lubricated with sterile lubricating gel, into the bladder via the urethra. A 50 ml collection tube without additive is used to aseptically collect the urine as it flows from the catheter. The catheter is removed after the urine is collected.

Swab samples from the blowhole and rectum are collected from each individual. A sterile swab is inserted into the blowhole during a breath, gently swabbed along the wall of the blowhole, and removed during the next breath. Fecal samples are obtained either from a small catheter inserted about 10 cm into the colon or from a sterile swab of the rectum. Cetacean feces may also be collected in the water column either from a vessel or a diver in the water. Pinniped feces may be collected directly from haul-out or rookery sites. The samples are sent to a diagnostic laboratory for culturing and species identification.

Milk samples are collected to measure the levels of lipophilic organic contaminants and to determine composition. All adult females are checked for lactation and milk samples are collected from all lactating females. A "breast-pump" apparatus is used to obtain the sample. Milk is expressed with gentle manual pressure exerted on the mammary gland while suction is provided by a 60 cc syringe attached by tubing to another 12 cc syringe placed over the nipple. Samples of up to 30-50 ml may be collected.

Colonic temperature is collected to understand vascular cooling and reproductive status (Rommel *et al.*1992, 1994). Temperature measurements are obtained with a linear array of thermal probes interfaced to a laptop computer. The probes are housed in a 3 mm flexible plastic tube. The probe is sterilized, lubricated, and then inserted into the colon through the anus to a depth of 0.25-0.40 m depending on the size of the animal. Temperature is continuously monitored.

Skin biopsies may be obtained from individuals displaying indications of skin disease. Gastric samples may be obtained using a standard stomach tube to evaluate health and evidence of brevetoxin exposure. Standard length and girth measurements may be taken and a series of ultrasonic measurements of blubber layer thickness may be obtained (the larger the animal, the more measurements). Investigators may also take samples of hair, nails, and vibrissae from pinnipeds: vibrissae are pulled from the root while nails and hair are simply clipped.

Administration of Drugs and Euthanasia

Representatives of the Health and Stranding Response Program may administer drugs to sedate or chemically restrain marine mammals during stranding response and disentanglement activities. They might use anesthetics and analgesics during research before performing biopsies, tooth extractions, and other procedures. Alternatively, they might administer antibiotics, antifungal agents, and other medicines during response and rehabilitation. Representatives of the program may administer these drugs orally, by injection, intubation, or inhalation. Orally administered medications are typically hidden in fish but may also be given via stomach tube.

Subcutaneous, intravenous, intramuscular, and intraperitoneal injections may be used to deliver drugs. All of these methods would require some level of animal restraint. Subcutaneous injections are made in the interface between the blubber layer and the skeletal muscle layer. Animals must be maintained in a certain position for prolonged periods of time. The most common site for Subcutaneous injections in pinnipeds is the craniodorsal thorax between the scapulae. Subcutaneous injections would not be used in cetaceans.

In general, intravenous injections are complicated and rarely used in marine mammals. In cetaceans, medications may be injected in the fluke vessel if the volume is low and the medicine is not harmful if delivered perivascularly. An indwelling catheter may be used if repeated administration or slow infusion occurs (McBain 2001).

Intramuscular drug injections require longer needles because of the thickness of skin and blubber. Caution is taken to avoid accidental injection into the blubber, which may cause sterile abscess formation or poor absorption (Gulland *et al.* 2001). Injection into the blubber also has different drug-partitioning properties than muscle. This may result in the failure to activate a systemic distribution of highly lipid soluble medications (Stoskopf *et al.* 2001). Injection sites for phocids are the muscles surrounding the pelvis, femur, and tibia. These sites, as well as the large muscles overlying the scapulae, are appropriate for otariids (Gulland *et al.* 2001). Intramuscular injections in cetaceans may be made off the midline, slightly anterior to, parallel to, or just posterior to the dorsal fin. Caution is taken to avoid the thoracic cavity if the injection is anterior to the dorsal fin (McBain 2001). Multiple injection sites may be used and the volume per site should be reasonable depending on the animal.

Intraperitoneal injections deliver medications into the abdominal cavity. Non-irritating drugs may be delivered by this method. During injection, caution must be taken to avoid damaging major organs. A contaminated needle or puncturing the gastrointestinal tract could introduce bacteria into the abdominal cavity (Gulland *et al.* 2001).

The Health and Response Program may euthanize marine mammals that have irreversibly poor condition and for whom rehabilitation would not be possible; rescue would be impossible; or no rehabilitation facility is available. Animals may be euthanized at a rehabilitation facility when veterinarians conclude that an animal cannot be released and cannot be placed in permanent captivity. Euthanasia procedures would only be carried out by an attending, experienced, and licensed veterinarian or other qualified individual. Sedation may precede the administration of euthanasia drugs. Pinnipeds are typically euthanized using a lethal injection of barbiturates or other agent normally used to euthanize domestic species. Smaller cetaceans can be euthanized by injecting barbiturates or other lethal agent into a vein of the flippers, dorsal fin, flukes, or caudal peduncle. It may also be injected directly into the heart of abdominal cavity using an indwelling catheter.

Small cetaceans may be sedated before they are injected. For large cetaceans, a method is currently being developed to sedate the animal via intramuscular injection and then deliver euthanasia agents using intravenous injection. Large cetaceans may be euthanized by lethal injection directly into the heart. Injection into a vein of the flippers or flukes would likely be unsuccessful. Large whales may also be euthanized by using ballistics (shooting) or by exsanguination (Geraci and Lounsbury 2005).

Auditory Brainstem Response/Auditory Evoked Potential

The Health and Stranding Response Program may conduct Auditory Brainstem Response and Auditory Evoked Potential procedures to evaluate the hearing abilities of individual animals or species. These procedures may be conducted on stranded animals, animals in rehabilitation, or animals captured during studies. SQ electrodes are used for obtaining evoked potential signals in pinnipeds. Procedures on odontocetes are non-invasive and can be conducted in short time frames. An animal may be resting at the surface or may be physically restrained (held by researchers) during the procedure. For odontocetes, sounds are presented through a jawphone attached to the lower jaw via suction cup.

Recording, ground, and reference suction cup electrodes are attached along the dorsal midline, starting approximately 6 cm behind the blowhole. Evoked potentials are recorded from the electrodes. Frequencies used for testing range from 5 to 120 kHz and the maximum sound pressure level is less than 160 decibels re μPa.. Procedures would only be conducted on odontocetes and pinnipeds.

Active and Passive Acoustics

In addition to Auditory Brainstem Response procedures, the Health and Stranding Response Program may conduct both active and passive acoustic activities. Passive recordings may be conducted using a hydrophone placed in the water directly off of a vessel or in a pool to record animal vocalizations and background noise. Investigators may use active acoustic playbacks to expose both cetaceans and pinnipeds to social sounds and feeding calls of the subject species during capture/release and rehabilitation and the physiological and physical response of the animals would be measured. Playbacks may be used to assess hearing to determine if animals undergoing rehabilitation are suitable for being returned to the wild. In addition, in some cases, playbacks of the subject species may be used to lure out-of-habitat animals to their natural habitat, or predatory sounds or other deterrents may be played to deter or haze animals from harmful situations, as described below.

Hazing

The Health and Stranding Response Program may haze ESA-listed marine mammals that are in the vicinity of an oil or hazardous material spill, harmful algal bloom, sonar, or any other potentially harmful situation. Methods include acoustic deterrent and harassment devices, visual deterrents, vessels, physical barriers, and capture and relocation. Acoustic deterrents used on cetaceans may include, but are not limited to, pingers, bubble curtains, Oikomi pipes, seal bombs, airguns, mid- and low-frequency sonar, predator calls, and aircraft. Other non-lethal deterrents such as booms or line in the water, or fire hoses may be used. Pinniped acoustic deterrents include seal bombs, Airmar devices, predator calls, bells, firecrackers, and starter pistols. Visual deterrents for pinnipeds include flags, streamers, flashing lights; barriers such as net or fencing may also be used to exclude or deter pinnipeds.

Import and Export of Marine Mammals or Marine Mammal Parts

The Health and Stranding Response Program commonly needs to export marine mammal parts to provide specimens to the international scientific community for analyses or as control or standard reference materials. Similarly, the Health and Stranding Response Program imports specimens obtained legally outside the U.S. for archival in the National Marine Mammal Tissue Bank or for real time analyses. Imported samples would be legally obtained from:

1. Any marine mammal directly taken in fisheries for such animals in countries and situations where such taking is legal;
2. Any marine mammal killed in subsistence harvest by native communities;
3. Any marine mammal killed incidental to commercial fishing operations;

4 Any marine mammal stranded live or dead; and

5. Captive animals, when sampling is beyond the scope of normal husbandry practices.

6. Samples taken from live animals conducted under other permitted studies.

An unlimited number and kinds of marine mammal specimens, including cell lines, would be imported and/or exported (worldwide) at any time during the year. Specimens would be taken from the Order Cetacean and the Order Pinnipedia (except walrus), including threatened and endangered species. Specimens from species under the jurisdiction of the USFWS, including walrus, polar bear, sea otter, marine otter, and Order Sirenia may be received, analyzed, curated, and imported/exported. Specimen materials may include, but are not limited to: earplugs; teeth; bone; tympanic bullae; ear ossicles; baleen; eyes; muscle; skin; blubber; internal organs and tissues; reproductive organs; mammary glands; milk or colostrums; serum or plasma; urine; tears; blood or blood cells; cells for culture; bile; fetuses; internal and external parasites; stomach and/or intestines and their contents; feces; flippers; fins; flukes; head and skull; and whole carcasses. Specimens are acquired opportunistically; therefore specific numbers and kinds of specimens, the countries of exportation, and the countries of origin cannot be predetermined.

The Health and Stranding Response Program might import or export any marine mammals under NMFS' and the U.S. Fish and Wildlife Service's jurisdiction, including species that are listed as endangered or threatened.

Sample Collection and Analysis

Specimens would be taken from the Order Cetacea and the Order Pinnipedia (except walrus), this includes threatened and endangered species. Specimen materials may include, but are not necessarily limited to: earplugs, teeth, bone, tympanic bullae, ear ossicles, baleen, eyes, muscle, skin, blubber, internal organs and tissues, reproductive organs, mammary glands, milk or colostrums, serum or plasma, urine, tears, blood or blood cells, cells for culture, bile, fetuses, internal and external parasites, stomach and/ or intestines and their contents, feces, air exhalate, flippers, fins, flukes, head and skull, and whole carcasses. Specimens may be acquired opportunistically with ongoing studies or prospective design plans; therefore specific numbers and kinds of specimens cannot be predetermined. Because all specimens will be acquired opportunistically, the Health and Stranding Response Program will have minimal control over the age, size, sex, or reproductive condition of any animals that are sampled.

Specific methods for biopsies, blood, breath, ultrasound, and other sampling are described previously. Marine mammal specimens collected for analysis or archiving would be legally obtained from the following sources:

1. On-going live animal capture/release programs;

2. Live animal capture/release as part of a disease, emergency response, or die-off investigation;

3. Live animals stranded or in rehabilitation;

4. Captive animals, when sampling is beyond the scope of normal husbandry
5. Animals found dead on the beach or at sea;
6. Animals directly taken in fisheries in countries where taking of such animals is legal;
7. Animals killed during subsistence harvests by native communities;
8. Animals killed incidental to recreational and commercial fishing operations;
9. Animals killed incidental to other human activities;
10. Animals found dead as part of NOAA investigations (*e.g.* harmful algal blooms, oil spills, etc.);
11. Soft parts sloughed, excreted, or discharged by live animals (including blowhole exudate);
12. Live animals during surveillance
13. Bones, teeth, or ivory found on the beach or on land within ¼ mile of the ocean;
14. Confiscated animals (*e.g.,* as part of enforcement action); or
15. Animals legally taken in other permitted research activities in the U.S. or abroad.

Specimen and data collection from marine mammal carcasses may follow the necropsy protocols for pinnipeds (Dierauf 1994), right whales (and other large cetaceans) (McLellan *et al.* 2004), and killer whales (Raverty and Gaydos 2004). These include how samples would be stored, transported, and analyzed. During live animal response or research, specimen and data collection protocols would depend on the samples being collected and the intended analyses.

Additional Activities Proposed For Authorization

The preceding suite of activities are those that the Health and Stranding Response Program has conducted for several years under pre-existing permits and plans to continue under the authority of the proposed permit. In addition to those pre-existing activities, the Health and Stranding Response Program has asked the Permits Division to authorize the following activities to their proposed permit.

Blood Sampling

Currently, no procedures exist to remotely collect blood from free-swimming animals. However, if blood sampling procedures were developed and approved within the 5-year period of the proposed permit, the Health and Stranding Response Program wants the authority to use any new procedures to conduct research.

Acoustics

The Permits Division does not currently authorize the use of the auditory evoked potential method on any mysticete whale. However, if the Permits Division allows investigators to use this procedure for mysticete whales during the 5-year period of the proposed permit, the Health and Stranding Response Program proposes to use this procedure to conduct research.

Permit Conditions

The proposed permit places the following terms and conditions on the activities of the Marine Mammal Health and Stranding Response Program:

A. Duration of Permit

1. Personnel listed in Condition C.1 of the proposed permit (hereinafter "Researchers") may conduct activities authorized by the proposed permit through June 30, 2013. The proposed permit expires on the date indicated and is non-renewable. The proposed permit may be extended by the Director, NMFS' Office of Protected Resources, pursuant to applicable regulations and the requirements of the MMPA and ESA.
2. Researchers must suspend a permitted activity in the event that serious injury or mortality[1] of protected species reaches the amount specified for that activity in Table 2 of Appendix 1. The Permit Holder must contact the Chief, NMFS Permits, Conservation and Education Division (hereinafter "Permits Division") by phone (301-713-2289) within two business days. The Permit Holder must also submit a written incident report as described in Condition E.2. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of the proposed permit.
3. If authorized take[2] is exceeded, Researchers must cease all permitted activities and notify the Chief, Permits Division by phone (301-713-2289) as soon as possible, but no later than within two business days. The Permit Holder must also submit a written incident report as described in Condition E.2. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of the proposed permit.

B. Number and Kind(s) of Protected Species, Location(s) and Manner of Taking

1 The proposed permit allows for unintentional serious injury and mortality caused by the presence or actions of researchers up to the limit in Tables 1 and 2. This includes, but is not limited to; deaths of dependent young by starvation following research-related death of a lactating female; deaths resulting from infections related to sampling procedures; and deaths or injuries sustained by animals during capture and handling, or while attempting to avoid researchers or escape capture. Note that for marine mammals, a serious injury is defined by regulation as any injury that will likely result in mortality.

2 By regulation, a take under the MMPA means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following: The collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a marine mammal in the wild. Under the ESA, a take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to do any of the preceding.

1. The tables in Appendix 1 of the proposed permit (and Tables 1 and 2 of this Opinion) outline the number of animals, by species, authorized to be taken, and the locations, manner, and time period in which they may be taken.
2. Detailed protocols for research conducted pursuant to MMPA section 109(h) and Title IV must be submitted to the Permits, Conservation, and Education Division in advance of the proposed activities for review in coordination with the Marine Mammal Commission, and approval will be granted at the discretion of the Chief, Permits, Conservation and Education Division, or as necessary, the Director, Office of Protected Resources.
3. Researchers working under the proposed permit may collect visual images (*i.e.*, any form of still photographs and motion pictures) as needed to document the permitted activities, provided the collection of such images does not result in takes of protected species.
4. The Permit Holder may use visual images collected under the proposed permit, including those authorized in Tables 1 and 2 of Appendix 1, in printed materials (including commercial or scientific publications) and presentations provided the images are accompanied by a statement indicating that the activity depicted was conducted pursuant to Permit No. 932-1905/MA-009526. This statement must accompany the images in all subsequent uses or sales.
5. Upon written request from the Permit Holder, approval for photography, filming, or audio recording activities not essential to achieving the objectives of the permitted activities, including allowing personnel not essential to the research (*e.g.* a documentary film crew) to be present, may be granted by the Chief, Permits Division.
    a. Where such non-essential photography, filming, or recording activities are authorized they must not influence the conduct of permitted activities in any way or result in takes of protected species.
    b. Personnel authorized to accompany the Researchers during permitted activities for the purpose of non-essential photography, filming, or recording activities are not allowed to participate in the permitted activities.
    c. The Permit Holder and Researchers cannot require or accept compensation in return for allowing non-essential personnel to accompany Researchers to conduct non-essential photography, filming, or recording activities.
6. Researchers must comply with the conditions listed in Appendices 2 and 3 related to the manner of research taking involving cetaceans and pinnipeds.
7. Researchers must comply with conditions listed in Appendix 4 and 5 related to methods of supervision, care, and transportation of research or enhancement subjects undergoing rehabilitation or in captivity.
8. Researchers must comply with conditions listed in Appendix 6 related to conducting auditory testing on marine mammals.

9. Researchers must comply with all provisions specified in Appendix 7 of the proposed permit for biological samples collected, received, archived, analyzed, imported or exported under authority of the proposed permit for both research and enhancement purposes.

C. Qualifications, Responsibilities, and Designation of Personnel

1. The following Researchers may participate in the conduct of the permitted activities in accordance with their qualifications and the limitations specified herein:
    a. Principal Investigator – Dr. Teri Rowles;
    b. Co-Investigators – Janet Whaley and NMFS' Regional Stranding Coordinators, and additional Co-investigators are authorized separately pursuant to Condition 6 below; and
    c. Research Assistants – any personnel identified by the Permit Holder or Principal Investigator and qualified to act pursuant to Conditions C.2, C.3, and C.4 of the proposed permit.
2. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities. The roles and responsibilities of personnel operating under the proposed permit are as follows:
    a. The Permit Holder is ultimately responsible for all activities of any individual who is operating under the authority of the proposed permit. Where the Permit Holder is an institution/facility, the Responsible Party is the person at the institution/facility who is responsible for the supervision of the Principal Investigator.
    b. The Principal Investigator (PI) is the individual primarily responsible for the taking, import, export and any related activities conducted under the permit. The PI must be on site during any activities conducted under the proposed permit unless a Co-Investigator named in Condition C.1 is present to act in place of the PI.
    c. Co-Investigators (CIs) are individuals who are qualified to conduct activities authorized by the permit without the on-site supervision of the PI. CIs assume the role and responsibility of the PI in the PI's absence.
    d. Research Assistants (RAs) are individuals who work under the direct and on-site supervision of the PI or a CI. RAs cannot conduct permitted activities in the absence of the PI or a CI.
3. Personnel involved in permitted activities must be reasonable in number and essential to conduct of the permitted activities. Essential personnel are limited to:
    a. Individuals who perform a function directly supportive of and necessary to the permitted activity (including operation of any vessels or aircraft essential to conduct of the activity);

b. Individuals included as backup for those personnel essential to the conduct of the permitted activity; and

c. Individuals included for training purposes.

4. Persons who require state or Federal licenses to conduct activities authorized under the permit (e.g., veterinarians, pilots) must be duly licensed when undertaking such activities.

5. Permitted activities may be conducted aboard vessels or aircraft, or in cooperation with individuals or organizations, engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities, except with written approval pursuant to Condition B.3.

6. The Permit Holder may request authorization from the Chief, Permits Division to add personnel to the proposed permit as indicated below. The Permit Holder cannot require or receive any direct or indirect compensation in return for requesting authorization for such person to act as a PI, CI, or RA under the permit.

a. The Permit Holder or PI may designate additional CIs provided that a copy of the letter designating the individual, and a copy of the individual's curriculum vitae, is provided to the Permits Division by facsimile on the day of designation and confirmed by mail.

b. The Responsible Party may request a change of PI by submitting a written request for personnel change to the Chief, Permits Division. The request must include a description of the individual's qualifications to conduct and oversee the activities authorized under the proposed permit.

D. Possession of Permit

1. The proposed permit cannot be transferred or assigned to any other person.

2. The Permit Holder and all other persons operating under the authority of the proposed permit must possess a copy of the proposed permit: when engaged in a permitted activity; when a protected species is in transit incidental to a permitted activity; and during any other time when any protected species taken or imported under such permit is in the possession of such persons.

3. A duplicate copy of the proposed permit must be attached to the container, package, enclosure, or other means of containment in which a protected species or protected species part is placed for purposes of storage, transit, supervision or care.

E. Reports

1. The Permit Holder must submit annual, final, and incident reports, and any papers or publications resulting from the research authorized herein to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Suite 13705, Silver Spring, MD 20910; phone (301) 713-2289; fax (301) 427-2521.

2. Written incident reports related to serious injury and mortality events or to exceeding authorized takes, must be submitted to the Chief, Permits Division within two weeks of the incident. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional research-related mortality or exceedence of authorized take.

3. An annual report must be submitted to the Chief, Permits Division by September 30 (beginning in 2009) for each year the permit is valid. The annual report describing activities conducted during the previous permit year must follow the format in Appendix 6.

4. A final report must be submitted to the Chief, Permits Division within 180 days after expiration of the permit (December 31, 2013), or, if the research concludes prior to permit expiration, within 180 days of completion of the research. The final report must follow the format in Appendix 6.

5. Research results must be published or otherwise made available to the scientific community in a reasonable period of time.

F. Notification and Coordination

1. The Permit Holder must provide written notification of planned field research to the appropriate Assistant Regional Administrators for Protected Resources at the addresses listed below. Such notification must be made at least two weeks prior to initiation of any field trip/season and must include the locations of the intended field study and/or survey routes, estimated dates of research, and number and roles (for example: PI, CI, veterinarian, boat driver, safety diver, animal restrainer, Research Assistant "in training") of participants.

Alaska Region, NMFS, P.O. Box 21668, Juneau, Alaska 99802-1668; phone (907) 586-7235; fax (907) 586-7012;

Northwest Region, NMFS, 7600 Sand Point Way NE, BIN C15700, Bldg. 1, Seattle, Washington 98115-0700; phone (206) 526-6150; fax (206) 526-6426;

Southwest Region, NMFS, 501 West Ocean Blvd., Suite 4200, Long Beach, California 90802-4213; phone (562) 980-4020; fax (562) 980-4027;

Pacific Islands Region, NMFS, 1601 Kapiolani Blvd., Suite 1110, Honolulu, Hawai'i 96814-4700; phone (808) 944-2200; fax (808) 973-2941;

Southeast Region, NMFS, 263 13th Ave South , St. Petersburg, Florida 33701; phone (727) 824-5312; fax (727) 824-5309; and

Northeast Region, NMFS, One Blackburn Drive, Gloucester, Massachusetts 01930-2298; phone (978) 281-9300; fax (987) 281-9394.

2. To the maximum extent practical, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year

to avoid unnecessary disturbance of animals. The appropriate Regional Office may be contacted at the address listed above for information about coordinating with other Permit Holders.

G. Observers and Inspections

1. NMFS may review activities conducted pursuant to the proposed permit. At the request of NMFS, the Permit Holder must cooperate with any such review by:

   a. Allowing any employee of NOAA or any other person designated by the Director, NMFS Office of Protected Resources to observe permitted activities; and

   b. Providing any documents or other information relating to the permitted activities.

Approach to the Assessment

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

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

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

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

When individual, listed plants or animals are expected to experience reductions in fitness, we would expect those reductions to also reduce the abundance, reproduction rates, or growth rates (or increase variance in one or more of these rates) of the populations those individuals represent (see Stearns 1992). Reductions in one or more of these variables (or one of the variables we derive from them) is a *necessary* condition for reductions in a population's viability, which is itself a *necessary* condition for reductions in a species' viability. On the other hand, when listed plants or animals exposed to an Action's effects are *not* expected to experience reductions in fitness, we would not expect the Action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (for example, see Anderson 2000, Mills and Beatty 1979, Stearns 1992). If we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

If, however, we conclude that listed plants or animals are likely to experience reductions in their fitness, our assessment tries to determine if those fitness reductions are likely to be sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In this step of our analyses, we use the population's base condition (established in the *Environmental Baseline* and *Status of Listed Resources* sections of this opinion) as our point of reference. Finally, our assessment tries to determine if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise. In this step of our analyses, we use the species' status (established in the *Status of the Species* section of this opinion) as our point of reference.

Evidence Available for the Consultation

To conduct these analyses, we considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. Animal species have been subjected to research and enhancement activities for more than a century and numerous groups have published guidelines on the use of wild animals in research. For example, the American Society of Mammalogists (2007) and the Canadian Council on Animal Care (2003) published guidelines for the use of wild mammals in research but those documents do not present data on the direct and indirect effects of the procedures they discuss on the animals that are subjected to the procedures. There is less information on the fitness consequences of those activities on individual animals or on the populations those individuals represent. The study published by Murray and Fuller (2000) represents one of the few reviews of the effects of research on vertebrates, but that study was limited to the effects of marking.

Nevertheless, we conducted electronic literature searches using the Library of Congress' *First Search* and *Dissertation Abstracts* databases, SCOPUS, *Web of Science*, and Cambridge Abstract's *Aquatic Sciences and Fisheries Abstracts* (ASFA) database services. The *First Search* databases provide access to general biological literature, master's theses, and doctoral dissertations back to 1980; ASFA provides access to journal articles, magazine articles, and conference proceedings back to 1964. Our searches specifically focus on the *ArticleFirst*, *BasicBiosis*, *Dissertation Abstracts*, *Proceedings* and *ECO* databases, which index the major journals dealing with issues of ecological risk (for example, the journals *Environmental Toxicology and Chemistry*, *Human and Ecological Risk Assessment*), marine mammals (*Journal of Mammalogy*, *Canadian Journal of Zoology*, *Marine Mammal Science*), ecology (*Ambio*, *Bioscience*, *Journal of Animal Ecology*, *Journal of Applied Ecology*, *Journal of the Marine Biological Association of the UK*, *Marine Pollution Bulletin*), and bioacoustics (*Journal of the Acoustical Society of America*).

Our prior experience demonstrated that electronic searches produce the lowest number of false positive (references produced by a search that are not relevant) and false negative (references not produced by a search that are relevant) results if we use paired combinations of the keywords research, tagging, capture, restraint, paired with the keywords cetacean, dolphin, marine mammal, pinniped, porpoise, seal, and whale.

We supplemented the results of these electronic searches by acquiring all of the references we had gathered that, based on a reading of their titles or abstracts, appeared to comply with the keywords presented in the preceding paragraph. If a reference's title did not allow us to eliminate it as irrelevant to this inquiry, we acquired it. We continued this process until we gathered all (100 percent) of the relevant references cited by the introduction and discussion sections of the relevant papers, articles, books, and, reports and all of the references cited in the materials and methods, and results sections of those documents. We did not conduct hand searches of published journals for this consultation. We organized the results of these searches using commercial bibliographic software.

We examined the references contained in these documents and any articles we collected through our electronic searches. If, based on a reading of their titles or abstracts, a reference appeared to comply with the keywords presented in the preceding paragraph, we acquired the reference. If a reference's title did not allow us to eliminate it as irrelevant to this inquiry, we acquired it. We continued this process until we identified all (100 percent) of the relevant references cited by the introduction and discussion sections of the relevant papers, articles, books, and, reports and all of the references cited in the materials and methods, and results sections of those documents. We did not conduct hand searches of published journals for this consultation. We organized the results of these searches using commercial bibliographic software.

Treatment of "Cumulative Impacts" (in the sense of NEPA)

The U.S. Council on Environmental Quality defined "cumulative effects" (which we refer to as "cumulative impacts" to distinguish between NEPA and ESA uses of the same term) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). The effects analyses of biological opinions considered the "impacts" on listed species and designated critical habitat that result from the incremental impact of an action by identifying natural and anthropogenic stressors that affect endangered and threatened species throughout their range (the *Status of the Species*) and within an Action Area (the *Environmental Baseline*, which articulate the pre-existing *impacts* of activities that occur in an Action Area, including the past, contemporaneous, and future *impacts* of those activities). We assess the effects of a proposed action by adding their direct and indirect effects to the *impacts* of the activities we identify in an *Environmental Baseline* (50 CFR 402.02), in light of the impacts of the status of the listed species and designated critical habitat throughout their range; as a result, the results of our effects analyses are equivalent to those contained in the "cumulative impact" sections of NEPA documents.

Action Area
The action area for this biological opinion encompasses the coastal waters and Exclusive Economic Zone of the United States, its territories, and possessions, and adjacent marine waters.

Status of Listed Resources and Environmental Baseline
NMFS has determined that the actions considered in this biological opinion may affect the following species provided protection under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.; ESA):

Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Steller sea lion (western population)	*Eumetopias jubatus*	Endangered
Steller sea lion (eastern population)		Threatened
Hawaiian monk seal	*Monachus schausinslandi*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Bowhead whale	*Balaena mysticetus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale (southern resident population)	*Orcinus orca*	Endangered
Right whale (North Atlantic)	*Eubalaena glacialis*	Endangered
Right whale (North Pacific)	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered

Designated critical habitat	
Right whale (North Atlantic)	portions of the north Atlantic Ocean
Right whale (North Pacific)	portions of the north Pacific Ocean
Steller sea lion	portions of the north Pacific Ocean
Hawai'ian monk seal	portions of the north Pacific Ocean
Green sea turtle	portions of the Caribbean Sea
Hawksbill sea turtle	portions of the Caribbean Sea
Leatherback sea turtle	portions of the Caribbean Sea

Critical Habitat

As described in the *Approach to the Assessment* section of this Opinion, NMFS uses two criteria to determine whether listed species or designated critical habitat is likely to be adversely affected by a proposed action. The first criterion is *exposure* or some reasonable expectation of a co-occurrence between one or more potential stressor associated with an action and a particular listed species or an area that has been designated as critical habitat: if we conclude that listed species or designated critical habitat are not likely to be exposed to the direct or indirect effects of an action (or interrelated or interdependent activities), we must also conclude that listed species or critical habitat are not likely to be adversely affected by those activities. The second criterion is the probability of a *response* given exposure, which considers the *susceptibility* of listed individuals or an area that has been designated as critical habitat to change given their exposure to the direct or indirect effects of an action. If a listed species or designated critical habitat are not likely to be exposed or they are not likely to respond to that exposure, we conclude that the listed species or designated critical habitat are not likely to be adversely affected by a proposed action.

Some of the emergency responses, research and enhancement activities might occur in an area that has been designated as critical habitat (particularly critical habitat that has been designated for Hawai'ian monk seals), so designated critical habitat might be exposed to the proposed activities. However, the proposed research or enhancement activities do not produce physical, chemical, or biotic stressors that would affect the quantity, quality, or availability of the physical or biological features that contribute to the conservation value of designated critical habitat. As a result, we conclude that the proposed emergency responses, research, and enhancement activities are not likely to adversely affect the conservation value of the critical habitat identified in the preceding list..

Introduction to this Section of the Opinion

The rest of this section of our Opinion consists of narratives for each of the threatened and endangered species that occur in the action area and that may be adversely affected by the activities that would be authorized by the proposed permit for the Health and Response Program. In each narrative, we present a summary of information on the distribution and population structure of each species to provides a foundation for the exposure analyses that appear later in this Opinion. Then we summarize information on the threats to the species and the species' status given those threats to provide points of reference for the jeopardy determinations we make later in this Opinion. That is, we rely on a species' status and trend to determine whether or not an action's direct or indirect effects are likely to increase the species' probability of becoming extinct.

Because the proposed action could occur in the Atlantic Ocean, Indian Ocean, Pacific Ocean, or Mediterranean Sea, the action area encompasses the entire range of virtually all of the species discussed in the following section. Consequently, the *Status of the Species* section of this Opinion is the same as the *Environmental Baseline*.

The topics that follow the *Status* subsection of the species' narratives serve a different purpose: they present background information that is designed to help readers understand the exposure, response, and risk analyses that we use to organize our assessment of the effects of the proposed action. To fulfill that purpose, the narratives that follow summarize information on the diving and social behavior of the different species because that behavior helps determine whether aerial and ship board surveys are likely to detect each species. We also summarize information on their vocalizations because that background information laws the foundation for our assessment of the how the different species are likely to respond to sounds produced by detonations.

More detailed background information on the status of these species and critical habitat can be found in a number of published documents including status reviews, recovery plans for the blue whale (NMFS 1998a), fin whales (2007), fin and sei whale (NMFS 1998b), fin whale NMFS 2007), humpback whale (NMFS 1991a), right whale (NMFS 2005), Hawai'ian monk seals (NMFS 2007a), Steller sea lions (NMFS 2008), a status review of Hawai'ian monk seals (NMFS 2007), and a status report on large whales prepared by Perry *et al*. (1999).

Climate Change

There is now widespread consensus within the scientific community that atmospheric temperatures on earth are increasing (warming) and that this will continue for at least the next several decades (IPCC 2001; Oreskes, 2004). There is also consensus within the scientific community that this warming trend will alter current weather patterns and patterns associated with climatic phenomena, including the timing and intensity of extreme events such as heat-waves, floods, storms, and wet-dry cycles. Threats posed by the direct and indirect effects of global climatic change is or will be common to all of the species we discuss in this Opinion. Because of this commonality, we present this narrative here rather than in each of the species-specific narratives that follow.

The IPCC estimated that average global land and sea surface temperature has increased by 0.6°C (±0.2) since the mid-1800s, with most of the change occurring since 1976. This temperature increase is greater than what would be expected given the range of natural climatic variability recorded over the past 1000 years (Crowley 2000). The IPCC reviewed computer simulations of the effect of greenhouse gas emissions on observed climate variations that have been recorded in the past and evaluated the influence of natural phenomena such as solar and volcanic activity. Based on their review, the IPCC concluded that natural phenomena are insufficient to explain the increasing trend in land and sea surface temperature, and that most of the warming observed over the last 50 years is likely to be attributable to human activities (IPCC 2001). Climatic models estimate that global temperatures would increase between 1.4 to 5.8°C from 1990 to 2100 if humans do nothing to reduce greenhouse gas emissions (IPCC 2001). These projections identify a suite of changes in global climate conditions that are relevant to the future status and trend of endangered and threatened species (Table 3).

Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (Houghton *et al*. 2001, McCarthy *et al*. 2001, Parry *et al*. 2007). The direct effects of climate change would result in increases in atmospheric temperatures, changes in sea surface temperatures, changes in patterns of precipitation, and changes in sea level. Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe, an increase in the mass of the Antarctic ice sheet, and a decrease in the Greenland ice sheet, although the magnitude of these changes remain unknown.

Table 3. Phenomena associated with projections of global climate change including levels of confidence associated with projections (adapted from IPCC 2001 and Campbell-Lendrum Woodruff 2007)

Phenomenon	Confidence in Observed Changes (observed in the latter 20th Century)	Confidence in Projected Changes (during the 21st Century)
Higher maximum temperatures and a greater number of hot days over almost all land areas	Likely	Very likely
Higher minimum temperatures with fewer cold days and frost days over almost all land areas	Very likely	Very likely
Reduced diurnal temperature range over most land areas	Very likely	Very likely
Increased heat index over most land areas	Likely over many areas	Very likely over most areas
More intense precipitation events	Likely over many mid- to high-latitude areas in Northern Hemisphere	Very likely over many areas
Increased summer continental drying and associated probability of drought	Likely in a few areas	Likely over most mid-latitude continental interiors (projections are inconsistent for other areas)
Increase in peak wind intensities in tropical cyclones	Not observed	Likely over some areas
Increase in mean and peak precipitation intensities in tropical cyclones	Insufficient data	Likely over some areas

The indirect effects of climate change would result from changes in the distribution of temperatures suitable for calving and rearing calves, the distribution and abundance of prey, and the distribution and abundance of competitors or predators. For example, variations in the recruitment of krill (*Euphausia superba*) and the reproductive success of krill predators have been linked to variations in sea-surface temperatures and the extent of sea-ice cover during the winter months. Although the IPCC (2001) did not detect significant changes in the extent of Antarctic sea-ice using satellite measurements, Curran (2003) analyzed ice-core samples from 1841 to 1995 and concluded Antarctic sea ice cover had declined by about 20% since the 1950s. The Antarctic Peninsula, which is the northern extension of the Antarctic continent, contains the richest areas of krill in the Southern Ocean. The extent of se ice cover around this Peninsula has the highest degree of variability relative to other areas within the distribution of krill. Relatively small changes in climate conditions are likely to exert a strong influence on the seasonal pack-ice zone in the Peninsula area, which is likely to affect densities of krill in this region. Because krill are important prey for baleen whales or form critical component of the food chains on which baleen whales depend, increasing the variability of krill densities or causing those densities to decline dramatically is likely to have adverse effect on populations of baleen whales in the Southern Ocean.

Reid and Croxall (2001) analyzed a 23-year time series of the reproductive performance of predators that depend on krill for prey — Antarctic fur seals (*Arctocephalus gazella*), gentoo penguins (*Pygoscelis papua*), macaroni penguins (*Eudyptes chrysolophus*), and black-browed albatrosses (*Thalassarche melanophrys*) — at South Georgia Island and concluded that these populations experienced increases in the 1980s followed by significant declines in the 1990s accompanied by an increase in the frequency of years with reduced reproductive success. The authors concluded that macaroni penguins and black-browed albatrosses had declined by as much as 50 percent in the 1990s, although incidental mortalities in longline fisheries probably contributed to the decline of the albatross. These authors concluded, however, that these declines result, at least in part, from changes in the structure of the krill population, particularly reduced recruitment into older age classes, which lowers the number of predators this prey species can sustain. The authors concluded that the biomass of krill within the largest size class was sufficient to support predator demand in the 1980s but not in the 1990s.

Similarly, a study of relationships between climate and sea-temperature changes and the arrival of squid off southwestern England over a 20-year period concluded that veined squid (*Loligo forbesi*) migrate eastwards in the English Channel earlier when water in the preceding months is warmer, and that higher temperatures and early arrival correspond with warm phases of the North Atlantic oscillation (Sims *et al*. 2001). The timing of squid peak abundance advanced by 120- 150 days in the warmest years compared with the coldest. Seabottom temperature were closely linked to the extent of squid movement and temperature increases over the five months prior to and during the month of peak squid abundance did not differ between early and late years. These authors concluded that the temporal variation in peak abundance of squid seen off Plymouth represents temperature-dependent movement, which is in turn mediated by climatic changes associated with the North Atlantic Oscillation.

Climate-mediated changes in the distribution and abundance of keystone prey species like krill and climate-mediated changes in the distribution of cephalopod populations worldwide is likely to affect marine mammal populations as they re-distribute throughout the world's oceans in search of prey. Blue whales, as predators that specialize in eating krill, seem likely to change their distribution in response to changes in the distribution of krill (for example, see Payne *et al*. 1986, 1990 and Weinrich 2001); if they did not change their distribution or could not find the biomass of krill necessary to sustain their population numbers, their populations seem likely to experience declines similar to those observed in other krill predators, which would cause dramatic declines in their population sizes or would increase the year-to-year variation in population size; either of these outcomes would dramatically increase the extinction probabilities of these whales.

Sperm whales, whose diets can be dominated by cephalopods, would have to re-distribute following changes in the distribution and abundance of their prey. This statement assumes that projected changes in global climate would only affect the distribution of cephalopod populations, but would not reduce the number or density of cephalopod populations. If, however, cephalopod populations collapse or decline dramatically, sperm whale populations are likely to collapse or decline dramatically as well.

The response of North Atlantic right whales to changes in the North Atlantic Oscillation also provides insight into the potential consequences of a changing climate on large whales. Changes in the climate of the North Atlantic have been directly linked to the North Atlantic Oscillation, which results from variability in pressure differences between a low pressure system that lies over Iceland and a high pressure system that lies over the Azore Islands. As these pressure systems shift from east to west, they control the strength of westerly winds and storm tracks across the North Atlantic Ocean. The North Atlantic Oscillation Index, which is positive when both systems are strong (producing increased differences in pressure that produce more and stronger winter storms) and negative when both systems are weak (producing decreased differences in pressure resulting in fewer and weaker winter storms), varies from year to year, but also exhibits a tendency to remain in one phase for intervals lasting several years.

Sea surface temperatures in the North Atlantic Ocean are closely related to this Oscillation and influences the abundance of marine mammal prey such as zooplankton and fish. In the 1970s and 1980s, the North Atlantic Oscillation Index have been positive and sea surface temperatures increased. These increased are believed to have produced conditions that were favorable for the copepod (*Calanus finmarchicus*), which is the principal prey of North Atlantic right whales (Conversi *et al*. 2001) and may have increased calving rates of these whales (we cannot verify this association because systematic data on North Atlantic right whale was not collected until 1982; Greene *et al*. 2003). In the late 1980s and 1990s, the NAO Index was mainly positive but exhibited two substantial, multi-year reversals to negative values. This was followed by two major, multi-year declines in copepod prey abundance (Pershing *et al.* 2001, Drinkwater *et al*. 2003). Calving rates for North Atlantic right whales followed the declining trend in copepod abundance, although there was a time lag between the two (Greene *et al*. 2003).
Although the NAO Index has been positive for the past 25 years, atmospheric models suggest that increases in ocean temperature associated with climate change forecasts may produce more severe fluctuations in the North Atlantic Oscillation. Such fluctuations would be expected to cause dramatic shifts in the reproductive rate of critically endangered North Atlantic right whales (Drinkwater *et al.* 2003; Greene *et al*. 2003) and possibly a northward shift in the location of right whale calving areas (Kenney 2007).

Changes in global climatic patterns are also projected to have profound effect on the coastlines of every continent by increasing sea levels and increasing the intensity, if not the frequency, of hurricanes and tropical storms. Based on computer models, these phenomena would inundate nesting beaches of sea turtles, change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and would increase the number of turtle nests that are destroyed by tropical storms and hurricanes. Further, the combination of increasing sea levels, changes in patterns of coastal erosion and accretion, and changes in rainfall patterns are likely to affect coastal estuaries, submerged aquatic vegetation, and reef ecosystems that provide foraging and rearing habitat for several species of sea turtles. Finally, changes in ocean currents associated with climate change projections would affect the migratory patterns of sea turtles. The loss of nesting beaches, by itself, would have catastrophic effect on sea turtles populations globally if they are unable to colonize any new beaches that form of if the beaches that form do not provide the sand depths, grain patterns, elevations above high tides, or temperature regimes necessary to allow turtle eggs to survive. When combined with changes in coastal habitats and oceans currents, the future climates that are forecast place sea turtles at substantially greater risk of extinction than they already face.

Guadalupe Fur Seal

Distribution

Historically, Guadalupe fur seals were distributed from Monterey Bay, California, south to the Revillagigedo Islands, Mexico. Since their populations were reduced by commercial sealing, Guadalupe fur seals have been found on Guadalupe Island (Mexico) in the eastern Pacific Ocean off Mexico; a few individuals have been known to range as far north as Sonoma County, California, south to Los Islotes Islands in Baja California, Mexico.

A few Guadalupe fur seals occupy California sea lion rookeries in the Channel Islands of California (Stewart *et al.* 1987 in Reeves *et al.* 1992).

Population Structure

Guadalupe fur seals are considered to represent a single population centered on Guadalupe Island, Mexico.

Threats to the Species

NATURAL THREATS. There is limited information on natural phenomena that kill or injure Guadalupe fur seals. Similarly, there are not data on whether and to what degree natural mortality limits or restricts patterns of growth or variability in this population of Guadalupe fur seals.

ANTHROPOGENIC THREATS. Guadalupe fur seals were driven close to extinction by sealers, sea otter hunters, and whalers between the late 1700s and early 1800s. Native Americans left the remains of Guadalupe fur seals in their middens (Bonner 1994), which suggests they have been hunted throughout modern history. After Guadalupe fur seals began to be hunted commercially in the early 1800s, however, their populations began to collapse. By 1825, Guadalupe fur seals were reported to have been exterminated from southern California. Incomplete records suggest that as many as 52,000 fur seals may have been killed on the islands off Mexico between 1806 and 1890; of this total, only about 6,600 Guadalupe fur seals were harvested from 1877 to 1884 (Reeves *et al.* 1992). Commercial sealing off Mexico continued until 1894.

Information on contemporary threats to Guadalupe fur seals remains largely unknown. However, juvenile, female Guadalupe fur seals have stranded in central and northern California with net abrasions around the neck, fish hooks and monofilament line, and polyfilament string (Hanni *et al.* 1997), which suggests that these fur seals may be captured and killed in gillnet fisheries in Mexico and the United States (Barlow *et al.* 1997).

Status

Guadalupe fur seals were listed as threatened under the Endangered Species Act of 1973 in 1985 (50 FR 51251; December 16, 1985). The State of California lists Guadalupe fur seals as a "fully protected mammal" in the Fish and Game Code of California (Chapter 8, Section 4700, d) and as a threatened species in the Fish and Game Commission California Code of Regulations (Title 14, Section 670.5, b, 6, H). The Guadalupe fur seal is also protected under the Convention on International Trade in Endangered Species and are fully protected under the laws of the government of Mexico. In 1975, the Mexican government declared Guadalupe Island a pinniped sanctuary. Critical habitat has not been designated for this species in the U.S.

By 1897, the Guadalupe fur seal was believed to be extinct. None of these fur seals were reported until a fisherman found about two dozen of them at Guadalupe Island in 1926, which appeared to have been their sole, remaining rookery.

The abundance of Guadalupe fur seals before their population was reduced is unknown, although some authors estimate population sizes ranging from 20,000 to 100,000 animals (Wedgeforth

1928; Hubbs 1956; Fleischer 1987). In the 1950s, fewer than 20 Guadalupe fur seals were known to exist. Since the 1950s, however, these fur seals are estimated to have increased in abundance by about 10 percent per year; by the mid-1970s, they had increased to about 1,000 animals; by the mid-1980s, they had increased to about 3,300 animals (Gallo-Reynoso 1994) and appear to have remained at this level since (Barlow *et al*. 1997). By 1993, their population was estimated to number about 7,300 animals (Gallo-Reynoso 1994).

The population of Guadalupe fur seals currently appears to increasing at an average annual growth rate of 13.7 percent. The cause of the population's growth since the 1950s remains unexplained.

Steller Sea Lion

Distribution

Steller sea lions are distributed around the rim of the North Pacific Ocean from the Channel Islands off Southern California to northern Hokkaido, Japan. In the Bering Sea, the northernmost major rookery is on Walrus Island in the Pribilof Island group. The northernmost major haulout is on Hall Island off the northwestern tip of St. Matthew Island. Their distribution also extends northward from the western end of the Aleutian chain to sites along the eastern shore of the Kamchatka Peninsula. Their distribution is probably centered in the Gulf of Alaska and the Aleutian Islands (NMFS 1992).

Within their range, land sites used by Steller sea lions are referred to as rookeries and haulouts. Rookeries are used by adult sea lions for pupping, nursing, and mating during the reproductive season (generally from late May to early July). Haulouts are used by all ages classes of both genders but are generally not where sea lions reproduce. Sea lions move on and offshore for feeding excursions. At the end of the reproductive season, some females may move with their pups to other haulout sites and males may "migrate" to distant foraging locations (Spaulding 1964). Sea lions may make semi-permanent or permanent one-way movements from one site to another (Chumbley *et al*. 1997, their Table 8; Burkanov *et al*. unpublished report [cited in Loughlin 1997]). Calkins and Pitcher (1982) reported movements in Alaska of up to1,500 km. They also describe wide dispersion of young animals after weaning, with the majority of those animals returning to the site of birth as they reach reproductive age.

Population Structure

The eastern population of Steller sea lions includes animals east of Cape Suckling, Alaska (144°W) south to California waters.

Threats to the Species

NATURAL THREATS. Killer whales and sharks prey on Steller sea lions, and given the reduced abundance of sea lions at multiple sites these successful predators may exacerbate the decline in local areas (e.g., Barrett-Lennard *et al*. 1995). In the Gulf of Alaska, 79 percent of killer whale attacks were on Steller sea lions, which led some investigators to conclude that Steller sea lions is a preferred prey of killer whales in this region. In other regions, less than 10 percent of killer whale attacks observed were on Steller sea lions (NPUMMRC 2006).

Burek *et al*. (2000, 2005) evaluated samples from the period of steepest decline in Steller sea lions populations (1970s to 1990s) and found no evidence of significant exposure of sea lions to several morbilliviruses, but did find exposure to several other viruses, such as phocid herpes-viruses, caliciviruses and others. While some of these viruses may contribute to low birth rates and reduce an individual's immunity, the extent to which they have affected Steller sea lion populations is unclear.

The degree to which the eastern and western populations of Steller sea lions are affected by a shift in the abundance of prey organisms caused by natural changes in sea surface temperature (as opposed to changes in the abundance of prey organisms caused by human activity) remains controversial. In 1976 and 1977, a well-documented shift from a cold to a warm regime has been correlated with dramatic changes in the structure and composition of the invertebrate and fish communities as well as the distribution of individual species in the North Pacific ocean and Bering Sea (Brodeur and Ware 1992; Beamish 1993; Francis and Hare 1994; Miller *et al*. 1994; Hollowed and Wooster 1992, 1995; Wyllie-Echeverria and Wooster 1998). For example, many populations of groundfish species (particularly species like pollock, Atka mackerel, cod and various flatfish species) increased in abundance as a result of strong year-classes spawned in the mid to late 1970s. The abundance of some species of long-lived flatfish (for example., arrowtooth flounder, Pacific halibut, yellowfin sole, and rock sole) has remained high since that regime shift, while the abundance of species like pollock, Atka mackerel, and Pacific cod have oscillated. Some investigators present these patterns as evidence of a natural change in the abundance of prey species for Steller sea lions. Other investigators, however, invoke other data as evidence that changes in the abundance of prey species for Steller sea lions has been caused by human activity, particularly commercial fishing for groundfish.

ANTHROPOGENIC THREATS. Steller sea lions currently appear to be threatened by one primary threat: changes in the quantity and quality of their forage base resulting from commercial fishing, although their initial decline may have resulted from a stress regime that included both natural (a shift in the sea surface temperatures in the North Pacific)and anthropogenic stressors (subsistence harvests, culls to reduce potential competition between sea lions and commercial fisheries, research, and the effect of commercial fisheries on the prey of Steller sea lions).

Of the two listed populations of Steller sea lions, the western population has the greatest risk of extinction. The endangered western population of Steller sea lions has declined by about 90 percent since the early 1970s and has declined dramatically throughout its range. This population is declining for many reasons and may now face threats that appear to be different from the ones that caused the population's initial decline. From the 1950s through the 1980s, animals from this population were killed intentionally and unintentionally by fishers, in commercial harvests, and in subsistence harvests which may have begun to destabilize the population. The harvest of over 45,000 pups from 1963 to 1972 probably changed the number of animals that recruited into the adult, breeding population (western population) and contributed to local population trends in the 1960s through the early 1980s in the Gulf of Alaska and the eastern Aleutian Islands. Similarly, subsistence harvests prior to the 1990s were not measured but may have contributed to population decline in localized areas where such harvests were concentrated.

At the same time, portions of the North Pacific Ocean have undergone major changes in temperatures that have probably contributed to a shift in the trophic structure of the fish community in the Aleutian Islands, Bering Sea, and Gulf of Alaska. This shift may explain the shift from marine systems dominated by herring and capelin to systems dominated by pollock and flatfish. At the same time, the Bering Sea, Aleutian Islands, and Gulf of Alaska ecosystems have experienced the development and expansion of major fisheries for essential sea lion prey. The fisheries have also contributed to changes in the trophic structure of these ecosystems, but as is the case with natural changes, the extent of fisheries-related effects on the ecosystems at large can not be determined. With respect to Steller sea lions, however, fisheries target important prey resources at times and in areas where sea lions forage. As discussed in the preceding section, the actual causes or the contribution of multiple causes has been, and continues to be, subject to extensive debate.

Status

Steller sea lions were listed as threatened under the Endangered Species Act of 1973 on November 26, 1990 (55 FR 49204). The listing followed a decline in the U.S. population of about 64% over the three decades prior to the listing. In 1997, the species was split into two separate populations based on demographic and genetic differences (Bickham *et al*. 1996, Loughlin 1997), the western population was reclassified to endangered while the eastern population remained threatened (62 FR 30772). Critical habitat for this species was designated on August 27, 1993 (58 FR 45269).

Numbers of Steller sea lions declined dramatically throughout much of the species' range, beginning in the mid- to late 1970s (Braham *et al*. 1980, Merrick *et al*. 1987, NMFS 1992, NMFS 1995). For two decades prior to the decline, the estimated total population was 250,000 to 300,000 animals (Kenyon and Rice 1961, Loughlin *et al*. 1984). The population estimate declined by 50-60% to about 116,000 animals by 1989 (NMFS 1992), and by an additional 15% by 1994.

WESTERN POPULATION OF STELLER SEA LIONS. The decline has generally been restricted to the western population of Steller sea lions which had declined by about 5% per year during the 1990s. Counts for this population have fallen from 109,880 animals in the late 1970s to 22,167 animals in 1996, a decline of 80% (NMFS 1995). Over the same time interval, the eastern population has remained stable or increased by several percent per year, in Southeast Alaska (Sease and Loughlin 1999), in British Columbia, Canada (P. Olesiuk, Department of Fisheries and Oceans, unpublished data), and in Oregon (R. Brown, Oregon Department of Fish and Wildlife, unpublished data). Counts in Russian territories have also declined and are currently estimated to be about one-third of historic levels (NMFS 1992).

Population viability analyses have been conducted by Merrick and York (1994) and York *et al*. (1996). The results of these analyses indicate that the next 20 years may be crucial for the western population of Steller sea lions, if the rates of decline observed in 1985 to 1989 or 1994 continue. Within two decades, it is possible that the number of adult females in the Kenai-to-Kiska region could drop to less than 5,000. Once the western population of Steller sea lions crosses this threshold, the small population size, by itself, could accelerate the population's decline to extinction. Extinction rates for rookeries or clusters of rookeries could increase sharply in 40 to 50 years and Steller sea lions could become extinct throughout the entire Kenai-to-Kiska region in the next 100-120 years.

Holmes and York (2003) extended earlier analyses of central Gulf of Alaska sea lions through the late 1990s. They reported a shift in the demographic causes of this population's decline during the 1990s: adult survivorship had reached its lowest point (20 percent below 1976 levels) while juvenile survivorship and fecundity remained relatively high. By the mid to late 1990s, adult continued to remain depressed, but was accompanied by reduced fecundity and a slight decline in juvenile survivorship to within 5 to 10 percent of 1976 levels. This reduced fecundity continues to affect this population and Holmes and York (2003) suggested that even a small reductions in adult and juvenile survivorship might cause the population to decline further.

EASTERN POPULATION OF STELLER SEA LIONS. The eastern population of Steller sea lions is listed as a threatened species (as a distinct population segment) and appears to be stable. About 47,885 pups were estimated to have existed in the eastern population of Steller sea lions in 2002 (based on counts of 4,877 pups in Alaska, 3,281 pups in British Columbia, 1,128 pups in Oregon, and 713 in California). The current minimum estimate for the eastern population of Steller sea lions is 43,728 animals.

Hawaiian Monk Seal

Distribution

The Hawaiian monk seal is found primarily on the Leeward Chain of the Hawaiian Islands, especially Nihoa, Necker, French Frigate Shoals, Pearl and Hermes Reef, Kure Atoll, Laysan, and Lisianski. Sightings on the main Hawaiian Islands have become more common in the past 15 years and a birth was recorded on Kauai and Oahu in 1988 and 1991 respectively (Kenyon 1981, Riedmann 1990). Midway was an important breeding rookery, but is no longer used (Reeves *et al.* 1992). Hawaiian monk seals breed primarily at Laysan Island, Lisianski Island, and Pearl and Hermes Reefs (Tomich 1986). Monk seals are increasingly sighted in the main Hawaiian Islands. Monk seals have been reported on at least three occasions at Johnston Island over the past 30 years (not counting nine adult males that were translocated there from Laysan Island in 1984).

The distribution, destinations, routes, food sources, and causes of monk seal movements when they are not traveling between islands are not well known (Johnson 1979), but recent tagging studies have shown individuals sometimes travel between the breeding populations in the northwest Hawaiian Islands.

Population Structure

Hawaiian monk seal appear to exist as a single population that occurs in the Northwest Hawai'ian Islands and Main Hawai'ian Islands. However, groups of individuals that occupy specific islands or atolls in the Hawai'ian Archipelago are treated as sub-populations for the purposes of research and management activity.

Pearl and Hermes Reef, the Midway Islands, and Kure Atoll form the three westernmost sub-populations of Hawaiian monk seals. There is a higher degree of migration among these sub-populations than among the sub-populations that occupy Laysan, Lisianski and French Frigate

Shoals, which are more isolated. As a result, population growth in the westernmost sub-populations can be influenced more by immigration than by intrinsic growth. Several recent cohorts (groups of individuals born in the same year) at all three sites indicate that survival of juveniles has declined.

Threats to the Species

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

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

The primary cause of adult female mortality affecting the recovery potential in the monk seal population during the 1980s and early 1990s was injury and death of female monk seals caused by "mobbing" attacks initiated by male monk seals. Although NMFS has developed and implemented measures to mitigate the effects of mobbing attacks, they are still considered a serious threat to Hawaiian monk seals. In recent years, low juvenile survival, in part due to food limitation, has been evident at all subpopulations of Hawai'ian monk seals in the Northwest Hawai'ian Islands.

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

ANTHROPOGENIC THREATS. Several human activities are known to threaten Hawai'ian monk seals: competition with commercial fisheries, entanglement in fishing gear, habitat destruction on breeding beaches, pollution, and unintentional human disturbance (Kenyon 1981, Riedman 1990, Reeves *et al.* 1992).

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

Establishment of a 20-person U.S. Coast Guard long-range navigation station at Kure Atoll in 1960 resulted in a significant disturbance of the seal population on Green Island beaches caused by the residents and their dogs and vehicles (Johnson et al., 1982, Kenyon, 1972). After the station was established and occupied, counts of monk seals declined rapidly on Green Island (Gerrodette and Gilmartin 1990, Kenyon 1972). Kenyon (1972) attributed this decline to human disturbance, which caused adult females to abandon prime pupping habitat. Pup survival declined first (Wirtz, 1968), followed by a decline in recruitment of breeding females; these two phenomena combined to skew the age structure skewed of monk seals toward older animals (Johnson *et al*. 1982) and bias the sex ratio of adults toward males (Reddy and Griffith 1988). The number of monk seals born on this atoll declined steadily from the late 1970s to the mid 1980s; in 1986, only one pup was born on the atoll (Reddy 1989, Gerrodette and Gilmartin 1990).

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

Status

Hawaiian monk seals were listed as endangered under the Endangered Species Act of 1973 on November 23, 1976 (41 FR 51611). A 5-year status review completed in 2007 recommended retaining monk seals as an endangered species (72 FR 46966, August 22, 2007). Critical habitat was originally designated for Hawai'ian monk seals on April 30, 1986 (51 FR 16047), and was extended on May 26, 1988 (53 FR 18988; CFR 226.201).

Monk seals are considered one of the most endangered groups of pinnipeds on the planet because all of their populations are either extinct (for example, the Caribbean monk seal) or near exist at numbers that are precariously close to extinction (Mediterranean and Hawai'ian monk seals).

Two periods of anthropogenic decline have been reported for Hawaiian monk seals. The first decline occurred in the 1800s when sealers, crews of wrecked vessels, and guano and feather hunters nearly hunted the population to extinction (Dill and Bryan 1912, Kenyon and Rice 1959). Following the collapse of this population, expeditions to the Northwest Hawai'ian Islands reported increasing numbers of seals (Bailey 1952). A survey in 1958 suggested that the population had partially recovered from its initial collapse. The population of Hawai'ian monk seals was believed to number slightly more than 1,000 seals at the end of this period (Rice 1960).

A second related decline occurred from the late 1950s to the mid-1970s. Consistent declines in the monk seal population trends have been recorded since surveys commenced in the late 1950s. Counts of Hawaiian monk seals made since the late 1950s and 1980s at the atolls, islands, and reefs where they haul out on the northwest Hawaiian Islands showed a 50% population decline (NMFS 1991). The total population for the five major breeding locations plus Necker Island for 1987 was estimated to be 1,718 seals including 202 pups of the year (Gilmartin 1988). This compares with 1,488 animals estimated for 1983 (Gerrodette 1985). In 1992 the Hawaiian monk seal population was estimated to be 1580 (standard error = 147; Ragen 1993). The best estimate of total abundance for 1993 was 1,406 (standard error = 131, assuming a constant coefficient of variation). Thus, between 1958 and 1993, mean beach counts declined by 60 percent. For the years 1985 to 1993 the mean beach counts declined by approximately 5 percent per year. This downward trend is expected to continue, mainly due to poor pup and juvenile survival in recent years. NMFS (2000, 2007) estimates the current monk seal population to be between 1,300 and 1,400 individuals. Data collected at five major haulouts recorded a 23 percent decline in the number of births in 1990 from the average annual levels recorded between 1983 and 1989 (NMFS 1991).

Regardless of which of these estimates, if any, most closely correspond to the actual size and trend of Hawai'ian monk seals, the evidence available suggest that these monk seals exist as a "small" population (that is, they experience phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself). For example, Hawai'ian monk seals have very low survival of juveniles and sub-adults due to starvation (which is believed to be caused by limitations in the food base), low juvenile survival has lead to low juvenile recruitment into the adult population, and the adult population increasingly consists of ageing females who reproductive success is expected to decline (if it has not already declined) in the foreseeable future. A positive feedback loop between reduced reproductive success of adult females and reduced recruitment into the adult population (which reduces the number of adult females) is the kind of demographic pattern that is likely to increase the monk seal's decline toward extinction. As a result, we assume that Hawai'ian monk seals have elevated extinction probabilities because of exogenous threats caused by anthropogenic activities, natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate), and endogenous threats caused by the small size of their population.

Blue Whale

Distribution

Blue whales are found along the coastal shelves of North America and South America (Rice 1974; Donovan 1984; Clarke 1980) in the North Pacific Ocean. In the North Pacific Ocean, blue whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska; in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Blue whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China and Yellow Seas, and the Philippine Sea (Gambell 1985).

In the western north Atlantic Ocean, blue whales are found from the Arctic to at least the mid-latitude waters of the North Atlantic (CeTAP 1982, Wenzel *et al.*1988, Yochem and Leatherwood 1985, Gagnon and Clark 1993). Blue whales have been observed frequently off eastern Canada, particularly in waters off Newfoundland, during the winter. In the summer month, they have been observed in Davis Strait (Mansfield 1985), the Gulf of St. Lawrence (from the north shore of the St. Lawrence River estuary to the Strait of Belle Isle), and off eastern Nova Scotia (Sears *et al*. 1987). In the eastern north Atlantic Ocean, blue whales have been observed off the Azores Islands, although Reiner *et al*. (1993) do not consider them common in that area.

In 1992, the U.S. Navy conducted an extensive acoustic survey of the North Atlantic using the Integrated Underwater Surveillance System's fixed acoustic array system (Clark 1995). Concentrations of blue whale sounds were detected in the Grand Banks off Newfoundland and west of the British Isles. In the lower latitudes, one blue whale was tracked acoustically for 43 days, during which time the animal traveled 1400 nautical miles around the western North Atlantic from waters northeast of Bermuda to the southwest and west of Bermuda (Gagnon and Clark 1993).

In the North Pacific Ocean, blue whales have been recorded off the island of Oahu in the main Hawai'ian Islands and off Midway Island in the western edge of the Hawai'ian Archipelago (Barlow *et al*. 1994b; Northrop *et al*. 1971; Thompson and Friedl 1982), although blue whales are rarely sighted in Hawaiian waters and have not been reported to strand in the Hawai'ian Islands. Nishiwaki (1966) reported that blue whales occur in the Aleutian Islands and in the Gulf of Alaska. Although blue whales have not been observed off Alaska since 1987 (Leatherwood *et al*. 1982; Stewart *et al*. 1987; Forney and Brownell 1996). No distributional information exists for the western region of the North Pacific.

In the eastern tropical Pacific Ocean, the Costa Rica Dome appears to be important for blue whales based on the high density of prey (euphausiids) available in the Dome and the number of blue whales that appear to reside there (Reilly and Thayer 1990). Blue whales have been sighted in the Dome area in every season of the year, although their numbers appear to be highest from June through November.

Blue whales have also been reported year-round in the northern Indian Ocean, with sightings in the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca (Mizroch *et al*. 1984). The migratory movements of these whales are unknown.

Historical catch records suggest that "true" blue whales and "pygmy" blue whale (*B. m. brevicada*) may be geographically distinct (Brownell and Donaghue 1994, Kato *et al*. 1995). The distribution of the "pygmy" blue whale is north of the Antarctic Convergence, while that of the "true" blue whale is south of the Convergence in the austral summer (Kato *et al*. 1995). "True" blue whales occur mainly in the higher latitudes, where their distribution in mid-summer overlaps with that of the minke whale (*Balaenoptera acutorostrata*). During austral summers, "true" blue whales are found close to edge of Antarctic ice (south of 58° S) with concentrations between 60°-80° E and 66°-70° S (Kasamatsu *et al*. 1996).

Population Structure

For this and all subsequent species, the term "population" refers to groups of individuals whose patterns of increase or decrease in abundance over time are determined by internal dynamics (births resulting from sexual interactions between individuals in the group and deaths of those individuals) rather than external dynamics (immigration or emigration). This definition is a reformulation of definitions articulated by Cole (1957, Futuyma (1986) and Wells and Richmond (1995) and is more restrictive than those uses of 'population' that refer to groups of individuals that co-occur in space and time but do not have internal dynamics that determine whether the size of the group increases or decreases over time (see review by Wells and Richmond 1995). The definition we apply is important to section 7 consultations because such concepts as 'population decline,' 'population collapse,' 'population extinction,' and 'population recovery' apply to the restrictive definition of 'population' but do not explicitly apply to alternative definitions. As a result, we do not treat the different whale "stocks" recognized by the International Whaling Commission or other authorities as populations unless those distinctions were clearly based on demographic criteria. We do, however, acknowledge those "stock" distinctions in these narratives.

At least three subspecies of blue whales have been identified based on body size and geographic distribution (*B. musculus intermedia*, which occurs in the higher latitudes of the Southern Oceans, *B. m. musculus*, which occurs in the Northern Hemisphere, and *B. m. brevicauda* which occurs in the mid-latitude waters of the southern Indian Ocean and north of the Antarctic convergence), but this consultation will treat them as a single entity. Readers who are interested in these subspecies will find more information in Gilpatrick *et al*. (1997), Kato *et al*. (1995), Omura *et al*. (1970) and Ichihara (1966).

In addition to these subspecies, the International Whaling Commission's Scientific Committee has formally recognized one blue whale population in the North Pacific (Donovan 1991), although there is increasing evidence that more than there may be more than one blue whale population in the Pacific Ocean (Gilpatrick *et al*. 1997, Barlow *et al*. 1995, Mizroch *et al*. 1984a, Ohsumi and Wada 1974). For example, studies of the blue whales that winter off Baja California and in the Gulf of California suggest that these whales are morphologically distinct from blue whales of the western and central North Pacific (Gilpatrick *et al*. 1997), although these differences might result from differences in the productivity of their foraging areas more than genetic differences (the southern whales forage off California; Sears *et al*.1987; Barlow *et al*.1997; Calambokidis *et al*. 1990).

The International Whaling Commission also groups all of the blue whales in the North Atlantic Ocean into one "stock" and groups blue whales in the Southern Hemisphere into six "stocks" (Donovan 1991), which are presumed to follow the feeding distribution of the whales.

Threats to the Species

NATURAL THREATS. Natural causes of mortality in blue whales are largely unknown, but probably includes predation and disease (not necessarily in their order of importance). Blue whales are known to become infected with the nematode *Carricauda boopis* (Baylis 1920), which are believed to have caused fin whales to die as a result of renal failure (Lambertsen 1986; see additional discussion under *Fin whales*). Killer whales and sharks are also known to attack, injure, and kill very young or sick fin and humpback whale and probably hunt blue whales as well (Perry *et al*. 1999).

ANTHROPOGENIC THREATS. Two human activities are known to threaten blue whales: whaling and shipping. Historically, whaling represented the greatest threat to every population of fin whales and was ultimately responsible for listing fin whales as an endangered species. As early as the mid-seventeenth century, the Japanese were capturing blue, fin, and other large whales using a fairly primitive open-water netting technique (Tønnessen and Johnsen 1982, Cherfas 1989). In 1864, explosive harpoons and steam-powered catcher boats were introduced in Norway, allowing the large-scale exploitation of previously unobtainable whale species. Before fin whales became the focus of whaling operations, populations of blue whales had already become commercially extinct (IWC 1995).

From 1889 to 1965, whalers killed about 5,761 blue whales in the North Pacific Ocean (NMFS 1998). Evidence of a population decline were evident in the catch data from Japan. In 1912, whalers captured 236 blue whales; in 1913, 58 blue whales; in 194, 123 blue whales; from 1915 to 1965, the number of blue whales captured declined continuously (Mizroch *et al.* 1984). In the eastern North Pacific, whalers killed 239 blue whales off the California coast in 1926. And, in the late 1950s and early 1960s, Japanese whalers killed 70 blue whales per year off the Aleutian Islands (Mizroch *et al.* 1984a).

Although the International Whaling Commission banned commercial whaling in the North Pacific in 1966, Soviet whaling fleets continued to hunt blue whales in the North Pacific for several years after the ban. Surveys conducted in these former-whaling areas in the 1980s and 1990s failed to find any blue whales (Forney and Brownell 1996). By 1967, Soviet scientists wrote that blue whales in the North Pacific Ocean (including the eastern Bering Sea and Prince William Sound) had been so overharvested by Soviet whaling fleets that some scientists concluded that any additional harvests were certain to cause the species to become extinct in the North Pacific (Latishev 2007). As its legacy, whaling has reduced blue whales to a fraction of their historic population size and, as a result, makes it easier for other human activities to push blue whales closer to extinction. Otherwise, whaling currently does not threaten blue whale populations.

In 1980, 1986, 1987, and 1993, ship strikes have been implicated in the deaths of blue whales off California (Barlow *et al.* 1997). In addition, several photo-identified blue whales from California waters were observed with large scars on their dorsal areas that may have been caused by ship strikes. Studies have shown that blue whales respond to approaching ships in a variety of ways, depending on the behavior of the animals at the time of approach, and speed and direction of the approaching vessel. While feeding, blue whales react less rapidly and with less obvious avoidance behavior than whales that are not feeding (Sears *et al.* 1983). Within the St. Lawrence Estuary, blue whales are believed to be affected by large amounts of recreational and commercial vessel traffic. Blue whales in the St. Lawrence appeared more likely to react to these vessels when boats made fast, erratic approaches or sudden changes in direction or speed (Edds and Macfarlane 1987, Macfarlane 1981). The number of blue whales struck and killed by ships is unknown because the whales do not always strand or examinations of blue whales that have stranded did not identify the traumas that could have been caused by ship collisions. In the California/Mexico stock, annual incidental mortality due to ship strikes averaged 0.2 whales during 1991B1995 (Barlow *et al.* 1997), but we cannot determine if this reflects the actual number of blue whales struck and killed by ships.

Status

Blue whales were listed as endangered under the ESA in 1973. Blue whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for blue whales.

It is difficult to assess the current status of blue whales because (1) there is no general agreement on the size of the blue whale population prior to whaling and (2) estimates of the current size of the different blue whale populations vary widely. We may never know the size of the blue whale population prior to whaling, although some authors have concluded that their population numbers about 200,000 animals before whaling. Similarly, estimates of the global abundance of blue whales are uncertain. Since the cessation of whaling, the global population of blue whales has been estimated to range from 11,200 to 13,000 animals (Maser *et al.* 1981; U. S. Department of Commerce 1983). These estimates, however, are more than 20 years old.

A lot of uncertainty surrounds estimates of blue whale abundance in the North Pacific Ocean. Barlow (1994) estimated the North Pacific population of blue whales at between 1,400 to 1,900. Barlow and Calambokidis (1995) estimated the abundance of blue whales off California at 2,200 individuals. Wade and Gerrodette (1993) and Barlow *et al.* (1997) estimated there were a minimum of 3,300 blue whales in the North Pacific Ocean in the 1990s.

The size of the blue whale population in the north Atlantic is also uncertain. The population has been estimated to number from a few hundred individuals (Allen 1970; Mitchell 1974) to 1,000 to 2,000 individuals (Sigurjónsson 1995). Gambell (1976) estimated there were between 1,100 to 1,500 blue whales in the North Atlantic before whaling began and Braham (1991) estimated there were between 100 and 555 blue whales in the North Atlantic during the late 1980s and early 1990s. Sears *et al*. (1987) identified over 300 individual blue whales in the Gulf of St. Lawrence, which provides a minimum estimate for their population in the North Atlantic. Sigurjónsson and Gunnlaugson (1990) concluded that the blue whale population had been increasing since the late 1950s and argued that the blue whale population had increased at an annual rate of about 5 percent between 1979 and 1988, although the level of confidence we can place in these estimates is low.

Estimates of the number of blue whales in the Southern Hemisphere range from 5,000 to 6,000 (review by Yochem and Leatherwood 1985) with an average rate of increase that has been estimated at between 4 and 5 percent per year. Butterworth *et al.* (1993), however, estimated the Antarctic population at 710 individuals. More recently, Stern (2001) estimated the blue whale population in the Southern Ocean at between 400 and 1,400 animals (coefficient of variation = 0.4). The pygmy blue whale population has been estimated at 6,000 individuals (Yochem and Leatherwood 1985)

The information available on the status and trend of blue whales do not allow us to reach any conclusions about the extinction risks facing blue whales as a species, or particular populations of blue whales. With the limited data available on blue whales, we do not know whether these whales exist at population sizes large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as "small" populations (that is, "small" populations experience phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself) or if blue whales might are threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate).

Bowhead Whale

Distribution

Bowhead whales were historically found in all arctic waters of the northern hemisphere. The Bering Sea population, which is also known as the western Arctic or Bering-Chukchi-Beaufort population, has been studied more than any other bowhead whale population. This population winters in the central and western Bering Sea (November to April) and migrates north and east through the eastern Chukchi Sea to the Beaufort Sea along the coast of Alaska and northwestern Canada (Brueggeman 1982, Braham *et al.* 1984). From June through September, these bowhead whales remain on foraging grounds in the eastern Beaufort Sea before migrating back to their wintering grounds in the Bering Sea (Hazard and Cubbage 1982; Richardson *et al.* 1987).

Bowhead whales in the western North Atlantic are currently segregated into two populations: the Davis Strait population occupies the Davis Strait, Baffin Bay, and the Canadian Arctic Archipelago while the Hudson Bay population occupies Hudson Strait, Hudson Bay, and Foxe Basin (Moore and Reeves 1993).

The Spitsbergen bowhead whale population, which is also known as the Greenland whale, bowhead whales in the eastern North Atlantic have been observed in the waters north of Iceland and as far east as the Laptev Sea. Shelden and Rugh (1995) reported sightings along the coastline of Greenland, in the waters near Spitsbergen Island, off North Cape in northern Norway, in the waters of Zemlya Frantsa-losifa (Franz Josef Land), near Novaya Zemlya, and near Severnaya Zemlya.

Population Structure

Bowhead whales are known to exist as five separate populations: (1) Sea of Okhotsk, which occurs in the north Pacific Ocean off the western coast of Siberia near the Kamchatka Peninsula; (2) Bering Sea; (3) Hudson Bay; (4) Davis Strait, which is found in Davis Strait, Baffin Bay, and along the Canadian Arctic Archipelago; and (5) Spitsbergen, which is found in the North Atlantic Ocean east of Greenland in the Greenland, Kara, and Barents Seas (IWC 1992). A separate Bering Sea population may have become extinct as a result of whaling activities, except for the component that migrated to the Beaufort Sea.

Threats to the Species

NATURAL THREATS. There is limited information on natural phenomena that kill or injure bowhead whales. Bowhead whales have no known predators, except perhaps killer whales (*Orcinus orca*) that have been reported to infrequently attack and kill bowhead whales (George *et al.* 1994). Other natural sources of mortality, however, remain largely unknown. Similarly, we do not know whether and to what degree natural mortality limits or restricts patterns of growth or variability in bowhead whale populations.

ANTHROPOGENIC THREATS. The Bering Sea population of bowhead whales is harvested by Inupiat in the Alaskan Beaufort, Bering, and Chukchi Seas. Since 1978, the IWC has imposed a quota on the number of bowheads landed, struck, or both by Alaskan natives. The IWC recently allocated the subsistence take of bowheads from the Alaska stock, establishing a 5-year block quota of 280 whales landed. For each of the years 1998-2002, the number of bowheads struck is not allowed to exceed 67 animals. In addition, the Russian Federation for the Natives of Chukotka has been granted an annual quota of five bowheads.

The total Alaskan subsistence harvest of bowheads between 1978 and 1991 ranged from 8 in 1982 to 30 in 1990, averaging 18 per year. From 1991 to 1995, a combined average of 19.4 bowhead whales per year were taken by the communities of Barrow, Nuiqsut, and Kaktovik (MMS 1996). The combined spring and fall harvest for 1998 was 41 whales landed and 12 struck and lost. In addition to the subsistence harvest, other man-induced impacts may contribute to morbidity and mortality. Commercial fishing occurs in the Bering Sea and elsewhere within the range of this stock. Interaction with fishing gear is rare, however whales with ropes caught in their baleen and with scarring caused by rope entanglement have been reported (Philo *et al.* 1993, NMML unpubl. data).

George *et al.* (1994) report three documented ship strike injuries observed among 236 bowheads taken in subsistence hunts. Man-made noise in arctic marine environments is increasing as the region becomes industrialized; these activities may adversely affect bowhead whales but the significance of those effects, if any, remain unknown (Richardson and Malme 1993, Richardson *et al.* 1995).

Shelden and Rugh (1995) suggested that the longevity and low fecundity rates of bowhead whales may be important factors in the slow recovery of bowhead whales since the termination of whaling.

Status

Bowhead whales were listed as endangered species on June 2, 1970 (35 FR 8495). Bowhead whales received further protection under the Convention on International Trade in Endangered Species of wild flora and fauna. Critical habitat has not been designated for bowhead whales.

Before exploitation, the Sea of Okhotsk population may have numbered between 3,000 and 6,500 animals (Shelden and Rugh 1995); it is now estimated to number between 300 and 400 animals (although these population estimates are not reliable). Individuals from this population may have mixed with individuals from the Bering Sea population, although the available evidence indicates the two stocks are essentially separate (Moore and Reeves 1993).

The Bering Sea population of bowhead whales declined from an estimated population of 10,400 to 23,000 animals (Woodby and Botkin 1993); by 1910, this population had been reduced to a few thousand individuals. From 1978 to 1983, this population was estimated to have numbered between 3,500 to 5,300 animals based on shore-based visual surveys (Zeh *et al.* 1993). The IWC Scientific Committee now recognizes the current population estimate to be 7,992 whales (95% C.I.: 6,900-9,200) (IWC 1995). A refined and larger sample of acoustic data from 1993 has resulted in an estimate of 8,200 animals, and is considered a better estimate for this population (IWC 1996).

The Spitsbergen population was reduced from 24,000 to a few "tens" of whales and has not recovered in the past 80 years. The Davis Strait and Hudson Bay populations declined from about 12,300 whales to less than 450, although significant whaling has not occurred in 80 years.

There are no reliable estimates of the size of the Hudson Bay population of bowhead whales, although Mitchell (1977) conservatively estimates it at 100 or less. More recently, this population has been estimated to number from 256 to 284 whales within Foxe Basin (Cosens *et al.* 1997).

The Davis Strait population is separated from the Bering Sea population by the heavy ice found across the Northwest passage (Moore and Reeves 1993). The population was estimated to have originally numbered over 11,700 (Woodby and Botkin 1993) but was significantly reduced by commercial whaling between 1719 and 1915. The Davis Strait population is currently estimated to be 350 animals (Zeh *et al.* 1993) and recovery is described as "at best, exceedingly slow" (Davis and Koski 1980). Canadian Inuit have expressed an interest in resuming subsistence hunting of bowhead whales in Davis Strait, although the International Whaling Commission has not acted on this request.

The Spitsbergen population of bowhead whales was believed to have been the most numerous of the bowhead whale populations: before they were hunted by whalers, they are estimated to have numbered about 24,000 animals (Woodby and Botkin 1993). Between 1940 and September 1990, 37 bowhead whale sightings have been reported from this region (Moore and Reeves 1993). With a population size numbering in the tens of animals, the Spitsbergen population of bowhead whales is now critically endangered (Shelden and Rugh 1995).

Fin whale

Distribution

Fin whales are distributed widely in every ocean except the Arctic Ocean. In the North Pacific Ocean, fin whales occur in summer foraging areas in the Chukchi Sea, the Sea of Okhotsk, around the Aleutian Islands, and the Gulf of Alaska; in the eastern Pacific, they occur south to California; in the western Pacific, they occur south to Japan. Fin whales in the eastern Pacific winter from California south; in the western Pacific, they winter from the Sea of Japan, the East China and Yellow Seas, and the Philippine Sea (Gambell 1985).

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

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

Fin whales are common off the Atlantic coast of the United States in waters immediately off the coast seaward to the continental shelf (about the 1,000-fathom contour). In this region, they are tend to occur north of Cape Hatteras where they accounted for about 46 percent of the large whales observed in surveys conducted between 1978 and 1982. During the summer months, fin whales in this region tend to congregate in feeding areas between 41°20'N and 51°00'N, from shore seaward to the 1,000-fathom contour.

In the Atlantic Ocean, Clark (1995) reported a general southward pattern of fin whale migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, and fin whales are found throughout the action area for this consultation in most months of the year. This species preys opportunistically on both invertebrates and fish (Watkins *et al.* 1984). They feed by filtering large volumes of water for the associated prey. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments.

Population Structure

Fin whales have two recognized subspecies: *Balaoptera physalus physalus* (Linnaeus 1758) occurs in the North Atlantic Ocean while *B. p. quoyi* (Fischer 1829) occurs in the Southern Ocean. These subspecies and the North Pacifc fin whales appear to be organized into separate populations, although the published literature on the population structure of fin whales does not demonstrates a lack of concensus on the population structure of fin whales.

In the North Atlantic Ocean, the International Whaling Commission recognizes seven management units or "stocks" of fin whales: (1) Nova Scotia, (2) Newfoundland-Labrador, (3) West Greenland, (4) East Greenland-Iceland, (5) North Norway, (6) West Norway-Faroe Islands, and (7) British Isles-Spain-Portugal. In addition, the population of fin whales that resides in the Ligurian Sea, in the northwestern Mediterranean Sea is believed to be genetically distinct from other fin whales populations (as used in this Opinion, "populations" are isolated demographically, meaning, they are driven more by internal dynamics — birth and death processes — than by the geographic redistribution of individuals through immigration or emigration. Some usages of the term "stock" are synonymous with this definition of "population" while other usages of "stock" do not).

In the North Pacific Ocean, the International Whaling Commission recognizes two "stocks": (1) East China Sea and (2) rest of the North Pacific (Donovan,1991). However, Mizroch *et al*. (1984) concluded that there were five possible "stocks" of fin whales within the North Pacific based on histological analyses and tagging experiments: (1) East and West Pacific that intermingle around the Aleutian Islands; (2) East China Sea; (3) British Columbia; (4) Southern-Central California to Gulf of Alaska; and (5) Gulf of California. Based on genetic analyses, Berube *et al*. (1998) concluded that fin whales in the Sea of Cortez represent an isolated population that has very little genetic exchange with other populations in the North Pacific Ocean (although the geographic distribution of this population and other populations can overlap seasonally). They also concluded that fin whales in the Gulf of St. Lawrence and Gulf of Maine are distinct from fin whales found off Spain and in the Mediterranean Sea.

Regardless of how different authors structure the fin whale population, mark-recapture studies have demonstrate that individual fin whales migrate between management units (Mitchell 1974; Gunnlaugsson and Sigurjónsson 1989), which suggests that these management units are not geographically isolated populations.

The recovery plan that has been drafted for fin whales treats the fin whales that occur off the Atlantic Coast of the U.S. as a single population that overlaps with the population the International Whaling Commission's Nova Scotia management unit (NMFS 2007). Individuals from this "population" of fin whales occur in the action area for this consultation.

Threats to the Species

NATURAL THREATS. Natural sources and rates of mortality are largely unknown, but Aguilar and Lockyer (1987) suggest annual natural mortality rates may range from 0.04 to 0.06 (based on studies of northeast Atlantic fin whales). The occurrence of the nematode *Crassicauda boopis* appears to increase the potential for kidney failure in fin whales and may be preventing some fin whale stocks from recovering from whaling (Lambertsen 1992, as cited in Perry *et al*. 1999). Killer whale or shark attacks may injure or kill very young or sick whales (Perry *et al*. 1999).

ANTHROPOGENIC THREATS. Three human activities are known to threaten fin whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to every population of fin whales and was ultimately responsible for listing fin whales as an endangered species. As early as the mid-seventeenth century, the Japanese were capturing fin, blue (*Balaenoptera musculus*), and other large whales using a fairly primitive open-water netting technique (Tønnessen and Johnsen 1982, Cherfas 1989). In 1864, explosive harpoons and steam-powered catcher boats were introduced in Norway, allowing the large-scale exploitation of previously unobtainable whale species. After blue whales were depleted in most areas, fin whales became the focus of whaling operations and more than 700,000 fin whales were landed in the Southern Hemisphere alone between 1904 and 1979 (IWC 1995).

As its legacy, whaling has reduced fin whales to a fraction of their historic population size and, as a result, makes it easier for other human activities to push fin whales closer to extinction. Otherwise, whaling currently does not threaten every fin whale population, although it may threaten specific populations. In the Antarctic Ocean, fin whales are hunted by Japanese whalers who have been allowed to kill up to 10 fin whales each year for the 2005-2006 and 2006-2007 seasons under an Antarctic Special Permit. The Japanese whalers plan to kill 50 fin whales per year starting in the 2007-2008 season and continuing for the next 12 years.

Fin whales are also hunted in subsistence fisheries off West Greenland. In 2004, 5 males and 6 females were killed and landed; 2 other fin whales were struck and lost in the same year. In 2003 2 males and 4 females were landed and 2 other fin whales were struck and lost (IWC 2005). Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery (IWC 2005), however, the IWC's Scientific Committee recommended limiting the number of fin whale killed in this fishery to 1 to 4 individuals until accurate population estimates are produced.

Despite anecdotal observations from fishermen which suggest that large whales swim through their nets rather than get caught in them (NMFS 2000), fin whales have been entangled by fishing gear off Newfoundland and Labrador in small numbers: a total of 14 fin whales are reported to have been captured in coastal fisheries in those two provinces between 1969 and 1990 (Lien 1994, Perkins and Beamish 1979). Of these 14 fin whales, 7 are known to have died as a result of that capture, although most of the animals that died were less than 15 meters in length (Lien

1994). Between 1999 and 2005, there were 10 confirmed reports of fin whales being entangled in fishing gear along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole *et al*. 2005, Nelson *et al*. 2007). Of these reports, Fin whales were injured in 1 of the entanglements and killed in 3 entanglements. These data suggest that, despite their size and strength, fin whales are likely to be entangled and, in some cases, killed by gear used in modern fisheries.

Fin whales are also killed and injured in collisions with vessels more frequently than any other whale. Of 92 fin whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, 31 (33%) showed evidence of collisions with ships (Laist *et al*. 2001). Between 1999 and 2005, there were 15 reports of fin whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole *et al*. 2005, Nelson *et al*. 2007). Of these reports, 13 were confirmed as ship strikes which were reported as having resulted in the death of 11 fin whales.

Ship strikes were identified as a known or potential cause of death in 8 (20%) of 39 fin whales that stranded on the coast of Italy in the Mediterranean Sea between 1986 and 1997 (Laist *et al*. 2001). Throughout the Mediterranean Sea, 46 of the 287 fin whales that are recorded to have stranded between 1897 and 2001 were confirmed to died from injuries sustained by ship strikes (Panigada *et al*. 2006). Most of these fin whales (n = 43), were killed between 1972 and 2001 and the highest percentage (37 of 45 or ~82%) killed in the Ligurian Sea and adjacent waters, where the Pelagos Sanctuary for Marine Mammals was established. In addition to these ship strikes, there are numerous reports of fin whales being injured as result of ship strikes off the Atlantic coast of France and the United Kingdom (Jensen and Silber 2003).

Status

Fin whales were listed as endangered under the ESA in 1970. In 1976, the IWC protected fin whales from commercial whaling (Allen 1980). Fin whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for fin whales.

It is difficult to assess the current status of fin whales because (1) there is no general agreement on the size of the fin whale population prior to whaling and (2) estimates of the current size of the different fin whale populations vary widely. We may never know the size of the fin whale population prior to whaling. Chapman (1976) estimated the "original" population size of fin whales off Nova Scotia as 1,200 and 2,400 off Newfoundland, although he offered no explanation or reasoning to support that estimate. Sergeant (1977) suggested that between 30,000 and 50,000 fin whales once populated the North Atlantic Ocean based on assumptions about catch levels during the whaling period. Sigurjónsson (1995) estimated that between 50,000 and 100,000 fin whales once populated the North Atlantic, although he provided no data or evidence to support that estimate. More recently, Palumbi and Roman (2006) estimated that about 360,000 fin whales (95% confidence interval = 249,000 - 481,000) populated the North Atlantic Ocean before whaling based on mutation rates and estimates of genetic diversity.

Similarly, estimates of the current size of the different fin whale populations and estimates of their global abundance also vary widely. The draft recovery plan for fin whales accepts a minimum population estimate of 2,362 fin whales for the North Atlantic Ocean (NMFS 2007); however, the recovery plan also states that this estimate, which is based on on shipboard and aerial surveys conducted in the Georges Bank and Gulf of St. Lawrence in 1999 is the "best" estimate of the size of this fin whale population (NMFS 2006, 2007). However, based on data produced by surveys conducted between 1978-1982 and other data gathered between 1966 and 1989, Hain *et al*. (1992) estimated that the population of fin whales in the western North Atlantic Ocean (specifically, between Cape Hatteras, North Carolina, and Nova Scotia) numbered about 1,500 whales in the winter and 5,000 whales in the spring and summer. Because authors do not always reconcile "new" estimates with earlier estimates, it is not clear whether the current "best" estimate represents a refinement of the estimate that was based on older data or whether the fin whale population in the North Atlantic has declined by about 50% since the early 1980s.

The East Greenland-Iceland fin whale population was estimated at 10,000 animals (95 % confidence interval = 7,600 - 14,200), based on surveys conducted in 1987 and 1989 (Buckland *et al*. 1992). The number of eastern Atlantic fin whales, which includes the British Isles-Spain-Portugal population, has been estimated at 17,000 animals (95% confidence interval = 10,400 - 28,900; Buckland *et al*. 1992). These estimates are both more than 15 years old and the data available do not allow us to determine if they remain valid.

Forcada *et al*. (1996) estimated the fin whale population in the western Mediterranean numbered 3,583 individuals (standard error = 967; 95% confidence interval = 2,130-6,027). This is similar to a more recent estimate published by Notarbartolo-di-Sciara *et al*. (2003). Within the Ligurian Sea, which includes the Pelagos Sanctuary for Marine Mammals and the Gulf of Lions, the fin whale population was estimated to number 901 (standard error = 196.1) whales. (Forcada *et al*. 1995).

Regardless of which of these estimates, if any, have the closest correspondence to the actual size and trend of the fin whale population, all of these estimates suggest that the global population of fin whales consists of tens of thousands of individuals and that the North Atlantic population consists of at least 2,000 individuals. Based on ecological theory and demographic patterns derived from several hundred imperiled species and populations, fin whales appear to exist at population sizes that are large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as "small" populations (that is, "small" populations experience phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself). As a result, we assume that fin whales are likely to be threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) than endogenous threats caused by the small size of their population.

Nevertheless, based on the evidence available, the number of fin whales that are recorded to have been killed or injured in the past 20 years by human activities or natural phenomena, does not appear to be increasing the extinction probability of fin whales, although it may slow the rate at which they recover from population declines that were caused by commercial whaling.

Humpback Whale

Distribution

Humpback whales are a cosmopolitan species that occur in the Atlantic, Indian, Pacific, and Southern Oceans. Humpback whales migrate seasonally between warmer, tropical or sub-tropical waters in winter months (where they reproduce and give birth to calves) and cooler, temperate or sub-Arctic waters in summer months (where they feed). In their summer foraging areas and winter calving areas, humpback whales tend to occupy shallower, coastal waters; during their seasonal migrations, however, humpback whales disperse widely in deep, pelagic waters and tend to avoid shallower coastal waters (Winn and Reichley 1985).

In the North Pacific Ocean, the summer range of humpback whales 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 as cited in NMFS 1991). These whales migrate to Hawai'i, southern Japan, the Mariana Islands, and Mexico during the winter.

In the Atlantic Ocean, humpback whales range from the mid-Atlantic bight, the Gulf of Maine, across the southern coast of Greenland and Iceland, and along coast of Norway in the Barents Sea. These humpback whales migrate to the western coast of Africa and the Caribbean Sea during the winter.

In the Southern Ocean, humpback whales occur in waters off Antarctica. These whales migrate to the waters off Venezuela, Brazil, southern Africa, western and eastern Australia, New Zealand, and islands in the southwest Pacific during the austral winter. A separate population of humpback whales appears to reside in the Arabian Sea in the Indian Ocean off the coasts of Oman, Pakistan, and India (Mikhalev 1997).

Population Structure

Descriptions of the population structure of humpback whales differ depending on whether an author focuses on where humpback whales winter or where they feed. During winter months in northern or southern hemispheres, adult humpback whales migrate to specific areas in warmer, tropical waters to reproduce and give birth to calves. During summer months, humpback whales migrate to specific areas in northern temperate or sub-arctic waters to forage. In summer months, humpback whales from different "reproductive areas" will congregate to feed; in the winter months, whales will migrate from different foraging areas to a single wintering area. In either case, humpback whales appear to form "open" populations; that is, populations that are connected through the movement of individual animals.

For example, NMFS' Stock Assessment Reports recognize four "stocks" of humpback whales in the North Pacific Ocean, based on genetic and photo-identification studies: two Eastern North Pacific stocks, one Central North Pacific stock, and one Western Pacific stock (Hill and DeMaster 1998). The first two of these "stocks" are based on where these humpback whales winter: the central North Pacific "stock" winters in the waters around Hawai'i while the eastern North Pacific "stock" (also called the California-Oregon-Washington-Mexico stock) winters along coasts of Central America and Mexico. However, Calambokidis *et al*. (1997) identified humpback whales from Southeast Alaska (central North Pacific), the California-Oregon-

Washington (eastern North Pacific), and Ogasawara Islands (Japan, Western Pacific) groups in the Hawai'ian Islands during the winter; humpback whales from the Kodiak Island, Southeast Alaska, and British Columbia groups in the Ogasawara Islands; and whales from the British Columbia, Southeast Alaska, Prince William Sound, and Shumagin-Aleutian Islands groups in Mexico.

Herman (1979), however, presented extensive evidence and various lines of reasoning to conclude that the humpback whales associated with the main Hawai'ian Islands immigrated to those waters only in the past 200 years. Winn and Reichley (1985) identified genetic exchange between the humpback whales that winter off Hawai'i and those that winter off Mexico (with further mixing on feeding areas in Alaska) and suggested that the humpback whales that winter in Hawai'i may have emigrated from wintering areas in Mexico. Based on these patterns of movement, we conclude that the various "stocks" of humpback whales are not true populations or, at least, they represent populations that experience substantial levels of immigration and emigration.

A "population" of humpback whales winters in an area extending from the South China Sea east through the Philippines, Ryukyu Retto, Ogasawara Gunto, Mariana Islands, and Marshall Islands (Rice 1998). Based on whaling records, humpback whales wintering in this area have also occurred in the southern Marianas through the month of May (Eldredge 1991). There are several recent records of humpback whales in the Mariana Islands, at Guam, Rota, and Saipan during January through March (Darling and Mori 1993; Eldredge 1991, 2003, Taitano 1991). During the summer, whales from this population migrate to the Kuril Islands, Bering Sea, Aleutian Islands, Kodiak, Southeast Alaska, and British Columbia to feed (Angliss and Outlaw 2007; Calambokidis 1997, 2001).

In the Atlantic Ocean, humpback whales aggregate in four feeding areas in the summer months: (1) Gulf of Maine, eastern Canada, (2) west Greenland, (3) Iceland and (4) Norway (Katona and Beard 1990; Smith *et al.* 1999). The principal breeding range for these whales lies from the Antilles and northern Venezuela to Cuba (Winn *et al.* 1975, Balcomb and Nichols 1982, Whitehead and Moore 1982). The largest contemporary breeding aggregations occur off the Greater Antilles where humpback whales from all of the North Atlantic feeding areas have been identified from photographs (Katona and Beard 1990, Clapham *et al.* 1993b, Mattila *et al.* 1994, Palsbøll *et al.* 1997, Smith *et al.* 1999, Stevick *et al.* 2003a). Historically, an important breeding aggregation was located in the eastern Caribbean based on the important humpback whale fisheries this region supported (Mitchell and Reeves 1983, Reeves *et al.* 2001, Smith and Reeves 2003). Although sightings persist in those areas, modern humpback whale abundance appears to be low (Winn *et al.* 1975, Levenson and Leapley 1978, Swartz *et al.* 2003). Winter aggregations also occur at the Cape Verde Islands in the Eastern North Atlantic (Reiner *et al.* 1996, Reeves *et al.* 2002, Moore *et al.* 2003). In another example of the "open" structure of humpback whale populations, an individual humpback whale migrated from the Indian Ocean to the South Atlantic Ocean and demonstrated that individual whales may migrate from one ocean basin to another (Pomilla and Rosenbaum 2005).

As discussed previously, a separate population of humpback whales appears to reside in the Arabian Sea in the Indian Ocean off the coasts of Oman, Pakistan, and India (Mikhalev 1997).

Threats to the Species

NATURAL THREATS. There is limited information on natural phenomena that kill or injure humpback whales. We know that humpback whales are killed by orcas (Dolphin 1989, Florez-González *et al*. 1984, Whitehead and Glass 1985) and are probably killed by false killer whales and sharks. Because 7 female and 7 male humpback whales stranded on the beaches of Cape Cod and had died from toxin produced by dinoflagellates between November 1987 and January 1988, we also know that adult and juvenile humpback whales are killed by naturally-produced biotoxins (Geraci *et al*. 1989).

Other natural sources of mortality, however, remain largely unknown. Similarly, we do not know whether and to what degree natural mortality limits or restricts patterns of growth or variability in humpback whale populations.

ANTHROPOGENIC THREATS. Three human activities are known to threaten humpback whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to every population of humpback whales and was ultimately responsible for listing humpback whales as an endangered species. From 1900 to 1965, nearly 30,000 whales were taken in modern whaling operations of the Pacific Ocean. Prior to that, an unknown number of humpback whales were taken (Perry *et al.* 1999). In 1965, the International Whaling Commission banned commercial hunting of humpback whales in the Pacific Ocean. As its legacy, whaling has reduced humpback whales to a fraction of their historic population size and, as a result, makes it easier for other human activities to push these whales closer to extinction.

Humpback whales are also killed or injured during interactions with commercial fishing gear, although the evidence available suggests that these interactions on humpback whale populations may not have significant, adverse consequence for humpback whale populations. Like fin whales, humpback whales have been entangled by fishing gear off Newfoundland and Labrador, Canada: a total of 595 humpback whales are reported to have been captured in coastal fisheries in those two provinces between 1969 and 1990 (Lien 1994, Perkins and Beamish 1979). Of these whales, 94 are known to have died as a result of that capture, although, like fin whales, most of the animals that died were smaller: less than 12 meters in length (Lien 1994). These data suggest that, despite their size and strength, humpback whales are likely to be entangled and, in some cases, killed by gear used in modern fisheries.

In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill *et al.* 1997). In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone. Also in 1996, a vessel from Pacific Missile Range Facility in Hawaii rescued an entangled humpback, removing two crab pot floats from the whale; the gear was traced to a recreational fisherman in southeast Alaska. The whale was successfully released, but subsequently became entrapped and was attacked and killed by tiger sharks in the surf zone.

Along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada, there were 160 reports of humpback whales being entangled in fishing gear between 1999 and 2005 (Cole *et al*. 2005, Nelson *et al*. 2007). Of these reports, 95 entanglements were confirmed resulting in the injury of 11 humpback whales and the death of 9 whales. No information is available on the number of humpback whales that have been killed or seriously injured by interactions with fishing fleets outside of U.S. waters.

The number of humpback whales killed by ship strikes is exceeded only by fin whales (Jensen and Silber 2003). On the Pacific coast, a humpback whale is killed about every other year by ship strikes (Barlow *et al*. 1997). The humpback whale calf that was found stranded on Oahu with evidence of vessel collision (propeller cuts) in 1996 suggests that ship collisions might kill adults, juvenile, and calves (NMFS unpublished data). Of 123 humpback whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, 10 (8.1%) showed evidence of collisions with ships (Laist *et al*. 2001). Between 1999 and 2005, there were 18 reports of humpback whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole *et al*. 2005, Nelson *et al*. 2007). Of these reports, 13 were confirmed as ship strikes which were reported as having resulted in the death of 7 humpback whales. Despite several literature searches, we did not identify information on the number of humpback whales killed or seriously injured by ship strikes outside of U.S. waters.

In addition to ship strikes in North America and Hawai'i, there are several reports of humpback whales being injured as result of ship strikes off the Antarctic Peninsula, in the Caribbean Sea, the Mediterranean Sea, off Australia, Bay of Bengal (Indian Ocean), Brazil, New Zealand, Peru, South Africa,

Status

Humpback whales were listed as endangered under the ESA in 1973. Humpback whales are listed as endangered on the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for humpback whales.

It is difficult to assess the current status of humpback whales for the same reasons that it is difficult to assess the status of fin whales: (1) there is no general agreement on the size of the humpback whale population prior to whaling and (2) estimates of the current size of the different humpback whale populations vary widely and produce estimates that are not always comparable to one another, although robust estimates of humpback whale populations in the western North Atlantic have been published. We may never know the size of the humpback whale population prior to whaling.

Winn and Reichley (1985) argued that the global population of humpback whales consisted of at least 150,000 whales in the early 1900s, with the largest population historically occurring in the Southern Ocean. Based on analyses of mutation rates and estimates of genetic diversity, Palumbi and Roman (2006) concluded that there may have been as many as 240,000 (95% confidence interval = 156,000 – 401,000) humpback whales in the North Atlantic before whaling began. In the western North Atlantic between Davis Strait, Iceland and the West Indies, Mitchell and Reeves (1983) estimated there were at least 4,685 humpback whales in 1865 based on available whaling records (although the authors note that this does not represent a "pre-exploitation estimate" because whalers from Greenland, the Gulf of St. Lawrence, New England, and the Caribbean Sea had been hunting humpback whales before 1865).

Estimates of the number of humpback whales occurring in the different populations that inhabit the Northern Pacific population have risen over time. In the 1980s, estimates ranged from 1,407 to 2,100 (Baker 1985; Darling and Morowitz 1986; Baker and Herman 1987), while recent estimates place the population size at about 6,000 whales (standard error = 474) in the North Pacific (Calambokidis *et al.* 1997; Cerchio 1998; Mobley *et al.* 1999). Based on data collected between 1980 and 1983, Baker and Herman (1987) used a capture-recapture methodology to produce a population estimate of 1,407 whales (95% confidence interval = 1,113 - 1,701). More recently, (Calambokidis *et al.* 1997) relied on resightings estimated from photographic records of individuals to produce an estimate of 6,010 humpback whales occurred in the North Pacific Ocean. Because the estimates produced by the different methodologies are not directly comparable, it is not clear which of these estimates is more accurate or if the change from 1,407 to 6,000 individuals results from a real increase in the size of the humpback whale population, sampling bias in one or both studies, or assumptions in the methods used to produce estimates from the individuals that were sampled. Since the last of these estimates was published almost 12 years ago, we do not know if the estimates represent current population sizes.

Stevick *et al*. (2003) estimated the size of the North Atlantic humpback whale population between 1979 and 1993 by applying statistical analyses that are commonly used in capture-recapture studies to individual humpback whales that were identified based on natural markings. Between 1979 and 1993, they estimated that the North Atlantic populations (what they call the "West Indies breeding population") consisted of between 5,930 and 12,580 individual whales. The best estimate they produced (11,570; 95% confidence interval = 10,290 -13,390) was based on samples from 1992 and 1993. If we assume that this population has grown according to the instantaneous rate of increase Stevick *et al*. (2003) estimated for this population (r = 0.0311), this would lead us to estimate that this population might consist of about 18,400 individual whales in 2007-2008.

Regardless of which of these estimates, if any, most closely correspond to the actual size and trend of the humpback whale population, all of these estimates suggest that the global population of humpback whales consists of tens of thousands of individuals and that the North Atlantic population consists of at least 2,000 individuals. Based on ecological theory and demographic patterns derived from several hundred imperiled species and populations, humpback whales appear to exist at population sizes that are large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as "small" populations (that is, "small" populations experience phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself). As a result, we assume that humpback whales will have elevated extinction probabilities because of exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) rather than endogenous threats caused by the small size of their population.

Killer Whale, Southern Resident Population

Distribution

Southern Resident killer whales are distributed from the Strait of Georgia, Strait of Juan de Fuca, Puget Sound, and southern Vancouver Island south along the Pacific coast of the United States to Monterey Bay, the Farallon Islands, and Point Reyes, California (Pacific Fishery Management Council and NMFS 2006).

These killer whales spend a significant portion of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound, particularly during the spring, summer, and fall, when all three pods are regularly present in the Georgia Basin (defined as the Georgia Strait, San Juan Islands, and Strait of Juan de Fuca) (Heimlich-Boran 1988, Felleman *et al.* 1991, Olson 1998, Osborne 1999).

Population Structure

Southern Resident killer whales consist of a single populations represented by three pods, identified as J, K, and L pods.

Threats to the Species

NATURAL THREATS. There is limited information on natural phenomena that kill or injure Southern resident killer whales. Similarly, we do not know whether and to what degree natural mortalities limit or restrict patterns of growth or variability in the southern resident killer whale population.

ANTHROPOGENIC THREATS. Three human activities are known to threaten Southern resident killer whales: live capture of whales for zoological displays, decline of their prey base, vessel traffic, shipping.

Olesiuk *et al*. (1990) estimated the Southern Resident population size in 1967 to be 96 animals. At about this time, marine mammals became popular attractions in zoos and marine parks, which increased the demand for interesting and exotic display animals. Between 1967 and 1973, it is estimated that 47 killer whales, mostly immature, were taken from the Southern Resident population for public display. The rapid removal of individual whales caused an immediate decline in numbers (Ford *et al*. 2000). By 1971, the level of removal decreased the population by about 30 percent, to approximately 67 whales (Olesiuk *et al*. 1990). In 1993, two decades after the livecapture of killer whales ended, the three Southern Resident pods – J, K, and L – totaled 96 animals (Ford et al. 2000).

Salmon are the primary prey species for Southern resident killer whales and have declined because of habitat degradation from development (e.g., agriculture, timber harvest, dam construction, urban construction), harvest practices, and hatchery operations. Some populations of salmon that were historically abundant have collapsed in size, while other salmon populations have increased because of hatchery production. Perhaps the single greatest change in food availability for resident killer whales since the late 1800s has been the decline of salmon in the Columbia River basin (Krahn *et al*. 2002).

Southern resident killer whales are also exposed to contaminants. Tissues collected from these whales have bee reported to contain high levels of persistent organic pollutants, such as PCBs and DDT, are documented in Southern Resident killer whales (Ross et al. 2000, Ylitalo et al. 2001, Herman et al. 2005). These and other chemical compounds have the ability to induce immune suppression, impair reproduction, and produce other adverse physiological effects, as observed in studies of other marine mammals. High levels of "newly emerging" contaminants, such as flame retardants (PBDEs), that may have similar negative effects are documented in killer whales, are also becoming more prevalent in the marine environment.

Status

Southern resident killer whales were listed as endangered under the Endangered Species Act of 1973, as amended, on November 18, 2005 (70 FR 69903). Critical habitat for Southern Resident killer whales was designated on November 29, 2006 (NMFS 2006).

There is very little information on the historical abundance of Southern Resident killer whales. Some evidence suggests that, until the mid- to late-1800s, the Southern Resident killer whale population may have numbered more that 200 animals (Krahn *et al*. 2002). Over the past decade, the Southern resident killer whales have fluctuated in numbers. For example, the population appeared to experience a period of recovery by increasing to 99 whales in 1995, but then declined by 20 percent to 79 whales in 2001 (- 3.3% per year) before another slight increase to 83 whales in 2003 (Ford *et al*. 2000; Carretta *et al*. 2004).

Although the current population estimate for 2006 is approximately 90 animals (+ 3.5% per year since 2001; Center for Whale Research 2006), the decline in the 1990's, unstable population status, and population structure (e.g., few reproductive age males and non-calving adult females) continue to be causes for concern. Moreover, it is unclear whether the recent increasing trend will continue because these observations may represent an anomaly in the general pattern of survival or a longer-term shift in the survival pattern. Several individuals disappeared in the fall of 2006 and one new calf has been identified since the 2006 population estimate.

A population numbering fewer than 100 individuals is sufficiently small for the population to experience demographic phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself. These phenomena would increase the extinction probability of Southern resident killer whales and amplify the potential consequences of human-related activities on this species. Based on their population size and population ecology (that is, slow-growing mammals that give birth to single calves with several years between births), we assume that Southern resident killer whales will have elevated extinction probabilities because of exogenous threats caused by anthropogenic activities (primarily human disturbance, fisheries that compete with killer whales for prey, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) *as well as* endogenous threats resulting from the small size of their population.

Right Whale, North Atlantic

Distribution

Right whales exist as three separate species: North Atlantic right whales (*Eubalaena glacialis*) that are distributed seasonally from the Gulf of Mexico north to waters off Newfoundland and Labrador (on the western Atlantic) and from northern Africa and Spain north to waters north of Scotland and Ireland (the Shetland and Orkney Islands; on the eastern Atlantic coast); North Pacific right whales (*E. japonica*) that historically ranged seasonally from the coast of Baja California north to the northern Bering Sea (on the eastern Pacific) and the south China Sea north to the Sea of Okhotsk and the Kamchatka Peninsula (on the western Pacific); and Southern right whales (*E. australis*) which historically ranged across the Southern Ocean, including waters off southern Australia, New Zealand, Chile, Argentina, and southern Africa (north to Madagascar).

In the western Atlantic Ocean, right whales generally occur in northwest Atlantic waters west of the Gulf Stream and are most commonly associated with cooler waters (21°C). North Atlantic right whales are most abundant in Cape Cod Bay between February and April (Hamilton and Mayo 1990 Schevill *et al*. 1986, Watkins and Schevill 1982), in the Great South Channel in May and June (Kenney *et al.* 1986, Payne *et al*. 1990), and off Georgia and Florida from mid-November through March (Slay *et al*. 1996). Right whales also frequent the Bay of Fundy, Browns and Baccaro Banks (in Canadian waters), Stellwagen Bank and Jeffrey's Ledge in the spring and summer months, and use mid-Atlantic waters as a migratory pathway between the winter calving grounds and their spring and summer nursery/feeding areas in the Gulf of Maine. The distribution of most members of this population during the winter remains unknown (NMFS 2004)

Population Structure

NMFS recognizes two extant groups of right whales in the North Atlantic Ocean (*E. glacialis*): an eastern population and a western population. A third population may have existed in the central Atlantic (migrating from east of Greenland to the Azores or Bermuda), but appears to be extinct, if it existed as a distinct population at all (Perry *et al*. 1999).

The degree to which the two extant populations of North Atlantic right whales are connected through immigration or emigration is unknown, but the two populations are treated as if they are isolated from one another.

Threats to the Species

NATURAL THREATS. Several researchers have suggested that the recovery of right whales in the northern hemisphere has been impeded by competition with other whales for food (Rice 1974, Scarff 1986). Mitchell (1975) analyzed trophic interactions among baleen whales in the western North Atlantic and noted that the foraging grounds of right whales overlapped with the foraging grounds of sei whales and both preferentially feed on copepods. Reeves *et al.* (1978) noted that several species of whales feed on copepods in the eastern North Pacific, so that the foraging pattern and success of right whales would be affected by other whales as well. Mitchell (1975) argued that the right whale population in the North Atlantic had been depleted by several centuries of whaling before steam-driven boats allowed whalers to hunt sei whales; from this, he hypothesized that the decline of the right whale population made more food available to sei whales and helped their population to grow. He then suggested that competition with the sei whale population impedes or prevents the recovery of the right whale population.

ANTHROPOGENIC THREATS. Several human activities are known to threaten North Atlantic right whales: whaling, commercial fishing, shipping, and water pollution. Historically, whaling represented the greatest threat to every population of fin whales and was ultimately responsible for listing fin whales as an endangered species. As its legacy, whaling reduced North Atlantic right whales to about 300 individuals in the western North Atlantic Ocean; the North Atlantic right whales population in the eastern North Atlantic Ocean is probably much smaller, although we cannot estimate the size of that population from the data available.

Of the current threats to North Atlantic right whales, entanglement in commercial fishing gear and ship strikes currently pose the greatest threat to the persistence of North Atlantic right whales. Along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada, there were 43 reports of right whales being entangled in fishing gear between 1999 and 2005 (n = 18; Cole *et al*. 2005, Nelson *et al*. 2007). Of the 39 reports that NMFS could confirm, right whales were injured in 5 of the entanglements and killed in 4 entanglements.

In the same region, there were 18 reports of right whales being struck by vessels between 1999 and 2005 (n = 18; Cole *et al*. 2005, Nelson *et al*. 2007). Of the 17 reports that NMFS could confirm, right whales were injured in two of the ship strikes and killed in nine.

Status

Right whales (both *E. glacialis* and *E. australi*s) were listed as endangered under the ESA in 1970. In April, 2008, NMFS divided right whales into three separate listings: Northern right whales (*E. glacialis*), North Pacific right whales (*E. japonica*), and Southern right whales (*E. australis*), all of which were listed as endangered. Since 1949, the northern right whale has been protected from commercial whaling by the International Whaling Commission. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA.

NMFS designated critical habitat for the North Atlantic population of right whales on 3 June 1994 (59 FR 28793).

In the Atlantic Ocean, Knowlton *et al*. (1994) concluded, based on data from 1987 through 1992, that the western North Atlantic right whale population was growing at a net annual rate of 2.5% (coefficient of variation = 0.12). This rate was also used in NMFS' marine mammal Stock Assessment Reports (e.g., Blaylock *et al*. 1995; Waring *et al.*, 1997). Since then, the data used in Knowlton *et al.* (1994) have been re-evaluated, and new attempts to model the trends of the western North Atlantic right whale population have been published (e.g., Kraus 1997, Caswell *et al*. 1999).

Caswell *et al.* (1999), using data on reproduction and survival through 1996, determined that the western North Atlantic right whale population was declining at a rate of 2.4% per year. One model they used suggested that the mortality rate of the right whale population has increased five-fold in less than one generation. According to Caswell *et al.* (1999), if the mortality rate as of 1996 does not decrease and the population performance does not improve, extinction could occur within 100 years and would be certain within 400 years, with a mean time to extinction of 191 years (also see NMFS 2005, 2006).

Although the rate at which the population of North Atlantic right whales is growing or declining remains uncertain, since the early 1990s NMFS has reported the population size of northern right whales as fluctuating around 300 animals. A population of 300 individuals is sufficiently small for the population to experience demographic phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself. These phenomena would increase the extinction probability of northern right whales and amplify the potential consequences of human-related activities on this species. Based on their population size and population ecology (that is, slow-growing mammals that give birth to single calves with several years between births), we assume that right whales will have elevated extinction probabilities because of exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) *as well as* endogenous threats resulting from the small size of their population.

In general, an individual's contribution to the growth (or decline) of the population it represents depends, in part, on the number of individuals in the population: the smaller the population, the more the performance of a single individual is likely to affect the population's growth or decline (Coulson *et al*. 2006). Given the small size of the northern right whale population, the performance (= "fitness" measured as the longevity of individuals and their reproductive success over their lifespan) of individual whales would be expected to have appreciable consequences for the growth or decline of the northern right whale population. Evidence of the small population dynamics of North Atlantic right whales appears in demographic models that suggest that the death or survival of one or two individual animals is sufficient to determine whether North Atlantic right whales are likely to accelerate or abate the rate at which their population continues to decline (Fujiwara and Caswell 2001). As populations and species become perilously close to extinction, the death, survival, or reproductive success of one or two individuals can be sufficient to make the difference between persistence and extinction.

Right Whale, North Pacific

Distribution

Very little is known about the distribution of North Pacific right whales because so few of these animals have been seen in the past 20 years. Whaling records from the 1800s and early 1900s report that right whales occurred across the North Pacific north of 35°N latitude (Maury 1852, Townsend 1935, Scarff 1986) These whales summered in the North Pacific Ocean and southern Bering Sea from April or May to September, with peak sightings in coastal waters of Alaska in June and July (Maury 1852, Townsend 1935, Omura 1958, Klumov 1962, Omura *et al.* 1969). Their summer range extended north of the Bering Strait (Omura *et al.* 1969). However, they were particularly abundant in the Gulf of Alaska from 145° to 151°W (Berzin and Rovnin 1966), and apparently concentrated in the Gulf of Alaska, especially south of Kodiak Islands and in the Eastern Aleutian Islands and southern Bering Sea shelf waters (Braham and Rice 1984).

The winter distribution patterns of right whales in the Pacific are virtually unknown, although some right whales have been sighted as far south as 27°N in the eastern North Pacific. They have also been sighted in Hawaii (Herman *et al.* 1980), California (Scarff 1986), Washington and British Columbia. Their migration patterns are unknown, but are believed to include north-south movements between summer and winter feeding areas. The scarcity of right whales is the result of an 800-year history of whaling that continued into the 1960s (Klumov 1962)

Population Structure

As used here, the term "population" refers to groups of individual animals that are demographically isolated from other groups. That is, populations are groups of individuals that are driven more by dynamics that are internal to the group — birth and death processes — than by immigration or emigration, which reflects geographic redistributions of individuals between populations. The growth or decline of populations defined in this way are driven by four processes — birth, death, immigration, and emigration — and it is possible to assess the effects of human activities that affect the "fitness" (the longevity and reproductive success) of individuals in such populations. Alternatives to this definition of "population," including some usages of the term "stock," are refer to the places and times individual animals aggregate, but do not provide information on whether these animals have demographic relationships that are essential for risk assessments.

Klumov (1962) suggested that there two populations of right whales existed in the North Pacific: a western population that occur in the Sea of Okhotsk during the summer and the northwestern North Pacific Ocean during the remainder of the year and an eastern population the occurred in the Bering Sea (as far north as the Bering Strait), Gulf of Alaska, and British Columbia. Brownell *et al*. (2001) concluded that the evidence available supported this hypothesis. Omura (1986) recognized two sub-populations in the western population of North Pacific right whales, but the International Whaling Commission concluded that this was unlikely (IWC 2001), although the evidence available is not sufficient to accept or refute Omura's conclusion. There is no information on the current population structure of North Pacific right whales.

Threats to the Species

NATURAL THREATS. There is limited information on natural phenomena that kill or injure right whales in the North Pacific. Several investigators have suggested that the recovery of right whales in the northern hemisphere has been impeded by competition with other whales for food (Rice 1974, Scarff 1986). Mitchell (1975) analyzed trophic interactions among baleen whales in the western North Atlantic and noted that the foraging grounds of right whales overlapped with the foraging grounds of sei whales and both preferentially feed on copepods. Reeves *et al.* (1978) noted that several species of whales feed on copepods in the eastern North Pacific, so that the foraging pattern and success of right whales would be affected by other whales as well. Mitchell (1975) argued that the right whale population in the North Atlantic had been depleted by several centuries of whaling before steam-driven boats allowed whalers to hunt sei whales; from this, he hypothesized that the decline of the right whale population made more food available to sei whales and helped their population to grow. He then suggested that competition with the sei whale population impedes or prevents the recovery of the right whale population.

ANTHROPOGENIC THREATS. Three human activities are known to threaten North Pacific right whales: whaling, commercial fishing, and shipping. Historically, whaling represented the greatest threat to North Pacific whales and was ultimately responsible for listing right whales as an endangered species. As its legacy, whaling reduced North Pacific right whales to less than 200 individuals.

Whalers began hunting North Pacific right whales in the early 1800s. From 1835 to the mid-1800s, commercial whaling occurred as early as March and continued until October (Maury 1852). Shelden *et al*. (2005) conducted further analyses of the data collected by Maury (1852) and Townsend (1935). Although the whaling season in the Bering Sea extended from May to October, they reported that about 32% of the right whale catches occurred in August and another 35% occurred in September.

Between 1839 and 1906, Townsend (1935, Chart C) recorded 2,118 North Pacific right whales that had been killed north of 40°N by whaling fleets. About 72% of these whales had been killed by 1851 and 97% had been killed by 1875 (Townsend 1935). By 1960, Brownell *et al*. (2001) concluded that North Pacific right whales had started to show signs of recovering from the consequences of whaling. Between 1963 and 1967, however, Soviet whaling vessels killed at least 508 North Pacific right whales, including 251 whales in the Gulf of Alaska and 121 in the southeastern Bering Sea. In 1967, despite the ban on hunting right whales, Soviet whaling vessels killed 126 right whales on the eastern side of Sakhalin Island in the Sea of Okhotsk (Latishev 2007). These additional harvests reversed the recovery of these whales and caused their population to collapse again.

In the North Pacific, Scarff (1986) concluded that entanglement in fishing gear, noise, or continued hunting by countries who are not members of the IWC were not serious threats to right whales. However, Scarff (1986) argued that right whales in the North Pacific are particularly vulnerable to ship strikes and marine pollution because of their habit of feeding at, or near, the water surface.

Undersea exploration and development of mineral deposits, and the dredging of major shipping channels are continuing threats to the coastal habitat of the right whale in both the North Atlantic and North Pacific. Offshore oil and gas activities have been proposed off the coast of the mid- and south- Atlantic U.S. and are currently being conducted in the Bering Sea and in eastern North Pacific.

In Russian waters, two fishery-related mortalities have been reported and offshore oil and gas development could potentially affect northern right whale habitat (Perry *et al.* 1999). Newly revealed Russian catch records show that approximately 3,212 southern right whales were harvested during the seasons 1948-1949 through 1979-1980:

Status

Right whales (both *E. glacialis* and *E. australis*) were listed as endangered under the ESA in 1970. In April, 2008, NMFS divided right whales into three separate listings: Northern right whales (*E. glacialis*), North Pacific right whales (*E. japonica*), and Southern right whales (*E.*

australis), all of which were listed as endangered. Since 1949, the northern right whale has been protected from commercial whaling by the International Whaling Commission. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA.

NMFS designated critical habitat for the North Pacific population of right whales in 2006 (71 FR 3827) and again in 2008 (73 FR 19000).

Before whaling began in the North Pacific Ocean, right whales were considered common or abundant in the North Pacific (Webb 1988). By 1900, observations of right whales in the North Pacific had become so rare it was impossible to know their population status or trend. In the Atlantic Ocean, the major known sources of anthropogenic mortality and injury of right whales include entanglement in commercial fishing gear and ship strikes.

Few North Pacific right whales have been seen in the past 20 years. In 1996, a group of 3 to 4 right whales (which may have included a calf) were observed in the middle shelf of the Bering Sea, west of Bristol Bay and east of the Pribilof Islands (Goddard and Rugh 1998). In June 1998, a lone whale was observed on historic whaling grounds near Albatross Bank off Kodiak Island, Alaska (Waite and Hobbs 1999). Surveys conducted in July of 1997 - 2000 in Bristol Bay reported observations of lone animals or small groups of right whales in the same area as the 1996 sighting (Hill and DeMaster 1998, Perryman *et al.* 1999).

Current estimates of the size of the right whale population in the Pacific Ocean range from a low of 100-200 (Braham and Rice 1984) to a high of 220-500 (Berzin and Yablokov 1978 [in Berzin and Vladimirov 1981]). Although Hill and DeMaster (1998) argue that it is not possible to reliably estimate the population size or trends of right whales in the North Pacific, Reeves *et al.* (2003) concluded that North Pacific right whales in the eastern Pacific Ocean exist as a small population of individuals while the western population of right whales probably consists of several hundred animals. The current population size of right whales in the North Pacific appears to be substantially fewer than 1,000 animals, although we cannot determine whether or to what degree the actual population size is smaller than 1,000 animals.

If the population is smaller than 100 – 500 individuals, it is sufficiently small for the population to experience demographic phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself. These phenomena would increase the extinction probability of North Pacific right whales and amplify the potential consequences of human-related activities on this species. Based on their population size and population ecology (that is, slow-growing mammals that give birth to single calves with several years between births), we assume that North Pacific right whales will have elevated extinction probabilities because of exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) *as well as* endogenous threats resulting from the small size of their population.

Sei Whale

Distribution

Sei whales occur in every ocean except the Arctic Ocean. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry *et al.* 1999). Sei whales are often associated with deeper waters and areas along the continental shelf edge (Hain *et al*. 1985); however, this general offshore pattern of sei whale distribution is disrupted during occasional incursions into more shallow and inshore waters (Waring *et al.* 2004).

In the western Atlantic Ocean, sei whales occur from Labrador, Nova Scotia,and Labrador in the summer months and migrate south to Florida, the Gulf of Mexico, and the northern Caribbean (Gambell 1985, Mead 1977). In the eastern Atlantic Ocean, sei whales occur in the Norwegian Sea (as far north as Finnmark in northeastern Norway), occasionally occurring as far north as Spitsbergen Island, and migrate south to Spain, Portugal, and northwest Africa (Jonsgård and Darling 1974, Gambell 1985).

In the north Pacific Ocean, sei whales occur from the Bering Sea south to California (on the east) and the coasts of Japan and Korea (on the west). During the winter, sei whales are found from 20°-23°N (Masaki 1977; Gambell 1985). Horwood (1987) reported that 75 - 85% of the North Pacific population of sei whales resides east of 180° longitude.

Sei whales occur throughout the Southern Ocean during the summer months, although they do not migrate as far south to feed as blue or fin whales. During the austral winter, sei whales occur off Brazil and the western and eastern coasts of Southern Africa and Australia.

Population Structure

The population structure of sei whales is largely unknown because there are so few data on this species. The International Whaling Commission's Scientific Committee groups all of the sei whales in the entire North Pacific Ocean into one population (Donovan 1991). However, some mark-recapture, catch distribution, and morphological research suggest more than one "stock" of sei whales may exist in the Pacific: one between 175°W and 155°W longitude, and another east of 155°W longitude (Masaki 1977); however, the amount of movement between these "stocks" suggests that they probably do not represent demographically-isolated populations as we use this concept in this Opinion.

Mitchell and Chapman (1977) divided sei whales in the western North Atlantic in two populations, one that occupies the Nova Scotian Shelf and a second that occupies the Labrador Sea. Sei whales are most common on Georges Bank and into the Gulf of Maine and the Bay of Fundy during spring and summer, primarily in deeper waters. There are occasional influxes of sei whales further into Gulf of Maine waters, presumably in conjunction with years of high copepod abundance inshore. Sei whales are occasionally seen feeding in association with right whales in the southern Gulf of Maine and in the Bay of Fundy.

Threats to the Species

NATURAL THREATS. Sei whales appear to compete with blue, fin, and right whales for prey and that competition may limit the total abundance of each of the species (Rice 1974, Scarff 1986). As discussed previously in the narratives for fin and right whales, the foraging areas of right and sei whales in the western north Atlantic Ocean overlap and both whales feed preferentially on copepods (Mitchell 1975). In the Southern Ocean, the sei whale population was reported to have increased in size after whalers had reduced the number of blue and fin whales in the region (IWC 1974); as these populations increase, the intensity of competition between these species should increase as well and the larger whales are most likely to prevail in that competition.

ANTHROPOGENIC THREATS. Two human activities are known to threaten sei whales: whaling and shipping. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. From 1910 to 1975, approximately 74,215 sei whales were caught in the entire North Pacific Ocean (Horwood 1987, Perry *et al.* 1999). From the early 1900s, Japanese whaling operations consisted of a large proportion of sei whales: 300 - 600 sei whales were killed per year from 1911 to 1955. The sei whale catch peaked in 1959, when 1,340 sei whales were killed. In 1971, after a decade of high sei whale catch numbers, sei whales were scarce in Japanese waters.

In the North Atlantic Ocean, sei whales were hunted from land stations in Norway and Iceland in the early- to mid-1880s, when blue whales started to become more scarce. In the late 1890s, whalers began hunting sei whales in Davis Strait and off the coasts of Newfoundland. In the early 1900s, whalers from land stations on the Outer Hebrides and Shetland Islands started to hunt sei whales. Between 1966 and 1972, whalers from land stations on the east coast of Nova Scotia engaged in extensive hunts of sei whales on the Nova Scotia shelf, killing about 825 sei whales (Mitchell and Chapman 1977).

Sei whales are occasionally killed in collisions with vessels. Of 3 sei whales that stranded along the Atlantic Coast of the U.S. between 1975 and 1996, 2 showed evidence of collisions with ships (Laist *et al*. 2001). Between 1999 and 2005, there were 3 reports of sei whales being struck by vessels along the Atlantic Coast of the U.S. and the Maritime Provinces of Canada (Cole *et al*. 2005, Nelson *et al*. 2007). Two of these ship strikes were reported as having resulted in the death of the sei whale.

Status

Sei whales were listed as endangered under the ESA in 1973. In the North Pacific, the International Whaling Commission began management of commercial taking of sei whales in 1970, and fin whales were given full protection in 1976 (Allen 1980). Sei whales are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the Marine Mammal Protection Act. They are listed as endangered under the IUCN Red List of Threatened Animals (Baillie and Groombridge 1996). Critical habitat has not been designated for sei whales.

Prior to commercial whaling, sei whales in the north Pacific are estimated to have numbered 42,000 individuals (Tillman 1977), although Ohsumi and Fukuda (1975) estimated that sei whales in the north Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000 or 38,000 whales by 1967, and reduced again to 20,600 to 23,700 whales by 1973. Japanese and Soviet catches of sei whales in the North Pacific and Bering Sea increased from 260 whales in 1962 to over 4,500 in 1968 and 1969, after which the sei whale population declined rapidly (Mizroch *et al.* 1984). When commercial whaling for sei whales ended in 1974, the population of sei whales in the North Pacific had been reduced to between 7,260 and 12,620 animals (Tillman 1977). In the same year, the north Atlantic population of sei whales was estimated to number about 2,078 individuals, including 965 whales in the Labrador Sea group and 870 whales in the Nova Scotia group (IWC 1977, Mitchell and Chapman 1977).

About 50 sei whales are estimated to occur in the North Pacific "stock" with another 77 sei whales in the Hawaiian "stock" (Lowry *et al*. 2007). The abundance of sei whales in the Atlantic Ocean remains unknown (Lowry *et al*. 2007). In California waters, only one confirmed and five possible sei whale sightings were recorded during 1991, 1992, and 1993 aerial and ship surveys (Carretta and Forney 1993, Mangels and Gerrodette 1994). No sightings were confirmed off Washington and Oregon during recent aerial surveys. Several researchers have suggested that the recovery of right whales in the northern hemisphere has been slowed by other whales that compete with right whales for food. Mitchell (1975) analyzed trophic interactions among baleen whales in the western north Atlantic and noted that the foraging grounds of right whales overlapped with the foraging grounds of sei whales and both preferentially feed on copepods.

Like blue whales, the information available on the status and trend of sei whales do not allow us to reach any conclusions about the extinction risks facing sei whales as a species, or particular populations of sei whales. With the limited data available on sei whales, we do not know whether these whales exist at population sizes large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as "small" populations (that is, "small" populations experience phenomena such as demographic stochasticity, inbreeding depression, Allee effects, among others, that cause their population size to become a threat in and of itself) or if sei whales might are threatened more by exogenous threats such as anthropogenic activities (primarily whaling, entanglement, and ship strikes) or natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate). However, sei whales have historically exhibited sudden increases in abundance in particular areas followed by sudden decreases in number. Several authors have reported "invasion years" in which large numbers of sei whales appeared off areas like Norway and Scotland, followed the next year by sudden decreases in population numbers (Jonsgård and Darling 1974).

With the evidence available, we do not know if this year-to-year variation still occurs in sei whales. However, if sei whales exist as a fraction of their historic population sizes, large amounts of variation in their abundance would increase the extinction probabilities of individual populations (Fagan and Holmes 2006, Fagan *et al*. 1999, 2001).

Sperm Whale

Distribution

Sperm whales occur in every ocean except the Arctic Ocean. Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea as far north as Cape Navarin. Mature, female, and immature sperm whales of both sexes are found in more temperate and tropical waters from the equator to around 45˚ N throughout the year. These groups of adult females and immature sperm whales are rarely found at latitudes higher than 50˚ N and 50˚ S (Reeves and Whitehead 1997). Sexually mature males join these groups throughout the winter. During the summer, mature male sperm whales are thought to move north into the Aleutian Islands, Gulf of Alaska, and the Bering Sea.

In the western Atlantic Ocean, sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight.

In the eastern Atlantic Ocean, mature male sperm whales have been recorded as far north as Spitsbergen (Oien, 1990). Recent observations of sperm whales and stranding events involving sperm whales from the eastern North Atlantic suggest that solitary and paired mature male sperm whales predominantly occur in waters off Iceland, the Faroe Islands, and the Norwegian Sea (Gunnlaugsson and Sigurjonsson 1990, Oien 1990, Christensen *et al*. 1992).

In the Mediterranean Sea sperm whales are found from the Alboran Sea to the Levant Basin, mostly over steep slope and deep offshore waters. Sperm whales are rarely sighted in the Sicilian Channel, and are vagrant in the northern Adriatic and Aegean Seas (Notarbartolo di Sciara and Demma 1997). In the Italian seas sperm whales are more frequently associated with the continental slope off western Liguria, western Sardinia, northern and eastern Sicily, and both coasts of Calabria.

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Sperm whales commonly concentrate around oceanic islands in areas of upwelling, and along the outer continental shelf and mid-ocean waters. Because they inhabit deeper pelagic waters, their distribution does not include the broad continental shelf of the Eastern Bering Sea and these whales generally remain offshore in the eastern Aleutian Islands, Gulf of Alaska, and the Bering Sea.

Several investigators have concluded that sperm whales have a strong preference for deeper water along or seaward of continental shelves. Berzin (1971) reported that they are restricted to waters deeper than 300 meters (984 feet), while Watkins (1977) and Reeves and Whitehead (1997) reported that sperm whales are not usually found in waters less than 1,000 meters (3,281 feet) deep. However, Watwood *et al*. (2006) evaluated 198 dives made by 37 individual sperm whales in three different geographic areas (Atlantic Ocean, Gulf of Mexico, and Ligurian Sea) and concluded that maximum dive depths varied among these areas (985 meter in the Atlantic Ocean, 644 meters in the Gulf of Mexico, and 827 in the Ligurian Sea), with the deepest dive (1,202 meters) recorded in the Atlantic Ocean. Nevertheless, sperm whales have been observed near Long Island, New York, in water between 41-55 meters (135-180 feet; Scott and Sadove 1997). When they are found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956).

Population Structure

The population structure of sperm whales is largely unknown. Lyrholm and Gyllenstein (1998) reported moderate, but statistically significant, differences in sperm whale mitochondrial (mtDNA) between ocean basins, although sperm whales throughout the world appear to be homogenous genetically (Whitehead 2003). Genetic studies also suggest that sperm whales of both genders commonly move across over ocean basins and that males, but not females, often breed in ocean basins that are different from the one in which they were born (Whitehead, 2003).

Sperm whales may not form "populations" as that term is normally conceived. Jaquet (1996) outlined a hierarchical social and spatial structure that includes temporary clusters of animals, family units of 10 or 12 females and their young, groups of about 20 animals that remain together for hours or days, "aggregations" and "super-aggregations" of 40 or more whales, and "concentrations" that include 1,000 or more animals (Peterson 1986, Whitehead and Wiegart 1990, Whitehead *et al*. 1991). The "family unit" forms the foundation for sperm whale society and most females probably spend their entire life in the same family unit (Whitehead 2002). The dynamic nature of these relationships and the large spatial areas they are believed to occupy might complicate or preclude attempts to apply traditional population concepts, which tend to rely on group fidelity to geographic distributions that are relatively static over time.

Atlantic Ocean

Based on harvests of tagged sperm whales or sperm whales with other distinctive marking, sperm whales in the North Atlantic Ocean appear to represent a single population, with the possible exception of the sperm whales that appear to reside in the Gulf of Mexico. Mitchell (1975) reported one sperm whale that was tagged on the Scotian Shelf and killed about 7 years later off Spain. Donovan (1991) reported five to six handheld harpoons from the Azore sperm whale fishery that were recovered from whales killed off northwest Spain, with another Azorean harpoon recovered from a male sperm whale killed off Iceland (Martin 1982). These patterns suggest that at least some sperm whales migrate across the North Atlantic Ocean.

Female and immature animals stay in Atlantic temperate or tropical waters year round. In the western North Atlantic, groups of female and immature sperm whales concentrate in the Caribbean Sea (Gosho *et al*. 1984) and south of New England in continental-slope and deep-ocean waters along the eastern United States (Blaylock *et al*., 1995). In eastern Atlantic waters, groups of female and immature sperm whales aggregate in waters off the Azores, Madeira, Canary, and Cape Verde Islands (Tomilin 1967).

Several investigators have suggested that the sperm whales that occupy the northern Gulf of Mexico are distinct from sperm whales elsewhere in the North Atlantic Ocean (Schmidly 1981, Fritts 1983, and Hansen *et al*. 1995), although the International Whaling Commission groups does not treat these sperm whales as a separate population or "stock."

In the Mediterranean Sea sperm whales are found from the Alboran Sea to the Levant Basin, mostly over steep slope and deep offshore waters. Sperm whales are rarely sighted in the Sicilian Channel, and are vagrant in the northern Adriatic and Aegean Seas (Notarbartolo di Sciara and Demma 1997). In the Italian seas sperm whales are more frequently associated with the continental slope off western Liguria, western Sardinia, northern and eastern Sicily, and both coasts of Calabria.

Bayed and Beaubrun (1987) suggested that the frequent observation of neonates in the Mediterranean Sea and the scarcity of sperm whale sightings from the Gibraltar area may be evidence of a resident population of sperm whales in the Mediterranean.

Indian Ocean
In the Northern Indian Ocean the International Whaling Commission recognized differences between sperm whales in the northern and southern Indian Ocean (Donovan 1991). Little is known about the Northern Indian Ocean population of sperm whales (Perry *et al.* 1999).

Pacific Ocean
Several authors have proposed population structures that recognize at least three sperm whales populations in the North Pacific for management purposes (Kasuya 1991, Bannister and Mitchell 1980). At the same time, the IWC's Scientific Committee designated two sperm whale stocks in the North Pacific: a western and eastern stock or population (Donovan 1991). The line separating these populations has been debated since their acceptance by the IWC's Scientific Committee. For stock assessment purposes, NMFS recognizes three discrete population centers of sperm whales in the Pacific: (1) Alaska, (2) California-Oregon-Washington, and (3) Hawai'i.
Sperm whales are widely distributed throughout the Hawai'ian Islands year-round (Rice 1960, Shallenberger 1981, Lee 1993, and Mobley *et al.* 2000). Sperm whale clicks recorded from hydrophones off Oahu confirm the presence of sperm whales near the Hawai'ian Islands throughout the year (Thompson and Friedl 1982). The primary area of occurrence for the sperm whale is seaward of the shelf break in the Hawai'ian Islands.

Sperm whales have been sighted in the Kauai Channel, the Alenuihaha Channel between Maui and the island of Hawaii, and off the island of Hawaii (Lee 1993, Mobley *et al.*1999, Forney *et al*. 2000). Additionally, the sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982). Twenty-one sperm whales were sighted during aerial surveys conducted in Hawaiian waters conducted from 1993 through 1998. Sperm whales sighted during the survey tended to be on the outer edge of a 50 - 70 km distance from the Hawaiian Islands, indicating that presence may increase with distance from shore. However, from the results of these surveys, NMFS has calculated a minimum abundance of sperm whales within 46 km of Hawaii to be 43 individuals (Forney *et al*. 2000).

Southern Ocean

Sperm whales south of the equator are generally treated as a single "population," although the International Whaling Commission divides these whales into nine different divisions that are based more on evaluations of whaling captures than the biology of sperm whales (Donovan 1991). Several authors, however, have argued that the sperm whales that occur off the Galapagos Islands, mainland Ecuador, and northern Peru are geographically distinct from other sperm whales in the Southern Hemisphere (Rice 1977, Wade and Gerrodette 1993, and Dufault and Whitehead 1995).

Threats to the Species

NATURAL THREATS. Sperm whales are hunted by killer whales (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), and short-finned pilot whales (*Globicephala melas*; Arnbom *et al*. 1987, Palacios and Mate 1996, Rice 1989, Weller *et al*. 1996, Whitehead 1995) and papilloma virus (Lambertson *et al*. 1987). Sperm whales have been observed with bleeding wounds their heads and tail flukes after attacks by these species (Arnbom *et al*. 1987, Dufault and Whitehead 1995). In October 1997, 25 killer whales were documented to have attacked a group of mature sperm whales off Point Conception, California (personal communication from K Roberts cited in Perry *et al*. 1999) and successfully killing one of these mature sperm whales.

Studies on sperm whales in the North Pacific and North Atlantic Oceans have demonstrated that sperm whales are infected by calciviruses and papillomavirus (Smith and Latham 1978, Lambertsen *et al*. 1987). In some instances, these diseases have been demonstrated to affect 10 percent of the sperm whales sampled (Lambertsen *et al*. 1987).

ANTHROPOGENIC THREATS. Three human activities are known to threaten sperm whales: whaling, entanglement in fishing gear, and shipping. Historically, whaling represented the greatest threat to every population of sperm whales and was ultimately responsible for listing sperm whales as an endangered species. Sperm whales were hunted all over the world during the 1800s, largely for its spermaceti oil and ambergris. Harvesting of sperm whales subsided by 1880 when petroleum replaced the need for sperm whale oil (Whitehead 2003).

The actual number of sperm whales killed by whalers remains unknown and some of the estimates of harvest numbers are contradictory. Between 1800 and 1900, the International Whaling Commission estimated that nearly 250,000 sperm whales were killed globally by whalers. From 1910 to 1982, another 700,000 sperm whales were killed globally by whalers (IWC Statistics 1959-1983). These estimates are substantially higher than a more recent estimate produced by Caretta *et al*. (2005), however, who estimated that at least 436,000 sperm whales were killed by whalers between 1800 and 1987. Hill and DeMaster (1999) concluded that about 258,000 sperm whales were harvested in the North Pacific between 1947 and 1987 by commercial whalers. They reported that catches in the North Pacific increased until 1968, when 16,357 sperm whales were harvested, then declined after 1968 because of harvest limits imposed by the IWC. Perry *et al*. (1999) estimated that, on average, more than 20,000 sperm whales were harvested in the Southern Hemisphere each year between 1956 and 1976.

These reports probably underestimate the actual number of sperm whales that were killed by whalers, particularly because they could not have incorporated realistic estimates of the number of sperm whales killed by Soviet whaling fleets, which often went unreported. Between 1947 and 1973, Soviet whaling fleets engaged in illegal whaling in the Indian, North Pacific, and southern Oceans. In the Southern Hemisphere, these whalers killed an estimated 100,000 whales that they did not report to the International Whaling Commission (Yablokov *et al*. 1998). Illegal catches in the Northern Hemisphere (primarily in the North Pacific) were smaller but still caused sperm whales to disappear from large areas of the North Pacific Ocean (Yablokov and Zemsky 2000).

In addition to large and illegal harvests of sperm whales, Soviet whalers had disproportionate effect on sperm whale populations because they commonly killed adult females in any reproductive condition (pregnant or lactating) as well as immature sperm whales of either gender.

When the International Whaling Commission introduced the International Observer Scheme in 1972, the IWC relaxed regulations that limited the minimum length of sperm whales that could be caught from 11.6 meters to 9.2 meters out of a concern that too many male sperm whales were being caught so reducing this size limit would encourage fleets to catch more females. Unfortunately, the IWC's decision had been based on data from the Soviet fleets who commonly reported female sperm whales as males. As a result, the new regulations allowed the Soviet whalers to continue their harvests of female and immature sperm whales legally, with substantial consequences for sperm whale populations. Berzin noted in a report he wrote in 1977, "the result of this was that some breeding areas for sperm whales became deserts" (Berzin 2007).

Although the International Whaling Commission protected sperm whales from commercial harvest in 1981, Japanese whalers continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). More recently, the Japanese Whaling Association began hunting sperm whales for research. In 2000, the Japanese Whaling Association announced that it planned to kill 10 sperm whales in the Pacific Ocean for research, which was the first time sperm whales have been hunted since the international ban on commercial whaling. Despite protests from the U.S. government and members of the IWC, the Japanese government harvested 5 sperm whales and 43 Bryde's whales in the last six months of 2000. According to the Japanese Institute of Cetacean Research (Institute of Cetacean Research undated), another 5 sperm whales were killed for research in 2002 – 2003. The consequences of these deaths on the status and trend of sperm whales remains uncertain, given that they probably have not recovered from the legacy of whaling; however, the renewal of a program that intentionally targets and kills sperm whales before we can be certain they recovered from a history of over-harvest places this species at risk in the foreseeable future.

Sperm whales are still hunted for subsistence purposes by whalers from Lamalera, Indonesia, which is on the south coast of the island of Lembata and from Lamakera on the islands of Solor. These whalers hunt in a traditional manner: with bamboo spears and using small wooden outriggers, 10–12 m long and 2 m wide, constructed without nails and with sails woven from palm fronds. The animals are killed by the harpooner leaping onto the back of the animal from the boat to drive in the harpoon. The maximum number of sperm whales killed by these hunters in any given year was 56 sperm whales killed in 1969.

In U.S. waters in the Pacific Ocean, sperm whales are known to have been incidentally captured only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991 - 1995 (Barlow *et al.* 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longline gear in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

Sperm whales are also killed by ship strikes. In May 1994 a sperm whale that had been struck by a ship was observed south of Nova Scotia (Reeves and Whitehead 1997) and in May 2000 a merchant ship reported a strike in Block Canyon (NMFS, unpublished data), which is a major pathway for sperm whales entering southern New England continental shelf waters in pursuit of migrating squid (CeTAP 1982, Scott and Sadove 1997).

Status

Sperm whales were listed as endangered under the ESA in 1973. Sperm whales have been protected from commercial harvest by the International Whaling Commission since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). They are also protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna and the MMPA. Critical habitat has not been designated for sperm whales.

The status and trend of sperm whales at the time of this summary is largely unknown. Hill and DeMaster (1999) and Angliss and Lodge (2004) reported that estimates for population abundance, status, and trends for sperm whales off the coast of Alaska were not available when they prepared the Stock Assessment Report for marine mammals off Alaska. Similarly, No information was available to support estimates of sperm whales status and trends in the western North Atlantic Ocean (Waring *et al.* 2004), the Indian Ocean (Perry *et al.* 1999), or the Mediterranean Sea.

Nevertheless, several authors and organizations have published "best estimates" of the global abundance of sperm whales or their abundance in different geographic areas. Based on historic whaling data,190,000 sperm whales were estimated to have been in the entire North Atlantic, but the IWC considers data that produced this estimate unreliable (Perry *et al.* 1999). Whitehead (2002) estimated that prior to whaling sperm whales numbered around 1,110,000 and that the current global abundance of sperm whales is around 360,000 (coefficient of variation = 0.36) whales. Whitehead's current population estimate (2002) is about 20% of past global abundance estimates which were based on historic whaling data.

Waring *et al*. (2007) concluded that the best estimate of the number of sperm whales along the Atlantic coast of the U.S. was 4,029 (coefficient of variation = 0.38) in 1998 and 4,804 (coefficient of variation = 0.38) in 2004, with a minimum estimate of 3,539 sperm whales in the western North Atlantic Ocean.

Barlow and Taylor (2005) derived two estimates of sperm whale abundance in a 7.8 million km^2 study area in the northeastern temperate Pacific: when they used acoustic detection methods they produced an estimate of 32,100 sperm whales (coefficient of variation = 0.36); when they used visual surveys, they produced an estimate of 26,300 sperm whales (coefficient of variation = 0.81). Caretta *et al*. (2005) concluded that the most precise estimate of sperm whale abundance off California, Oregon, and Washington was 1,233 (coefficient of variation = 0.41; based on ship surveys conducted in the summer and fall of 1996 and 2001). Their best estimate of the abundance of sperm whales in Hawai'i was 7,082 sperm whales (coefficient of variation = 0.30) based on ship-board surveys conducted in 2002.

Mark and recapture data from sperm whales led Whitehead and his co-workers to conclude that sperm whale numbers off the Galapagos Islands decreased by about 20% a year between 1985 and 1995 (Whitehead *et al*. 1997). In 1985 Whitehead *et al.* (1997) estimated there were about 4,000 female and immature sperm whales, whereas in 1995 they estimated that there were only a few hundred. They suggested that sperm whales migrated to waters off the Central and South American mainland to feed in productive waters of the Humboldt Current, which had been depopulated of sperm whales as a result of intensive whaling.

The information available on the status and trend of sperm whales do not allow us to make definitive statement about the extinction risks facing sperm whales as a species or particular populations of sperm whales. However, the evidence available suggests that sperm whale populations probably exhibit the dynamics of small populations, causing their population dynamics to become a threat in and of itself. The number of sperm whales killed by Soviet whaling fleets in the 1960s and 1970s would have substantial and adverse consequence for sperm whale populations and their ability to recover from the effects of whaling on their population. The number of adult female killed by Soviet whaling fleets, including pregnant and lactating females whose death would also have resulted in the death of their calves, would have had a devastating effect on sperm whale populations. In addition to decimating their population size, whaling would have skewed sex ratios in their populations, created gaps in the age structure of their populations, and would have had lasting and adverse effect on the ability of these populations to recover (for example, see Whitehead 2003).

Populations of sperm whales could not have recovered from the overharvests of adult females and immature whales in the 30 to 40 years that have passed since the end of whaling, but the information available does not allow us to determine whether and to what degree those populations might have stabilized or whether they have begun the process of recovering from the effects of whaling. Absent information to the contrary, we assume that sperm whales will have elevated extinction probabilities because of both exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) as well as endogenous threats caused by the legacy of overharvests of adult females and immature whales on their populations (that is, a population with a disproportion of adult males and older animals coupled with a small percentage of juvenile whales that recruit into the adult population).

Effects of the Proposed Action

The ESA does not define harassment nor has NMFS defined this term, pursuant to the ESA, through regulation. However, the Marine Mammal Protection Act of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish and Wildlife Service's regulatory definition of harass[3].

For this biological opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents. We are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences.

Potential Stressors

Table 2 identifies the activities the proposed permit would authorize representatives of the Health and Stranding Response Program to conduct on endangered and threatened marine mammals over the next five years. It is important to distinguish between the two major categories contained in that table: (1) Emergency Response Actions and (2) Prospective Health Assessment Research Activities.

The Emergency Response Actions of the Health and Stranding Response Program entail responses to health emergencies involving marine mammals that were caused by other natural or anthropogenic phenomena. We assume that the physical, chemical, or biotic stressors associated with these responses will be less severe than the stressors that caused the health emergency in the first place.

The Prospective Health Assessment Research Activities of the Health and Stranding Response Program entail studies and other investigations that may or may not be conducted on animals that are in distress. Because they may be conducted on animals that are not in distress, we assume that these investigations pose new or additional risks to endangered or threatened marine mammals.

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[3] An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.4)

Exposure Analysis

As discussed in the *Approach to the Assessment* section of this Opinion, the second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an Action's effects and the populations or subpopulations those individuals represent.

Exposure to Emergency Response Actions

During responses to health emergencies, the proposed permit authorizes the Health and Stranding Response Program to expose endangered or threatened marine mammals to close approaches, aerial and vessel surveys, disentanglements, capture, restraint, handling, tagging, sample collections that include biopsy samples, anesthesia, sedation, treatment, import/export of animals, transport, relocation, rehabilitation, and release on beaches and in coastal waters and waters of the Exclusive Economize Zone of the United States, its territories, and possessions, and international waters. The proposed permit would also authorize the Health and Stranding Response Program to euthanize an unlimited number of endangered and threatened marine mammals on beaches and in coastal waters and waters of the Exclusive Economize Zone of the United States, its territories, and possessions.

Although the number of endangered and threatened marine mammals that would be exposed to these activities will be determined by the number that are involved in health emergencies in any given year, the number of endangered and threatened marine mammals the Health and Stranding Response Program has interacted with between 2001 and 2007 provides some insight into the number of interactions that might occur in any given year or over the five-year period of the proposed permit (assuming that the data from existing reports are representative of the patterns that will occur over the next five-year period).

Table 4 identifies the number of different endangered species that the Health and Stranding Response Program interacted with between 2003 and 2007 during attempts to disentangle individual whales from fishing and other gear. Data are from the Provincetown Center for Coastal Studies and the Hawaiian Islands Humpback Whale National Marine Sanctuary (data are from NMFS 2007). Table 5 identifies the number of stranding events involving endangered or threatened species in the six NMFS regions between 2001 and 2005 (data are from NMFS 2007).

Between 2003 and 2007, two species — humpback whales and North Atlantic right whales — represented about 87 percent of the Health and Stranding Response Program's disentanglement efforts along the North Atlantic and in the Hawai'ian Islands (Table 4). Between 2001 and 2005, three species — humpback whales, Hawai'ian monk seals, and Steller sea lions —represented about 78 percent of the animals involved in stranding events (Table 4). Adding stranding events involving fin whales, Southern resident killer whales, North Atlantic right whales, and sperm whales accounts for about 97 percent of the stranding events that the Health and Stranding Response Program responded to between 2001 and 2005.

Table 4. The number of different endangered species that the Health and Stranding Response Program interacted with between 2003 and 2007 during attempts to disentangle individual whales from fishing and other gear. Data are from the Provincetown Center for Coastal Studies and the Hawaiian Islands Humpback Whale National Marine Sanctuary (as reported in NMFS 2007)

Species	2003	2004	2005*	2006	2007	Totals
Fin whale	1	3	0	1	0	**5**
Humpback whale	16	6	13	16	7	**58**
Right whale, North Atlantic	5	2	2	0	2	**11**
Sei whale (possible)	0	0	0	1	0	**1**
Unknown mysticete	1	2	1	0	0	**4**
Totals	**23**	**13**	**16**	**18**	**9**	**79**

* Estimates of the number of humpback whales disentangled in 2005, 2006, and 2007 include data from the Humpback Whale National Marine Sanctuary in Hawai'i

On average, 132 endangered or threatened marine mammals stranded each year between 2001 and 2005, with 70 of those 132 animals (about 53 percent) representing cetaceans (primarily humpback whales, fin whales, sperm whales, and Southern resident killer whales) and 62 of the 132 animals (about 47 percent) representing pinnipeds (primarily Hawai'ian monk seals and Steller sea lions). We assume that these whales consisted of any age, gender, reproductive condition, or health condition.

Based on the data available, Hawai'ian monk seals, Steller sea lions, fin whales, humpback whales, Southern resident killer whales, North Atlantic right whales, and sperm whales appear most likely to be exposed to Emergency Response Actions of the Health and Stranding Response Program over the five-year interval of the proposed permit. The Health and Stranding Response Program is not likely to interact with blue whales or North Pacific right whales over the five-year period of the proposed permit, although such interactions are possible if a health emergency involving one or more of these species occurs.

Exposure to Prospective Health Assessment Research Activities

The prospective health assessment research activities of the Health and Stranding Response Program are conducted on stranded animals and free-ranging animals that occur in areas with known health concerns or in areas of previous health concerns. Marine mammals that are captured for these health assessments may have visible health problems (for example, skin lesions), they may have been exposed to known toxins, or they may have been exposed to other physical, chemical, or biotic stressors that are known to produce adverse health outcomes in marine mammals.

The proposed permit would authorize representatives of the Health and Stranding Response Program to capture, restrain, handle, tag, take samples (including biopsy samples), and release up to 300 pinnipeds each year for the next five years, although these activities would not be authorized for endangered or threatened pinnipeds. The proposed permit would allow three of these pinnipeds to die as a result of their capture and restraint. Each year for the next five years, the proposed permit would also authorize representatives of the Health and Stranding Response Program to collect samples from up to 400 pinnipeds that have been captured during other lawful activities, such as subsistence harvests and incidental capture in fisheries.

Table 5. The number of stranding events involving endangered or threatened species in the six NMFS regions between 2001 and 2005. Data from NMFS' Southwest Region for 2001 were not available. Data are from NMFS 2007.

Species		2001		2002		2003		2004		2005		Total		Mean
		n	%	n	%	n	%	n	%	n	%	n	%	n
1	Blue whale	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0
2	Bowhead whale	0	0.0000	0	0.0000	1	0.0072	1	0.0085	1	0.0057	3	0.0046	1
3	Fin whale	9	0.0849	7	0.0565	8	0.0580	6	0.0513	5	0.0287	35	0.0531	7
4	Gray whale, Western Pacific	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0
5	Humpback whale	17	0.1604	47	0.3790	50	0.3623	34	0.2906	64	0.3678	212	0.3217	42
6	Killer whale, Southern resident	29	0.2736	3	0.0242	0	0.0000	1	0.0085	0	0.0000	33	0.0501	7
7	Right whale, North Atlantic	4	0.0377	5	0.0403	0	0.0000	5	0.0427	5	0.0287	19	0.0288	4
8	Right whale, North Pacific	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0
9	Right whale, Southern	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0
10	Sei whale	3	0.0283	2	0.0161	2	0.0145	2	0.0171	0	0.0000	9	0.0137	2
11	Sperm whale	7	0.0660	10	0.0806	10	0.0725	7	0.0598	5	0.0287	39	0.0592	8
Cetacean sub-total		**69**		**74**		**71**		**56**		**80**		**350**		**70**
12	Guadalupe fur seal	1	0.0094	0	0.0000	0	0.0000	4	0.0342	2	0.0115	7	0.0106	1
13	Hawaiian monk seal	23	0.2170	28	0.2258	27	0.1957	24	0.2051	40	0.2299	142	0.2155	28
14	Mediterranean monk seal	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0
15	Steller sea lion	13	0.1226	22	0.1774	40	0.2899	33	0.2821	52	0.2989	160	0.2428	32
Pinniped sub-total		**37**		**50**		**67**		**61**		**94**		**309**		**62**
Totals		**106**		**124**		**138**		**117**		**174**		**659**		**132**

The proposed permit would authorize representatives of the Health and Stranding Response Program to behaviorally harass up to 5,000 large whales each year during close approaches, aerial and vessel surveys. Each year for the next five years, the proposed permit would also authorize representatives of the Health and Stranding Response Program to tag and collect samples (including biopsy samples and respiratory gases) up to 100 large whales per year and collect samples from up to 400 large whales that have been captured during other lawful activities.

Although the Health and Stranding Response Program and the proposed permit have not identified particular endangered or threatened species that might be exposed to one or more of the procedures associated with prospective health assessments, based on the data available, Hawai'ian monk seals, Steller sea lions, fin whales, humpback whales, Southern resident killer whales, North Atlantic right whales, and sperm whales seem most likely to be exposed to those investigations over the five-year interval of the proposed permit. The Health and Stranding Response Program does not seem likely to conduct investigations on blue whales, bowhead whales, or North Pacific right whales over the five-year period of the proposed permit, although such investigations are possible.

Response Analysis

As discussed in the *Approach to the Assessment* section of this Opinion, once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure. These analyses represent our *response analyses* represent our integration and synthesis of the best scientific and commercial data available in the form of papers published in peer-reviewed journals, studies and reviews that exist as "gray" literature that is usually distributed by government agencies or non-governmental organizations, and books. For the purposes of consultation, our assessments try to detect potential lethal, physiological (sub-lethal), or behavioral responses that might result in reducing the fitness of listed individuals.

Our response analyses continue to distinguish between the probable responses of endangered and threatened marine mammals to the Emergency Response Actions of the Health and Stranding Response Program and the Prospective Health Assessment Research activities that are undertaken by the Program.

Responses to Emergency Response Activities

The Emergency Response Actions of the Health and Stranding Response Program entail responses to health emergencies involving marine mammals that were caused by other natural or anthropogenic phenomena. In this case, the Health and Stranding Response Program responds to health emergencies involving endangered or threatened marine mammals that have stranded[3], have become entangled in fishing and other gear, or otherwise appear to be in distress. During health emergencies, we assume that the endangered and threatened marine mammals will

3 For these analyses, we define a "stranded marine mammal" as "any dead marine mammal on a beach or floating nearshore; any live cetacean on a beach or in water so shallow that it is unable to free itself and resume normal activity; any live pinniped which is unable or unwilling to leave the shore because of injury or poor health" (Gulland *et al*. 2001, Wilkinson 1991)

primarily respond to the stressor or stressors that created the health emergency in the first place rather than respond to efforts of representative of the Health and Stranding Response Program to eliminate or mitigate the causes of the health emergency. That is, we assume that the response of endangered and threatened marine mammals to stressors associated with responses to health emergencies will be less significant than their responses to the stressor or stressors that created the health emergency in the first place.

Responses to Prospective Health Assessment Research Activities

The Prospective Health Assessment Research Activities of the Health and Stranding Response Program are conducted on stranded animals and free-ranging animals that occur in areas with known health concerns or in areas of previous health concerns. Marine mammals that are captured for these health assessments may have visible health problems (for example, skin lesions) or they may have been exposed to known toxins.

Aerial Surveys

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program uses aerial surveys to (1) locate imperiled marine mammals; (2) monitor behavior or disease in a given population or individual; and (3) survey the extent of disease outbreaks or die-offs. The type of aircraft used to respond to health emergencies depends upon the aircraft available at the time of the response and the logistics of the response. The frequency of surveys depends on the circumstances of stranded or entangled animals, the disease, or the occurrence of a unusual mortality event.

Aerial surveys are flown along predetermined transect lines at a set altitude and air speed while observers scan the water for signs of marine mammals. When participants in aerial surveys sight a marine animal or group of marine mammals, the survey aircraft descends and circles over the animal or animals while photographs are taken. The time and altitude of the aircraft depends on the aircraft and the response or research situation.

When survey aircraft fly below certain altitudes (about 1,500 feet), they have caused marine mammals to exhibit behavioral responses that might constitute a significant disruption of their normal behavior patterns. Based on reports from surveys of similar activities associated with Pacific Ocean populations of whales, about 6 percent of the individual whales showed behavior indicative of disturbance (e.g., diving or changing their behavior) coincident with the approach of aircraft. About 7 percent of the humpback whales approached during aerial surveys changed their behavior coincident with the approach of aircraft. However, the approach of these whales by the aircraft did not appear to have resulted in long-term changes in the whales' behavior that would suggest long-term adverse effects on individuals, pods, or population.

The proposed permit includes conditions that restrict these types of close, aerial approaches and should eliminate or minimize these behavioral responses.

Vessel Surveys

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program may conduct vessel surveys to: collect data on animal abundance, to assess animals;

locate animals for research activities; and collect research samples. The program also uses vessel surveys to monitor animals subsequent to their release, to assess their health, for photo-identification, and tracking. The program also uses vessels as a platform for conducting animal sampling.

For small cetaceans, inshore monitoring surveys are conducted using small (5-7 m) outboard motor powered boats. Animals are located by having crew members visually search waters as the boat proceeds along a specified route at slow speeds (8-16 km/hr). Animals outfitted with Very High Frequency (VHF) radio tags are located by listening for the appropriate frequency and, after detecting a signal, maneuvering the boat towards the animal using a combination of signal strength and directional bearings. Frequencies and remote sensors may also be monitored. Once a group of animals is located, the boat approaches the group so that crew members can assess their physical and medical condition. Photographs of the dorsal fins of individual animals are taken for later identification and matching to existing dorsal fin catalogs. When an animal is located that has been recently caught for a health evaluation, an attempt is made to photograph the dorsal fin and body to confirm identification, health, position, and behavior. A photograph of the dorsal fin would also be used to assess would healing from tag attachment. The area behind and below the posterior aspect of the dorsal fin may also be photographed to assess biopsy wound healing. A telephoto lens would be used for photographs, so vessels would not need to be too close to animals.

Multiple approaches may be required to obtain appropriate quality photographs, particularly if there are multiple individuals within a group. A close approach will be terminated and the boat will move away from a group of marine mammals if members of the group begin to display behavior that suggests they are experiencing undue stress (e.g., significant avoidance behavior such as "chuffing" or forced exhalation, tail slapping, or erratic surfacing).

Capture, Handling, and Restraint

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program may need to capture marine mammals to collect samples, perform an examination, or attach tags or scientific instruments. Capture methods include, but are not limited to, nets, traps, conditioning, anesthesia, and immobilization. Net types used to capture pinnipeds on land may include, but are not limited to, circle, hoop, dip, stretcher, and throw nets. Net guns and pole nooses may be used for capture.

Investigators typically capture seals that are resting onshore by stalking them and placing them in individual hoop nets. As an alternative, investigators might inject use an immobilizing agent, administered remotely by a dart, to subdue older animals. Young pups may be caught, picked up, and handled by researchers during their investigations.

Herding boards may be used to maneuver animals into cages. For water captures of pinnipeds, dip nets, large nets, modified gill nets, floating or water nets, and platform traps may be used. Purse seine nets may be used offshore of haul-out sites to capture pinnipeds when they stampede into the water (Jeffries *et al.* 1993). Animals become entangled in these nets when the nets are pulled ashore. Once removed from the net, adult or juvenile pinnipeds are usually placed head first into individual hoop nets. Older animals may be restrained using gas anesthesia (administered through an endotracheal tube), a fabric restraining wrap, a restraining net, or through sedation. Pups may be restrained by hand, in a hoop net, or with the inhalation of a gas anesthesia (administered through a mask over their nose).

For health assessment studies of small cetaceans, small schools of animals are approached for identification. If the school contains animals desired for capture, the school is followed until it is in waters that facilitate safe captures (waters outside of boating channels, equal to or less than 1.5 m deep, where currents are minimal).Typically no more than three animals are captured at one time. The animals are encircled with a 600 m long by 4 m deep seine net, deployed at high speed from an 8 m long commercial fishing motor boat. Small (5-7 m) outboard-powered vessels are used to help contain the animals until the net circle is complete. These boats make small, high-speed circles, creating acoustic barriers.

Once the net is completed, about 15-25 handlers are deployed around the outside of the corral to correct net overlays and aid any animals that may become entangled in the net. The remaining 10-20 or more team members prepare for sampling and data collection and begin the process of isolating the first individual. Isolation is accomplished by pinching the net corral into several smaller corrals.

Handlers are usually able to put their arms around the selected animal as it bobs in place or swims slowly around the restricted enclosure. However, a few animals may strike the net and become entangled. After animals are restrained by handlers, an initial evaluation is performed by a trained veterinarian. Once cleared by the veterinarian, the animal is transported to the processing boat via a navy mat and/or a sling. A sling is also used to place an animal back in the water for release.

In some cases, animals may need to be captured in deep waters. A break-away hoop-net is used to capture individuals as they ride at the bow of the boat. When they surface to breathe, the hoop is placed over their head and they move through the hoop, releasing the net. The additional drag of the net slows the animals substantially, but the design allows the animal to still use its flukes to reach the surface to breathe. The net is attached to a tether and large float, and the animal is retrieved, maneuvered into a sling and brought onboard the capture boat. All other procedures are the same for animals capture using either technique.

With both capture techniques, following restraint, animals are generally placed on foam pads on the deck of a boat, either solid hulled or inflatable, or another safe platform. The animal is shaded by a canvas top. The animal's respirations and behavior are monitored and recorded by one researcher. Another team member is responsible for ensuring that the animal's eyes are shaded from direct sunlight. Two to four personnel are positioned around the animal for restraint, as necessary, and to keep the animal wet and cool using buckets of water and sponges.

Some animals do not acclimate well to being on the platform; for these individuals the assessment is conducted in the water. Animals that appear to be pregnant (but not in the late 2nd or 3rd trimester) and young animals may also be worked up in the water when this is considered to be in the dolphin's best interest. In addition, for animals that have been caught in previous years a reduced sampling protocol may be employed, reducing the need for the animal to be removed from the water.

During responses to emergency situations, investigators may capture small cetaceans in shallow water using a net deployed from a boat with methods similar to those described previously. In rivers and canals, investigators may use their bodies to herd animals then catch them with their hands. In deep water, hoop net may be used to capture animals.

To disentangle large whales, whales may be either physically or chemically restrained. Physical restraint of the animal is accomplished by attaching control lines, floats, and buoys to the entangling gear with a grappling hook or by attaching new gear to the animal to hold it.

Responders use control lines to pull themselves up to the whale. Floats and buoys are used to slow the animal down by increasing drag. Response to entangled small cetaceans typically requires in-water capture of free-swimming animals. Entangled pinnipeds are typically captured on land when they are hauled out. These capture methods are described above.

Responses of Whales to Being Restrained. "Restraint procedures constitute one of the most stressful incidents in the life of an animal, and intense or prolonged stimulation can induce detrimental responses (Fowler 1978)." Each restraint incident has some effect on the behavior, life, or activities of an animal. A variety of somatic, psychological, and behavioral stressors can be associated with capture and restraint of wild animals. These include strange sounds, sights, and odors, the effects of chemicals or drugs, apprehension (which may intensify to become anxiety, fright, or terror), and territorial or hierarchical upsets associated with displacement of animals by researchers who come onto rookeries and haulouts. Animals that are stressed can incur contusions, concussions, lacerations, nerve injuries, hematomas, and fractures in their attempts to avoid capture or escape restraint (Fowler 1978). The stress response can change an animal's reaction to many drugs, including those commonly used for chemical restraint, which can have lethal consequences.

The annual reports from the current and previous permits held by NMML and ADF&G indicate that some animals showing distress and/or adverse reactions to drugs or handling that were not immediately released, subsequently died. Continuous stimulation of the adrenal cortex, as from stress associated with chronic disturbance or repeated capture, can cause muscle weakness, weight loss, increased susceptibility to bacterial infections, and poor wound healing, and can lead to behavioral changes including increased aggressive and antisocial tendencies (Fowler 1986). Capture myopathy is a possible consequence of the stress associated with chase, capture, and handling in numerous mammal species (Fowler 1978). Capture myopathy is characterized by degeneration and necrosis of striated and cardiac muscles and usually develops within 7 to 14 days after capture and handling. It has been observed both in animals that exert themselves maximally and those that remain relatively quiet, and occurs with either physical or chemical restraint. Fear, anxiety, overexertion, repeated handling, and constant muscle tensions such as may occur in protracted alarm reaction are among the factors that predispose an animal to this disease. A variety of factors may function in concert or individually. The muscle necrosis is likely due to acidemia resulting from a build up of lactic acid following profound muscle exertion: once necrosis has occurred, the prognosis for recovery is not favorable. The number of times an animal is captured, the method(s) of restraint, as well as the age and general condition of the animal are all factors that will affect an animal's response to capture.

Transport

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program has historically used vehicles, boats, or aircraft to transport marine mammals to rehabilitation facilities or release sites. Cetaceans may be transported on stretchers, foam pads, or air mattresses. For short-term transport, closed-cell foam pads are preferred because they are rigid and do not absorb water. Open cell foam is typically used for long-term transport of cetaceans because it can contour to the animal's form. Boxes may be constructed to transport the animal upright in a stretcher. Cetaceans must be protected from exhaust fumes, sun, heat, cold, and wind, as transport often occurs on the flatbed of a truck. Animals are kept moist and cool, to avoid overheating (Geraci and Lounsbury 2005).

Small pinnipeds are typically transported in plastic kennel cages. Cages are large enough for animals to turn around, stretch out, and raise their heads. Cages should prevent animal contact with waste and allow proper air circulation. As with cetaceans, pinnipeds traveling by vehicle must be protected from the sun, heat, cold, wind, and exhaust fumes. Pinnipeds may overheat during transit and wetting the animal helps to prevent hyperthermia (Geraci and Lounsbury 2005). Large pinnipeds may need to be sedated during transport.

Close Approach

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program proposes to continue to closely approach marine mammals by aircraft, surface vessel, and on foot for disentanglement, photo-identification, behavioral observation, hazing (during emergency response), capture, tagging, marking, biopsy sampling, skin scrapes, swabs, collection of sloughed skin and feces, breath sampling, blood sampling, administration of drugs, video recording, and incidental harassment. These close approaches have involved more than one vessel and will continue to do so.

In general, small boats, including inflatable-hulled boats, are often used to approach marine mammals for photo-identification and behavioral observation and as a prelude to further research (e.g., to obtain biopsy samples or to apply a tag). When photographs are taken from boats, the animals will be approached closely enough to maximize the quality of the photographic images (i.e., well-focused images, utilizing at least one half of the slide viewing area). Distance for optimal approach varies with the species being photographed. Generally, large whales are approached within approximately 15-20 m. Smaller animals are approached within about 5-10 m. Bow-riding animals are photographed opportunistically from the bow of the main research vessel and these animals approach the vessel on their own.

In the absence of definitive information on the long-term consequences of existing whale watching activities, scientific investigations, or the combination of the two on endangered whales, we considered lines of evidence that would suggest that these consequences are not adverse and those that would suggest these consequences are adverse. It is important to note at the outset that the existing evidence is equivocal and gives no particular insight into the long-term consequences of exposing whales to continuous human disturbance in areas that are critically important to their ecology.

The primary lines of evidence that might suggest that existing levels of whale watching and close approaches for field investigations would not be expected to have adverse consequence for individual whales or populations of those whales consist of the trend of the whale populations and a few published papers. Specifically, several investigators offer the increasing trend of the whale populations, particularly populations of humpback whales, to conclude that current levels of research have not had adverse consequence (for example, Bengston 2004). This evidence is not compelling for several reasons. First, the trends of these whale populations remains uncertain and changes in those trends may reflect improvements in sampling techniques or changes in their geographic distribution. Second, if we allow that whale populations are increasing in abundance, those populations might recover at a faster rate without the chronic effects of human disturbance. And. finally, the activities in question would have primarily sub-lethal consequences on individual whales (that is, they would affect their growth, health, or reproductive success) whose consequences on whale populations would be delayed in time and would be concealed by any imprecision in population estimates.

The second line of evidence consists of reports from investigators and in the literature that suggest that the response of whales to research were short-lived, which we interpret to mean that the responses would not be expected to affect the fitness of individual whales. Annual reports from the North Gulf Oceanic Society and two other investigators reported that most whales did not react to approaches by their vessels or only small numbers of whales reacted. For example, in their 1999 report on their research activities, NGOS noted that they observed signs that whales were "disturbed" in only 3 out of 51 encounters with whales and that the whales' behavioral responses consisted of breaching, slapping tail and pectoral fin, and diving away from research vessel.

Gauthier and Sears (1999), Weinrich *et al.* (1991, 1992), Clapham and Mattila (1993), Clapham *et al.* (1993) concluded that close approaches for biopsy samples or tagging did cause humpback whales to respond or caused them to exhibit "minimal" responses when approaches were "slow and careful." This caveat is important and is based on studies conducted by Clapham and Mattila (1993) of the reactions of humpback whales to biopsy sampling in breeding areas in the Caribbean Sea. These investigators concluded that the way a vessel approaches a group of whales had a major influence on the whale's response to the approach; particularly cow and calf pairs. Based on their experiments with different approach strategies, they concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting responses that might indicate stress.

Several lines of evidence suggest that the consequences of these human activities might be greater than we expect for individual whales, if not for whale populations. First, it is important to note that Clapham and Matilla (1993) noted that any human observations of a whale's behavioral response may not reflect a whale's actual experience, so our use of behavioral observations as indicators of a whale's response to research may or may not be correct. The whales in the action area may have habituated to being closely approached by researchers and whale watch vessels, which would suggest that the whales would not perceive these close approaches as potential threats and, therefore, would not respond behaviorally to close approaches or experience stress responses (Fowler 1999, Romero and Wikelsky 2002).

Several investigators reported behavioral responses to close approaches that suggest that individual whales might experience stress responses. Baker *et al*. (1983) described two responses whales to vessels, including: (1) "horizontal avoidance" of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and (2) "vertical avoidance" of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged. Watkins *et al.* (1981) found that both finback and humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startled reaction, and moving away from the vessel with strong fluke motions. Bauer (1986) and Bauer and Herman (1986) studied the potential consequences of vessel disturbance on humpback whales wintering off Hawaii. They noted changes in respiration, diving, swimming speed, social exchanges, and other behavior correlated with the number, speed, direction, and proximity of vessels. Results were different depending on the social status of the whales being observed (single males when compared with cows and calves), but humpback whales generally tried to avoid vessels when the vessels were 0.5 to 1.0 kilometer from the whale. Smaller pods of whales and pods with calves seemed more responsive to approaching vessels.

Baker *et al*. (1983) and Baker and Herman (1987) summarized the response of humpback whales to vessels in their summering areas and reached conclusions similar to those reached by Bauer and Herman (1986): these stimuli are probably stressful to the humpback whales in the action area, but the consequences of this stress on the individual whales remains unknown. Studies of other baleen whales, specifically bowhead and gray whales document similar patterns of short-term, behavioral disturbance in response to a variety of actual and simulated vessel activity and noise (Richardson et. al, 1985; Malme *et al*. 1983). For example, studies of bowhead whales revealed that these whales oriented themselves in relation to a vessel when the engine was on, and exhibited significant avoidance responses when the vessel's engine was turned on even at distance of approximately 3,000 ft (900 m). Weinrich *et al*. (1992) associated "moderate" and "strong" behavioral responses with alarm reactions and stress responses, respectively.

Jahoda *et al*. (2003) studied the response of 25 fin whales in feeding areas in the Ligurian Sea to close approaches by inflatable vessels and biopsy samples. They concluded that close vessel approaches caused these fin whales to stop feeding and swim away from the approaching vessel. The fin whales also tended to reduce the time they spent at surface and increase their blow rates, suggesting an increase in their metabolic rates which might indicate a stress response to the approach. In their study, whales that had been disturbed while feeding remained disturbed indefinitely after the exposure ended. They recommended keeping vessels more than 200 meters from whales and having approaching vessels move a low speeds to reduce visible reactions in these whales.

The low, relative frequency of "no responses" when compared with "moderate" and "strong" behavioral responses noted in the literature would suggest that most of the whales in the action area are not habituated to the close approaches and still perceive the close approaches as potential threats. If these responses are representative of the most serious consequences these whales might experience as a result of their exposure to close approaches, the different species of whale have been exposed to a large number of stressful stimuli each year.

Beale and Monaghan (2004) concluded that the level of disturbance was a function of the distance of humans to the animals, the number of humans making the close approach, and the frequency of the approaches. These results would suggest that the cumulative effects of the various human activities in the action area would be greater than the effects of the individual activity. None of the existing studies examined the potential effects of numerous close approaches on whales or gathered information of levels of stress-related hormones in blood samples that are more definitive indicators of stress (or its absence) in animals.

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004, Frid 2003, Frid and Dill 2002, Gill *et al*. 2000, Gill and Sutherland 2001, Harrington and Veitch 1992, Lima 1998, Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response or more serious physiological changes with chronic exposure to stressors), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002, Romero 2004, Sapolsky *et al*. 2000, Walker *et al*. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996, Mullner *et al*. 2004), and the death of individual animals (Daan *et al*. 1996, Feare 1976, Waunters *et al*. 1997).

The empirical evidence that is available suggests that close approaches for biopsy samples may be stressful for some individual whales being approached, although the significance of this stress response or its consequences on the fitness of individual whales remains unknown. Recognizing that the existing research permits require investigators to adopt the procedures developed by Clapham and Mattila (1993) for biopsy sampling of humpback whales in the West Indies, we provisionally assume that current levels of close approaches produce the same results as Clapham and Matilla (1993): short- to mid-term stress responses that have no long-term behavioral changes that might result in fitness consequences for individual whales.

Tagging and Attachment of Scientific Instruments

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program proposes to continue to tag marine mammals to monitor an animal's movements after it has been released from a stranding site, after rehabilitation, or after samples have been taken during research activities. The Program uses a variety of tags and other scientific instruments, including, but not limited to, roto-tags (cattle tags), button tags, VHF radio tags, satellite tags, Passive Integrated Transponder (PIT) tags, D-tags, code division multiple access tags, pill, time-depth recorders (TDRs), life history transmitters (LHX tags), and CRITTERCAMS (video cameras).

Specific instruments representatives of the Health and Stranding Response Program propose to employ will depend on the species being tagged and the research or question being addressed. The methods used to attach tags and other instruments depends on the type of tags, the species involved, and the circumstances. Tags have traditionally been attached to cetaceans using bolt, buoy, punch, harness, suction cup, implant, or ingestion. Tags have traditionally been attached to pinnipeds using glue, bolt, punch, harness, suction cup, surgical implant, or ingestion.

Tags are generally attached to free-swimming cetaceans by crossbow, compound bow, rifles, spear guns, slingshot (or throwing device), pole or jab spears. Attachments are temporary and occur via a suction cup device or implant. Scientific instruments attached to suction cups include, but are not limited to D-tags, TDRs, VHF tags, satellite tags, and CRITTERCAMS.

Large, slow moving whales have traditionally been tagged using suction cups and a pole delivery system that is cantilevered on the bow of a boat. Bow-riding animals have been tagged using hand-held poles. Fast-swimming toothed whales have traditionally been tagged using crossbows. Tags are attached on the dorsal surface of the animal behind the blowhole, closer to the dorsal fin. Tag placement ensures that the tag will not cover or obstruct the whale's blowhole, even if the cup migrates after placement (movement would be toward the tail).

Implantable tags may be attached in free-swimming animals by mounting the instrument on an arrow tip or other device designed to penetrate the skin of the animal. Tags would typically be attached by crossbow and may include, but not limited to satellite tags, VHF tags, and temperature-depth recorders. Buoys are used to attach VHF or satellite tags to gear on entangled whales. Buoys may also be attached to increase drag in an attempt to slow the whale for disentanglement.

For animals in hand, tags may be attached for longer deployments. Roto-tags may be attached to cetaceans with a plastic pin to the trailing edge of the dorsal fin. Button tags are plastic disks attached with a bolt through the dorsal fin. VHF tags (roto-radio tags) may also be bolted through the trailing edge of the dorsal fin. The bolts on each type of tag are held in place by corrodible nuts, so that the tag will eventually be released.

Satellite or VHF tags can be mounted on a molded plastic or fabric saddle that would be bolted through the dorsal fin (Geraci and Lounsbury 2005) or dorsal ridge. Plastic saddles would be padded on the inside to reduce skin irritation. Saddles would be attached to the dorsal fin with two or three Delrin pins secured with magnesium nuts. The nuts would corrode in seawater, allowing the package to be released within a few days or weeks.

Dorsal ridge "spider tags" are currently used on beluga whales (NMFS Permit No. 782-1719) (Litzky et al. 2001). Up to four holes are bored in the region of the anterior terminus of the dorsal ridge using a coring device (trochar) with a diameter of no more than 1 cm. Each insertion and exit point for the trochars would be prepared by cleaning with an antiseptic wipe, or equivalent. Rods of nylon or other non-reactive material, not greater than 1 cm in diameter and 50 cm in length, would then be pushed through the holes and attached to the wire cables or fabric flange or straps of the satellite tags or through bolt holes in the tag. The wire cables would be tightened to hold the tag against the back of the animal to minimize tag movement and drag, but would not be put under significant tension to avoid pressure necrosis around the pin insertion points. The other attachment systems would be manipulated to achieve the best possible fit depending on their design. Excess rod would then be cut off. All equipment would be sterilized in cold sterile solution, alcohol, or equivalent, and kept in air- and water-tight containers prior to use. Trochars and rods would be coated with antiseptic gel prior to insertion and each trochar would only be used for one hole before it is cleaned, sharpened, and resterilized. Where more than one instrument is to be attached, the number of pins would be limited to four.

A fast drying epoxy adhesive is used to glue scientific instruments to pinnipeds. Instruments may be attached to the dorsal surface, head, or flippers and will release when the animal molts. A harness can be used to attach scientific instruments. Roto-tags can be attached to flippers using a single plastic pin. Tags can also be surgically implanted into the body cavity or muscle of pinnipeds. Implanted tags include PIT and LHX tags.

Responses of Marine Mammals to CRITTERCAM TAGS. CRITTERCAM tags are a fairly recent tool for studying animal behavior and ecology in the marine environment. They are essentially video cameras attached to a suction cup. CRITTERCAM tags are neutrally buoyant and are attached with one to ten suction cups. These tags are packaged in cylindrical housings designed as a compromise between weight, pressure tolerance, robustness and low hydrodynamic profile.

Attaching CRITTERCAM involves the close approach of a small research vessel along side the whale and the use of a four-meter pole to lower the device onto the dorsal region. The device will passively detach from the whale with a galvanic/magnesium release system, usually within 24 hours. Although CRITTERCAMS create hydrodynamic drag, the proportion of the CRITTERCAM to the animal's size and weight is such that the energetic demand on the animal would likely be insignificant. A pin in the suction cup dissolves to release the system from the animal. The CRITTERCAM is expected to remain attached for 24 hours or less and then is retrieved by the permit holder. Disturbance to the whale may occur only during the approach of the researchers and attachment of the CRITTERCAM.

Deployment trials to date indicate that study animals generally exhibit little observable reaction to the CRITTERCAM. No incidences of harm to subject animals have been reported. A few significant reactions to the CRITTERCAM have been observed (Marshall 1998). When reactions were evident, it was almost always during tagging or a short period immediately after tagging. A few pinnipeds seemed curious of the instrument and a few others reacted aggressively toward it for short periods (Marshall 1998). Some pinnipeds attempted to remove the CRITTERCAM by rolling on their backs after deployment. The reactions seemed to be correlated with the position of the instrument on the animal's back (Marshall 1998). Deployments have been limited to programmed periods of up to one week, partly because hydrodynamic drag created by the instrument exerts an additional energetic demand on the animal. Over long periods this could result in reduced foraging success, increased metabolic load and resultant stress to the animal (see Marshall 1998). There is little or no evidence observed that animals with CRITTERCAM attached were rejected by other members of their species or targeted by predators (Marshall 1998).

Responses to Pit Tags. Passive integrated transponders or PIT tags, are small externally mounted or implanted Radio Frequency Identification (also known as RFID tags) products used to identify animals and other objects for a lifetime. Each tag consists of integrated circuitry and an antenna that are encapsulated in glass; the tags are "passive" because they do not contain batteries; they are activated when exposed to a transceiver or reader that generates an electromagnetic signal that activates the tag. When they are activated, PIT tags are programmed to transmit a unique, unchangeable code only when activated.

PIT tags are usually cylindrical in shape and are biologically inert. Size can vary in length from 11 mm to 32 mm long and have diameters in the 2.0 mm to 3.5 mm range. Most tags are implanted using a modified hypodermic syringe-style device fitted with a 6 to 12 gauge needle to implant the tag inside an animal's body cavity, under its skin, in cartilage or in a muscle. However, some methods implant PIT tags surgically (Gries and Letcher 2002).

PIT tags have been used with a wide variety of animal species that include fish (Clugston 1996, Dare 2003, Skalski *et al*. 1998), amphibians (Thompson 2004), reptiles (Geis *et al*. 2003, Germano and Williams 2003), birds, terrestrial mammals (Neubaum *et al*. 2005, Wright *et al*. 1998), sea otters (Thomas *et al*. 1987), manatees (Wright et al. 1997), southern elephant seals (Galimberti *et al*. 2000), and Hawaiian monk seals (NMFS Permit No. 848-1695). When PIT tags are inserted into animals that have large body sizes relative to the size of the tag, empirical studies have generally demonstrated that the tags have no adverse effect on the growth, survival, reproductive success, or behavior of individual animals (Brännäs *et al*. 1994, Clugston 1996, Elbin and Burger 1994, Hockersmith *et al*. 2003, Jemison *et al*. 1995, Keck 1994, Skalski *et al*. 1998).

LHX tags are satellite linked, delayed transmission life history transmitters. The tag allows continuous monitoring from up to five built in sensors. The tag is implanted into the abdominal cavity of a pinniped. When the animal dies, the tag is released from the body and transmits the data to a satellite. The battery life of an LHX tag is well over five years. LHX tags are being evaluated under current NMFS PR1 research permits (Permit No.1034-1685 [for California sea lions] and No. 881-1668 [for Steller sea lions]).

Marking

As discussed in the *Description of the Proposed Action*, the Health and Stranding Program proposes to mark marine mammals for research using methods are include, but are not limited to: bleach, crayon, zinc oxide, paint ball, notching, and freeze branding. Hot branding will not be used as a marking method. Crayons, zinc oxide, and paint balls can be used on cetaceans and pinnipeds for temporary, short-term marking. Bleach or dye (human hair dye) markings can be used on pinnipeds. These marks are temporary, with the length of time dependent on molting. Notching can be used to permanently mark cetaceans by cutting a piece from the trailing edge of the dorsal fin. Notching in pinnipeds removes a piece of skin from the hind flipper of phocids (true or earless seals) and the foreflipper of otariids (sea lions and fur seals).

The Health and Stranding Network may mark cetaceans using freeze brands on both sides of the dorsal fin or just below the dorsal fin. Freeze branding is used during health assessment studies to mark all animals for post-release monitoring. Freeze branding uses liquid nitrogen to destroy the pigment producing cells in skin. Each brand (typically 2" numerals) is super-cooled in liquid nitrogen and applied to the dorsal fin for 15-20 seconds. After the brand is removed, the area is wetted to return the skin temperature to normal. Brands will eventually re-pigment, but may remain readable for five years or more.

Information on the effects of marks on marine mammals is limited because investigators do not appear to study the acute or chronic effects of any marks they use on marked animals (Murray and Fuller 2000). In a review of 238 papers that had been published in major ecological journals in 1995, Murray and Fuller (2000) concluded that more than 90 percent of the articles they reviewed either did not specify the potential effects of marking on study subjects or did not appear to consider those effects when reporting study results (see Table 5). Only 7 percent of the articles they reviewed explicitly considered the effects of marking on study subjects. As a result, the information we would need to assess the effects of marking on marine mammals, particularly of cetaceans, is not available.

TEMPORARY MARKS: Paints, bleaches, and dyes have been used successfully to temporarily mark Steller sea lions and other pinnipeds. The duration of the mark depends on, among other things, the type of paint or dye used, and the season applied. As a result, paints and dyes can be used to identify individuals for weeks to months. Paint marks can be applied remotely using a paint gun that fires pellets filled with pigment that burst on impact and leave a spot on the animal's skin. This method does not allow use of alphanumeric characters and, therefore, is only practical when crude marks are needed.

Table 5. Data from a review of papers that had been published in 1995 whose methods involved marking (data from Murray and Fuller 2000)

Journal	Number of Papers Reviewed	No Marking Effects (implicit)	No Marking Effects (explicit)	Marking Tests or Modifications
American Naturalist	4	4	0	0
Animal Behavior	62	59	2	1
Canadian Journal of Zoology	50	46	0	4
Conservation Biology	10	8	0	2
Ecology	31	28	2	1
Journal of Animal Ecology	15	15	0	0
Journal of Wildlife Management	37	30	3	4
Oecologia	12	10	0	2
Oikos	17	15	0	2
Total	**238**	**215**	**7**	**16**
Percentages		**90**	**3**	**7**

If animals are captured and restrained before they are marked, bleaches and dyes can be used to make unique alphanumeric marks on their fur. This method likely involves more stress to individual animals than remote marking and commonly disturbs other members of the social group that contains the animal that is targeted for marking. However, marks can be made large enough to be easily read from a distance, making it unnecessary to recapture the animal for identification.

RESPONSES OF MARINE MAMMALS TO TEMPORARY MARKS. In addition to the effects of capture and restraint described above, the attachment of an instrument can have both short- and long-term adverse effects. Possible chronic, short-term effects can include a reduction in foraging activity or an increase in grooming at the expense of other behaviors (Kenward 1987). These types of effects are likely present after most tagging events and may be as much a delayed result of the capture and handling as of the tag's presence. Short-term effects can lead to acute problems for animals of various species: the presence of a tag has exacerbated capture shock and led to death in hares; the disturbance of tagging has resulted in desertion by incubating birds; abandonment or rejection of young in birds and ungulates was seen following tagging; and tagging may be enough to stop a dispersing animal from securing a territory, or push an animal over the brink of starvation when food is short (Kenward 1987). The hydrodynamic drag created by the instrument can exert an additional energetic demand on an animal which could, over time, result in reduced foraging success, increased metabolic load, and resultant stress to the animal.

PERMANENT MARKS: When the objectives of a study require investigators to recognize individual animals for more than a season or a few years, temporary or semi-permanent marks must be re-applied, or a permanent mark can be used. As discussed above, applying both temporary and semi-permanent marks usually requires capture and restraint of the animal. Given that each capture event is stressful, and has the potential to injure the animal, when the objective is only to have animals that can be individually recognized from a distance, it is more advantageous to apply a permanent mark from the start. Using permanent marks is also favored over re-applying temporary marks when the interval between capture events is longer than the duration of the temporary mark. Hot brands have been used for many years to permanently mark domestic livestock and some species of wildlife, including Steller sea lions and other pinnipeds. Cryo-branding, or freeze branding has also been used successfully to permanently mark numerous species, including white-tail dear, horses, and harbor seals.

Freeze branding is considered by some to be more acceptable for marking wildlife than hot branding because, if it is done correctly, there is a negligible risk of infection (Day *et al*., 1980). There are two techniques for producing a freeze brand. One method involves application of a coolant, such as liquid nitrogen, to destroy the pigment cells in an area such that unpigmented hair grows back. The other method also uses a coolant, but the contact time is longer such that a "bald" brand where hair does not grow back, similar to a hot brand, results.

To produce the best results on animals with lighter pelage, a bald brand is preferred. There is more preparation required for producing bald freeze brands than hot brands. To achieve optimal results, the area to be branded must be clipped or shaved and the skin swabbed with methylated spirits (an alcohol/glycerin mixture). The freeze branding tool then needs to remain in contact with the animal's skin for 25-60 seconds per character to produce a bald brand (Hobbs and Russell 1979) versus 2-4 seconds per character for a hot brand (Merrick et al. 1996). As a result, freeze branding could take several minutes longer per animal than hot branding due to the extra preparation of the fur and the longer contact times required for a bald brand.

RESPONSE OF MARINE MAMMALS TO FREEZE BRANDING. There is limited information on the response of marine mammals to freeze branding. Macpherson and Penner (1967) reported that adult and juvenile seals tried to escape their restraints as soon as cold irons were applied to their skin (evidence of pain). Both Lay *et al*. (1992) and Schwartzkopf-Genswein *et al*. (1997) reported that domestic cattle also tried to break free from their restraints during freeze-branding and showed evidence of discomfort or avoidance responses for up to five days after they had been branded. Sherwin et al. (2002) reported that four species of bats experienced "discomfort" during freeze branding, but did not provide more information on the response of these small mammals to the branding procedure.

Based on this limited information, we assume that marine mammals that are subjected to freeze-branding would experience acute pain and physiological stress responses while the brand is applied, would experience discomfort for several hours or days following the branding, but would not suffer adverse effects on their health, longevity, or reproductive success.

Biopsy Sampling

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program proposes to continue to collect skin, blubber, or other tissue samples using biopsy samples of free ranging animals, animals captured for health assessment studies, and animals in rehabilitation. The proposed permit does not authorize representatives of the Health and Response Program to take biopsy samples of large whale calves that are less than 6 months in age or mothers attending such calves as part of their Prospective Health Assessment program (these activities would be authorized, as appropriate, for responses to health emergencies).

Skin and blubber biopsy samples are typically taken from a vessel using crossbows, compound bows, dart guns, or pole spears. A crossbow would be used to collect a sample from animals within approximately 5 to 30 m of the bow of the vessel. The depth of the biopsy tip penetration would vary depending on the species being sampled and the depth of their blubber layer. For small cetaceans, such as bottlenose dolphins, the biopsy tip used to collect blubber for contaminant analysis penetrates to a depth of approximately 1.0-2.5 cm. Shorter tips may be used when only skin sampling is required. Sloughed skin can aggregate in the wake behind a moving animal, the slick "footprint" after a whale submerges, or in the water following surface active behaviors, such as breaching. This skin may be collected for analyses. Skin may also be collected from the suction cup used to temporarily attach scientific instruments to cetaceans.

Blubber biopsy samples may be taken during health assessment studies. Skin obtained with the blubber biopsy is used for genetic analyses. Skin scrapings, biopsy samples, or needle aspirates will be collected for clinical diagnoses from sites of suspected lesion These samples are processed by various diagnostic laboratories and a sub-sample is sent to the National Marine Mammal Tissue Bank (NMMTB). Blubber and muscle biopsies may be collected from pinnipeds. Prior to sampling, investigators would inject animals with local anesthetics (using subcutaneous and intramuscular injections), clean the site with a topical antiseptic, make small incisions with a sterile scalpel blade, and push a sterile biopsy punch through the blubber and into the muscle layer to obtain ~ a 50 mg tissue sample. Investigators would apply pressure and irrigate the wound but would not close the wound with sutures.

RESPONSE OF MARINE MAMMALS TO BIOPSY SAMPLES. We assume that marine mammals might respond one way to the strike of the biopsy dart and infection at the point of penetration and another way to the close approach of the boat that carries the investigators who will take the sample. The behavioral responses of large whales to the strike of biopsy darts has been studied on a several whale species including humpback, gray (*Eschrictius robustus*), minke (*Balaenoptera acutorostrata*), fin (*B. physalus*), blue (*B. musculus*), North Atlantic right

(*Eubalaena glacialis*) and sperm whales (*Physeter macrocephalus*). Potential infection at the point of penetration has not been the subject of focused study, although anecdotal observations of the point of penetration or elsewhere among the many whales resighted in days following the taking of a biopsy has produced no evidence of infection (NMFS 1992a).

With the exception of the death of a single Common dolphin (*Delphinus delphis*) (Bearzi 2000), most cetaceans have exhibited mild behavioral responses to biopsy darting (e.g. International Whaling Commission 1989; Whitehead *et al*. 1990; Brown *et al*. 1991; Weinrich *et al*. 1991, 1992; Barrett-Lennard *et al*. 1996; Weller *et al*. 1997). Otherwise biopsy samples have been successfully taken from about 90 percent (91.2) of whales that are approached (Gauthier and Sears 1999) without killing the animal from which the biopsy sample will be taken.

Gauthier and Sears (1999) studied the behavioral responses of minke, fin, blue, and humpback whales to biopsy samples taken using punch-type tips fired from crossbows. These whales showed no behavioral reaction to about 45 percent of successful biopsies. Behavioral responses in the remainder of the biopsies ranged from tail flicks, hard tail flicks, submerging below water surface, or some combination of these responses. Humpback whales displayed more of these responses than fin or blue whales, but most individuals of any of these species resumed their normal behavior within a few minutes of the sample. Whales that had been inadvertently biopsied more than once displayed either no response (52 percent displayed no behavioral response to the first biopsy, 57 percent displayed no behavioral response to the second biopsy) or short-term behavioral responses.

Weinrich *et al*. (1992) studied the behavioral responses of humpback whales in the Gulf of Maine (specifically Jeffrey's Ledge and Stellwagen Bank), classifying the responses into the categories: no reaction, low-level reaction (immediate dives but no other overtly forceful behavior), moderate reactions (trumpet blows, hard tail flicks, but no prolonged evidence of behavioral disturbance), and strong reactions (surges, tail slashes, numerous trumpet blows). Out of 71 biopsy attempts, 7.0% resulted in no behavioral responses, 26.8% resulted in low-level behavioral responses, 60.6% involved a moderate reaction, and 5.6% involved a strong reaction. Nevertheless, these authors concluded that the responses they observed probably depends on the specific activity of the animal prior to the approach. They also recognized that continuous or repeated exposure to stimuli that produce moderate, adverse responses could produce alarm reactions and potential stress responses.

Clapham and Mattila (1993) also concluded that humpback whales exhibited low to moderate reactions to being struck by biopsy darts. They found that 66.6% of humpback whales that had been biopsied showed no behavioral reaction or low-level reaction to the procedure. A study by Clapham *et al.* (1993) noted that studies on biopsy procedures showed no evidence of significant impact on [cetaceans] in either the short or long term.

The proposed permit would allow representatives of the Health and Stranding Response Program to take biopsy samples of up to 100 endangered or threatened whales each year for five years. Assuming that the results of Weinrich *et al*. (1992) are representative of the range of responses that whales might exhibit when they are struck by biopsy darts, about 7 of the 100 whales the

Health and Stranding Response Program proposes to take biopsy samples from each year might be expected to exhibit no visible behavioral responses to the biopsy dart, about 27 whales might exhibit "low-level" behavioral responses, about 61 might exhibit "moderate" behavioral responses, and 7 might exhibit "strong" behavioral responses (because of rounding, these values do not total 100).

Blood Sampling

As discussed in the *Description of the Proposed Action*, the Health and Response Program proposes to collect blood samples from the dorsal fin, caudal peduncle, pectoral flipper, or flukes. At any of these sites, blood would be sampled using an 18- gauge 4-cm needle, with a scaled down needle bore for calves, Dall's porpoise, and harbor porpoise. With phocid seals and otariids , blood samples may be collected through the bilaterally divided extradural vein, which overlies the spinal cord. Otariids may also be sampled using the caudal gluteal vein. Sampling would be done with a 20-gauge, 4-cm needle for small animals and an 18-gauge, 4-cm needle for larger animals. Phocids may be sampled by inserting a needle into the metatarsal region of the hind flipper (Geraci and Lounsbury 2005).

Breath Sampling

As discussed in the *Description of the Proposed Action*, the Health and Response Program proposes to sample the breath of cetaceans or pinnipeds to assess their nutritional status and health. This procedure uses a specially-designed vacuum cylinder to collect breath samples from free ranging cetaceans. The equipment typically does not touch the animal, although in some instances there may be brief (less than 10 seconds) contact. An individual animal may be approached up to three times to obtain a sample. Samples may also be collected during health assessments or on any live captured animal. The samples will then be examined using gas chromatography-mass spectrometry for volatile compounds to evaluate respiratory disease, nutritional status, and physical condition.

Ultrasound Sampling

As discussed in the *Description of the Proposed Action*, the Health and Response Program proposes to use ultrasound to sample free-ranging animals and animals captured during emergency response or research studies. Ultrasound may be used to evaluate blubber thickness, wounds, lesions, the presence of lesions, pregnancy, reproductive organs, and blood vessels. During health assessment studies, a diagnostic ultrasound is used to examine the condition of the internal organs and to measure testis length and diameter to assess male maturity. Females are also examined by a veterinarian during the initial evaluation for pregnancy and the presence of developing follicles. Females determined to be in late-term pregnancy (late 2nd and 3rd trimester) are tagged with a roto-tag so they can be avoided in subsequent sets, and then immediately released.

This procedure, by itself, poses no risk of injury to an animal. The greatest risk associated with this procedure occur when animals are captured and restrained for the procedure (see discussion above).

Other Sampling

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program proposes to collect other samples from marine mammals, including tooth extraction, urine, blowhole, fecal, milk, sperm, and colonic temperatures. Most of these samples would be collected during health assessment studies.

SCAT COLLECTION. The Health and Stranding Response Program also collects cetacean feces in the water column and pinniped feces from haul-out or rookery sites.

Kucey (2005) conducted observations on ten sites in British Columbia used by Steller sea lions, primarily for hauling out and one rookery. Kucey (2005) observed Steller sea lion use of the sites for about 1 to 2 weeks before researchers landed on the site for scat collection, and continued to observe Steller sea lion sites for 1 to 2 weeks post disturbance. Kucey (2005) recorded more than 1,000 disturbance events at the sites, which included a number of predetermined disturbance events to collect scats, and the branding of pups at the rookery. Researchers were present on haulout sites during scat collection for about two hours, whereas during branding researchers occupied the rookery for about 6 hours. Kucey (2005) observed that scat collection disturbance resulted in all animals entering the water (fleeing the site) as researchers went ashore. Three of the sites that she monitored never recovered to predisturbance levels, and those that did recover returned to predisturbance levels about 4 days after the disturbance. Her study, however, could not detect whether the sites were reoccupied by the same or new individuals (such that individuals were unaware of the previous disturbance event). Notably, one of the sites that did not return to predisturbance numbers was the rookery site where branding occurred.

TOOTH EXTRACTION. Teeth would be extracted from animals by a veterinarian trained in this procedure. The tissue surrounding the tooth (usually #15 in the lower left jaw) is infiltrated with Lidocaine without epinephrine (or equivalent local anesthetic), applied through a standard, high-pressure, 30 gauge needle dental injection system. Once the area is anesthetized, the tooth is elevated and extracted using dental extraction tools. A cotton plug soaked in Betadine, or equivalent, solution is inserted into the alveolus (pit where the tooth was) as a local antibiotic and to stop bleeding. This plug is removed prior to release. This procedure is modified from that described by Ridgway *et al.*(1975), wherein the entire mandible was anesthetized. The revised procedure has been used in captivity and in live capture and release sampling for many years. Extracted teeth are sectioned, stained, and growth layer groups are counted.

During health assessment studies, the Health and Stranding Response Program may collect urine samples opportunistically, by holding an open sterile container in an animal's urine stream or using urinary catheterization. A veterinarian experienced with cetaceans and a qualified veterinary technician perform the catheterization procedure. The dolphin would be lying on its side on the foam-covered deck of the boat serving as the veterinary laboratory. Wearing sterile surgical gloves, the assistant gently retracts the folds of the genital slit to allow visualization of the urethral orifice. The veterinarian (wearing sterile gloves) carefully inserts a sterile urinary catheter, lubricated with sterile lubricating gel, into the bladder via the urethra. A 50 ml collection tube without additive is used to aseptically collect the urine as it flows from the catheter. The catheter is removed after the urine is collected.

RESPONSE OF MARINE MAMMALS TO TOOTH EXTRACTION. The potential adverse effects of tooth extractions relate to the risks of capture, anesthesia, and the possibility of infection following extraction. The procedure may result in more than momentary pain, which could temporarily interfere with the animal's ability to forage. However, there are no data on the long-term effects of this procedure

COLLECTION OF BLOWHOLE AND FECAL SWABS. The Health and Stranding Response Program also proposes to collect swab samples from the blowholes and rectum of individual marine mammals. For this procedure, a sterile swab is inserted into the blowhole during a breath, gently swabbed along the wall of the blowhole, and removed during the next breath. Fecal samples are obtained either from a small catheter inserted about 10 cm into the colon or from a sterile swab of the rectum.

RESPONSES OF MARINE MAMMALS TO SWABS. The potential adverse affects relate primarily to the risks of capture and restraint, as described above. In addition, there is the slight potential to introduce or spread infection if the loops and swabs are not used properly. There is the potential for perforation, and subsequent infection, when fecal loops are inserted into the rectum. There is the possibility for damage to the cornea of the eye if ocular swabbing is done incorrectly. When performed by a qualified, experienced person using commonly accepted standards of good practice, these risks are likely negligible.

MILK SAMPLES. The Health and Stranding Response Program collects milk samples to measure the levels of lipophilic organic contaminants and to determine composition. All adult females are checked for lactation and milk samples are collected from all lactating females. A "breast-pump" apparatus is used to obtain the sample. Milk is expressed with gentle manual pressure exerted on the mammary gland while suction is provided by a 60 cc syringe attached by tubing to another 12 cc syringe placed over the nipple. Samples of up to 30-50 ml may be collected.

COLONIC TEMPERATURES. The Health and Stranding Response Program collects colonic temperature to understand vascular cooling and reproductive status (Rommel *et al.*1992, 1994). Temperature measurements are obtained with a linear array of thermal probes interfaced to a laptop computer. The probes are housed in a 3 mm flexible plastic tube. The probe is sterilized, lubricated, and then inserted into the colon through the anus to a depth of 0.25-0.40 m depending on the size of the animal. Temperature is continuously monitored.

GASTRIC LAVAGE. Gastric samples may be obtained using a standard stomach tube to evaluate health and evidence of brevetoxin exposure. Standard length and girth measurements may be taken and a series of ultrasonic measurements of blubber layer thickness may be obtained (the larger the animal, the more measurements).

Administration of Drugs and Euthanasia

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program may administer drugs to sedate or chemically restrain marine mammals during stranding response and disentanglement activities. They might use anesthetics and analgesics during research before performing biopsies, tooth extractions, and other procedures.

Alternatively, they might administer antibiotics, antifungals, and other medicines during response and rehabilitation. Representatives of the program may administer these drugs orally, by injection, intubation, or inhalation. Orally administered medications are typically hidden in fish but may also be given via stomach tube.

Subcutaneous, intravenous, intramuscular, and intraperitoneal injections may be used to deliver drugs. All of these methods would require some level of animal restraint. Subcutaneous injections are made in the interface between the blubber layer and the skeletal muscle layer. Animals must be maintained in a certain position for prolonged periods of time. The most common site for subcutaneous injections in pinnipeds is the craniodorsal thorax between the scapulae. Subcutaneous injections would not be used in cetaceans.

In general, intravenous injections are complicated and rarely used in marine mammals. In cetaceans, medications may be injected in the fluke vessel if the volume is low and the medicine is not harmful if delivered perivascularly. An indwelling catheter may be used if repeated administration or slow infusion occurs (McBain 2001).

Intramuscular drug injections require longer needles because of the thickness of skin and blubber. Caution is taken to avoid accidental injection into the blubber, which may cause sterile abscess formation or poor absorption (Gulland *et al.* 2001). Injection into the blubber also has different drug-partitioning properties than muscle. This may result in the failure to activate a systemic distribution of highly lipid soluble medications (Stoskopf *et al.* 2001). Injection sites for phocids are the muscles surrounding the pelvis, femur, and tibia. These sites, as well as the large muscles overlying the scapulae, are appropriate for otariids (Gulland *et al.* 2001). Intramuscular injections in cetaceans may be made off the midline, slightly anterior to, parallel to, or just posterior to the dorsal fin. Caution is taken to avoid the thoracic cavity if the injection is anterior to the dorsal fin (McBain 2001). Multiple injection sites may be used and the volume per site should be reasonable depending on the animal.

Intraperitoneal injections deliver medications into the abdominal cavity. Non-irritating drugs may be delivered by this method. During injection, caution must be taken to avoid damaging major organs. A contaminated needle or puncturing the gastrointestinal tract could introduce bacteria into the abdominal cavity (Gulland *et al.* 2001).

The Health and Response Program may euthanize marine mammals that have irreversibly poor condition and for whom rehabilitation would not be possible; rescue would be impossible; or no rehabilitation facility is available. Animals may be euthanized at a rehabilitation facility when veterinarians conclude that an animal cannot be released and cannot be placed in permanent captivity. Euthanasia procedures would only be carried out by an attending, experienced, and licensed veterinarian or other qualified individual. Sedation may precede the administration of euthanasia drugs. Smaller cetaceans can be euthanized by injecting barbiturates or other lethal agent into a vein of the flippers, dorsal fin, flukes, or caudal peduncle. It may also be injected directly into the heart of abdominal cavity using an indwelling catheter.

Small cetaceans may be sedated before they are injected. For large cetaceans, a method is currently being developed to sedate the animal via intramuscular injection and then deliver euthanasia agents using intravenous injection. Large cetaceans may be euthanized by lethal injection directly into the heart. Injection into a vein of the flippers or flukes would likely be unsuccessful. Large whales may also be euthanized by using ballistics (shooting) or by exsanguination (Geraci and Lounsbury 2005).

Response of Sea Lions and Fur Seals to Anesthesia. A fairly high mortality rate caused by anesthesia has been reported in otariids (Gage 1993). Delivery of anesthesia in pinnipeds can be complicated by their particular anatomical and physiological specializations to the marine environment and by the logistics of working with wild animals. Determining the proper dose is dependent on a fairly accurate assessment of the animal's weight and condition, as miscalculation of an animal's weight can lead to an overdose, which can have lethal consequences (Fowler 1986). The typical induction time for most chemical restraint agents is 10 to 20 minutes following intramuscular injection. As a result, darting can be dangerous because it can spook an animal into the water before the immobilization has taken affect, which can result in drowning.

In February 1993, under Permit No. 771 (64), an adult female darted with Telazol died. Although the animal was "one of the farthest from the water" among the animals on the beach, she moved toward the water within 30 seconds of being darted. Within 5 minutes she had rolled over into the surf and appeared unable to swim. By the time the researchers reached the animal she was not breathing and was given Dopram (a respiratory stimulant). She resumed breathing and began moving her head side to side and moving her foreflippers slightly. When these movements on the part of the animal began to interfere with the researcher's efforts to collect samples and attach a transmitter, the animal's head was covered in an attempt to calm her. By the time attachment of the transmitter was nearly completed it was noted that the female had been still for about a minute. Upon removing the rain jacket it was discovered that her pupils were dilated and she had no blink reflex. Attempts at resuscitation were unsuccessful and it was believed that the animal's immersion in sea water after darting may have triggered the dive response (breath holding, decreased heart rate, and reduced peripheral blood flow) and/or she may have aspirated sea water. It was also suggested that covering the animal's head may have contributed to her death by making her condition difficult to monitor and/or by pushing her back into the dive reflex.

The safest injection site for projectile syringes (darts) are in the deep muscle areas of the hind limbs (Scott and Ayars 1980). However, the blubber layer on pinnipeds can make delivery of an injectable drug into the muscle, where needed for proper absorption and distribution, difficult. In addition, inadvertent injection of drugs into the blubber frequently results in aseptic necrosis, sometimes leading to large abscesses (Geraci and Sweeney 1986). Injections into the chest cavity or stomach region can result in puncture of the lungs or stomach, which may kill the animal.

In February 1993, under Permit No. 771(64), issued to NMML, a pup that was accidentally darted with Telazol when it unexpectedly moved in front of the target adult animal died, apparently as a result of inadvertent intravenous injection of a drug intended for intramuscular administration in a larger animal.[2] According to the report, the dart struck on the left flank, about 5 inches forward of the hip and about 2 inches off the spine, which apparently, as indicated by necropsy, entered the kidney, effectively causing an intravenous injection. Necropsy also revealed slight trauma to the kidney. The pup had also regurgitated approximately a liter or more of milk following the darting and may have aspirated some, which could have contributed to the death.

Hyperthermia (over-heating) can occur in animals under anesthesia because the blubber layer can make heat dissipation a problem, even at ambient temperatures that are comfortable for the researchers: otariids over 25 kg tend to become hyperthermic during anesthesia (Gage 1990). Hypothermia can also occur in sedated animals, during anesthesia or post-recovery, as many drugs can affect thermoregulation. In hypothermia, the reduction in body temperature reduces tissue metabolism, while hyperthermia increases it. Both of these can have implications for the animal's reaction to any drugs administered, as well as any pathological conditions that may exist.

About 10% of animals induced with Telazol (tiletamine-zolazepam) or gas were observed to become apneic (stop breathing) within five minutes of induction (Gage 1990). Tiletamine is a cyclohexamine, which is a dissociative anesthetic that induces catatonia. It also has an analgesic effect through its action on the spinal cord, but it does not block visceral pain. Both hyperthermia and hypothermia are possible consequences of immobilization with tiletamine, depending on ambient temperatures. Respiratory depression is also possible, as is hypersalivation, which can lead to choking or aspiration of fluid. There is an excitatory phase seen with tiletamine characterized by occasional muscle spasms resembling seizures, due to spinal reflex firings, which can be minimized by using tiletamine in combination with diazepam. Zolazepam is a benzodiazepine (an anti-anxiety drug) that has a sedative effect and is a skeletal muscle relaxant. Zolazepam slightly depresses cardiovascular function. Both tiletamine and zolazepam are excreted in the kidneys and are contraindicated in animals with severe renal or hepatic disease. The safety of these drugs is adversely affected in animals that are ill, stressed, or which have suffered from physical exertion (e.g. have been chased) prior to administration of the drug. There is no antidote (reversal agent) for tiletamine. Diazepam, which is a benzodiazepine similar to zolazepam, is metabolized slowly, with clinical effects typically disappearing within 60 to 90 minutes (Fowler 1986). There is a reversal agent for zolazepam, flumazenil. However, because zolazepam is used in combination with tiletamine to reduce the effects of the excitatory phase, reversing the effects of zolazepam in the absence of a reversal agent for tiletamine could result in convulsions and other side effects.

Inhalation anesthetics such as isoflurane gas are used to induce anesthesia in animals that can be manually restrained, and are commonly used to augment analgesia or increase the depth of anesthesia in animals previously immobilized by injectable agents. Prolonging immobilization by administering repeated doses of injectable agents is associated with a high risk of mortality,

2 Memorandum for the Record from R.L. Merrick, dated 10 March 1993, RE: Steller sea lion mortalities during field work, February 1993. Permit No. 771(64)

and an additional dose of Telazol should never be given (Gage 1990).[3] Isoflurane, a halogenated ether with potent anesthetic action (Stedman's Medical Dictionary 2000), is an inhaled general anesthetic that induces reversible depression of the central nervous system, resulting in unconsciousness, analgesia, voluntary muscular relaxation, and suppression of reflex activity (Fowler 1986). Isoflurane is especially useful for short procedures in which rapid recovery and few aftereffects are desirable. The effects of inhalation anesthetics increase predictably with increased dose, unlike injectable agents, which tend to be unpredictable and idiosyncratic among animals (Fowler 1986). In general, captive animals have been observed to fully recover from anesthesia with isoflurane after 8 hours (Gage 1990). Isoflurane gas appears to have the best recovery characteristics, and be safe and reliable, in otariids (Haulena and Heath 2001).

Auditory Brainstem Response/Auditory Evoked Potential

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program may conduct Auditory Brainstem Response and Auditory Evoked Potential procedures to evaluate the hearing abilities of individual animals or species. These procedures may be conducted on stranded animals, animals in rehabilitation, or animals captured during studies. Procedures on odontocetes are non-invasive and can be conducted in short time frames. An animal may be resting at the surface or may be physically restrained (held by researchers) during the procedure. For odontocetes, sounds are presented through a jawphone attached to the lower jaw via suction cup.

With cetaceans, recording, ground, and reference suction cup electrodes are attached along the dorsal midline, starting approximately 6 cm behind the blowhole. Evoked potentials are recorded from the electrodes. Frequencies used for testing range from 5 to 120 kHz and the maximum sound pressure level is less than 160 decibels re μPa. This procedure would only be conducted on odontocetes.

With pinnipeds, thin needle electrodes would be used instead of suction cups. Animals would be sedated or anesthetized (for other purposes) when AEP procedures are conducted or the procedures would be conducted on captive animals that had been trained to participate in the procedure.

Active and Passive Acoustics

In addition to Auditory Brainstem Response procedures, the Health and Stranding Response Program may conduct both active and passive acoustic activities. Passive recordings may be conducted using a hydrophone placed in the water directly off of a vessel or in a pool to record animal vocalizations and background noise. Investigators may use active acoustic playbacks to expose both cetaceans and pinnipeds to social sounds and feeding calls of the subject species during capture/release and rehabilitation and the physiological and physical response of the animals would be measured. Playbacks may be used to assess hearing to determine if animals undergoing rehabilitation are suitable for being returned to the wild. In addition, in some cases,

[3] Note that several of the animals that died under previous permits issued to ADF&G were given repeat injections of medetomidine and/or ketamine, the injectable agents used to immobilize them. See annual reports for Permits No. 771 and 965.

playbacks of the subject species may be used to lure out-of-habitat animals to their natural habitat, or predatory sounds or other deterrents may be played to deter or haze animals from harmful situations, as described below.

Hazing

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program may haze ESA-listed marine mammals that are in the vicinity of an oil or hazardous material spill, harmful algal bloom, sonar, or any other potentially harmful situation. Methods include acoustic deterrent and harassment devices, visual deterrents, vessels, physical barriers, and capture and relocation. Acoustic deterrents used on cetaceans may include, but are not limited to, pingers, bubble curtains, Oikomi pipes, seal bombs, airguns, mid- and low-frequency sonar, predator calls, and aircraft. Other non-lethal deterrents such as booms or line in the water, or fire hoses may be used. Pinniped acoustic deterrents include seal bombs, Airmar devices, predator calls, bells, firecrackers, and starter pistols. Visual deterrents for pinnipeds include flags, streamers, flashing lights; barriers such as net or fencing may also be used to exclude or deter pinnipeds.

Import and Export of Marine Mammals or Marine Mammal Parts

As discussed in the *Description of the Proposed Action*, the Health and Stranding Response Program commonly needs to export marine mammal parts to provide specimens to the international scientific community for analyses or as control or standard reference materials. Similarly, the Health and Stranding Response Program imports specimens obtained legally outside the U.S. for archival in the National Marine Mammal Tissue Bank or for real time analyses. Imported samples would be legally obtained from:

1. Any marine mammal directly taken in fisheries for such animals in countries and situations where such taking is legal;
2. Any marine mammal killed in subsistence harvest by native communities;
3. Any marine mammal killed incidental to commercial fishing operations;
4 Any marine mammal stranded live or dead;
5. Captive animals, when sampling is beyond the scope of normal husbandry practices; and
6. Samples taken from live animals conducted under other permitted studies.

An unlimited number and kinds of marine mammal specimens, including cell lines, would be imported and/or exported (worldwide) at any time during the year. Specimens would be taken from the Order Cetacean and the Order Pinnipedia (except walrus), including threatened and endangered species. Specimens from species under the jurisdiction of the USFWS, including walrus, polar bear, sea otter, marine otter, and Order Sirenia may be received, analyzed, curated, and imported/exported. Specimen materials may include, but are not limited to: earplugs; teeth; bone; tympanic bullae; ear ossicles; baleen; eyes; muscle; skin; blubber; internal organs and tissues; reproductive organs; mammary glands; milk or colostrums; serum or plasma; urine; tears; blood or blood cells; cells for culture; bile; fetuses; internal and external parasites; stomach and/or intestines and their contents; feces; flippers; fins; flukes; head and skull; and whole carcasses. Specimens are acquired opportunistically; therefore specific numbers and kinds of specimens, the countries of exportation, and the countries of origin cannot be predetermined.

The Health and Stranding Response Program might import or export any marine mammals under NMFS' and the U.S. Fish and Wildlife Service's jurisdiction, including species that are listed as endangered or threatened.

Cumulative Effects

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

NMFS expects whale watching operations, vessel traffic and aircraft and helicopter tours, and research activities to continue for the foreseeable future, mostly in the winter range in Hawaii and summer range in Alaska. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on whale populations. Information on the effects of repeated harassment by research activities, vessel traffic, and whale watchers is also lacking. However, it appears that the number of humpback whales in the central North Pacific stock has been increasing in the presence of these activities and there is insufficient information on the trends of fin and sperm whales. Therefore, at the present time, continuation of these activities in the action area do not appear to pose any threat to, or prevent the survival and recovery of, humpback whales. As for fin and sperm whales, conclusions on the cumulative effects of these disturbances can not be drawn at this time.

Integration and Synthesis of Effects

In the *Assessment Approach* section of this opinion, we stated that we measure risks to listed individuals using changes in the individuals' "fitness" or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect listed plants or animals exposed to an action's effects to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (Anderson 2000, Mills and Beatty 1979, Brandon 1978, Stearns 1977, 1992). As a result, if we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

The following discussions summarize the probable risks associated with the activities that would be authorized by the proposed permit for the Marine Mammal Health and Stranding Response Program. As discussed in the Exposure Analyses subsection of this Opinion, we need to distinguish between the Emergency Response Actions that would be undertaken by the Health and Stranding Response Program and the Prospective Health Assessment Research activities undertaken by the program.

EMERGENCY RESPONSE ACTIVITIES. The emergency response actions of the Health and Stranding Response Program entail responses to health emergencies involving marine mammals that were caused by other natural or anthropogenic phenomena, particularly responses to marine mammals that have stranded, have become entangled in fishing and other gear, or otherwise appear to be in distress.

During responses to health emergencies, the proposed permit would authorize the Health and Stranding Response Program to expose endangered or threatened marine mammals to close approaches, aerial and vessel surveys, disentanglements, capture, restraint, handling, tagging, sample collections that include biopsy samples, anesthesia, sedation, treatment, import/export of animals, transport, relocation, rehabilitation, and release on beaches and in coastal waters and waters of the Exclusive Economize Zone of the United States, its territories, and possessions, and international waters. The proposed permit would also authorize the Health and Stranding Response Program to euthanize and unlimited number of endangered and threatened marine mammals on beaches and in coastal waters and waters of the Exclusive Economize Zone of the United States, its territories, and possessions.

In those circumstances, we assume the primary stressor facing the animal is that which caused its distress and we assume that if the Health and Stranding Response Program did not respond to the animal's distress, the animal would die, suffer serious injury or impairment, or other health outcomes that would reduce its longevity or reproductive success. That is, we assume that the marine mammals involved in these health emergencies are less likely to experience reductions in fitness because of the Health and Stranding Response Program's response to these health emergencies than they would if the program did not mount emergency response actions.

Based on the data available, we would expect about 130 endangered or threatened marine mammals to be involved in stranding events, on average, during each year of the five year permit. If the data available are representative of patterns that might occur over the next five years, about 53 percent of these stranding events would involve cetaceans (primarily humpback whales, fin whales, sperm whales, and Southern resident killer whales) and about 47 percent would involve pinnipeds (primarily Hawai'ian monk seals and Steller sea lions). We assume that these whales and pinnipeds may represent any age, gender, reproductive condition, or health condition.

Based on the data available, Hawai'ian monk seals, Steller sea lions, fin whales, humpback whales, Southern resident killer whales, North Atlantic right whales, and sperm whales appear most likely to be exposed to emergency response actions of the Health and Stranding Response Program over the five-year interval of the proposed permit. The Health and Stranding Response Program is not likely to interact with blue whales, western Pacific gray whales, and North Pacific right whales over the five-year period of the proposed permit, although such interactions are possible if a health emergency involving one or more of these species develops.

PROSPECTIVE HEALTH ASSESSMENT RESEARCH ACTIVITIES. The prospective health assessment research activities of the Health and Stranding Response Program are conducted on stranded animals and free-ranging animals that occur in areas with known health concerns or in areas of previous health concerns. Marine mammals that are captured for these health assessments may have visible health problems (for example, skin lesions), they may have been exposed to known toxins, or they may have been exposed to other physical, chemical, or biotic stressors that are known to produce adverse health outcomes in marine mammals.

The proposed permit would authorize representatives of the Health and Stranding Response Program to behaviorally harass up to 5,000 large whales each year during close approaches, aerial and vessel surveys. Each year for the next five years, the proposed permit would also authorize representatives of the Health and Stranding Response Program to tag and collect samples (including biopsy samples and respiratory gases) up to 100 large whales per year and collect samples from up to 400 large whales that have been captured during other lawful activities.

Although representatives of the Health and Stranding Response program have conducted health assessments of endangered or threatened marine mammals involved in mass stranding events of unusual mortality events, representatives of the program have not conducted prospective health assessments of endangered or threatened marine mammals. As a result, we do not know how many endangered or threatened marine mammals might actually be subjected to one or more of the procedures associated with the prospective health assessments. Based on the health assessments the Program has conducted over the past five years, the program does not seem likely to expose even a fraction of the number of endangered or threatened individuals identified in Table 2 of this Opinion.

Although the Health and Stranding Response Program and the proposed permit have not identified particular endangered or threatened species that might be exposed to one or more of the procedures associated with prospective health assessments, based on the data available, Fin whales, humpback whales, Southern resident killer whales, North Atlantic right whales, and sperm whales seem most likely to be exposed to those investigations over the five-year interval of the proposed permit. The Health and Stranding Response Program does not seem likely to conduct investigations on blue whales, bowhead whales, or North Pacific right whales over the five-year period of the proposed permit, although such investigations are possible.

We have no information on the potential consequences of those procedures for individual animals that are subjected to them. However, based on this limited evidence available, we conclude that whales are likely to respond to close approaches and aerial or vessel surveys with a wide range of behavioral responses rather than response with more serious consequences (such as physical injury). Their behavioral responses would range from no reaction, low-level reaction (immediate dives but no other overtly forceful behavior), moderate reactions (trumpet blows, hard tail flicks, but no prolonged evidence of behavioral disturbance), and strong reactions (surges, tail slashes, numerous trumpet blows).

If the results of Weinrich *et al*. (1992) are representative of the range of responses endangered and threatened whales are likely to exhibit to biopsy sampling, then 7 of these whales are not likely to respond to the biopsy sample, 27 are likely to respond with “low-level” behavioral responses, 61 are likely to respond with “moderate” behavioral responses, and 6 are likely to respond with “strong” behavioral responses. “Moderate” and “strong” responses might be accompanied by physiological stress responses, but the evidence available does not allow us to conclude that these animals are likely to experience reduced fitness as a result of these responses..

When survey aircraft fly below certain altitudes (about 1,500 feet), they have caused marine mammals to exhibit behavioral responses that might constitute a significant disruption of their normal behavior patterns. Based on reports from surveys of similar activities associated with Pacific Ocean populations of whales, about 6 percent of the individual whales showed behavior indicative of disturbance (e.g., diving or changing their behavior) coincident with the approach of aircraft. As a result, of the 5,000 close approaches of large whales that the Health and Stranding Response Program proposes to conduct each year over the next five years, we would expect about 300 individuals to exhibit disturbance responses. However, the approach of these whales by the aircraft did not appear to have resulted in long-term changes in the whales' behavior that would suggest long-term adverse effects on individuals, pods, or populations

Conclusion

After reviewing the current status of Guadalupe fur seal, Steller sea lion (western population), Steller sea lion (eastern population), Hawaiian monk seal, blue whale, bowhead whale, fin whale, humpback whale, killer whale (southern resident population), right whale (North Atlantic), right whale (North Pacific), sei whale, and sperm whale, the environmental baseline for the action area, the effects of the proposed research programs, and the cumulative effects, it is NMFS' biological opinion that issuance of the marine mammal permit and permit amendments to the National Marine Fisheries Service's Marine Mammal Health and Stranding Response Program is not likely to jeopardize the continued existence of Guadalupe fur seal, Steller sea lion (western population), Steller sea lion (eastern population), Hawaiian monk seal, blue whale, bowhead whale, fin whale, humpback whale, killer whale (southern resident population), right whale (North Atlantic), right whale (North Pacific), sei whale, and sperm whale.

INCIDENTAL TAKE STATEMENT

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

However, as discussed in the accompanying biological opinion, any "take" associated with the proposed permit is part of the intended purpose of the activities that would be authorized by the permit and, therefore, is not incidental take. Therefore, NMFS does not expect the proposed action to incidentally take threatened or endangered species.

CONSERVATION RECOMMENDATIONS

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

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

1. *Cumulative Impact Analysis.* Before authorizing any additional permits for activities similar to those contained in the proposed permit, the Permits Division should work with the Marine Mammal Commission, International Whaling Commission, and the marine mammal research community to identify a research program that would have sufficient power to determine the cumulative impacts of existing levels of research whales and other marine mammals. This includes the cumulative lethal, sub-lethal, and behavioral impacts of research permits on listed species

2. *Estimation of actual levels of "take."* Before authorizing any additional permits for activities similar to those contained in the proposed permits, the Permits Division should review the annual reports and final reports submitted by researchers that have conducted whale research as well as any data and results that can be obtained from the permit holders. This should be used to estimate the amount of harassment that occurs given the level of research effort, and how the harassment affects the life history of individual animals. The results of the study should be provided to NMFS' Endangered Species Division for use in the consultations of future research activities.

3. *Assessment of Coordination Conditions.* The Permits Division should assess the effectiveness of its permit conditions for notification and coordination within the next six months (December 2008).

4. *Coordination Meetings*. The Permits Division should continue to work with NMFS' Regional Offices to conduct meetings among regional species coordinators, permit holders conducting research within a region, and future applicants to insure that the results of all research programs or other studies on specific threatened or endangered species are coordinated among the different investigators.

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

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

REINITIATION NOTICE

This concludes formal consultation on NMFS' proposal to issue a permit to NMFS' Marine Mammal Health and Stranding Response Program, pursuant to the provisions of section 10 of the Endangered Species Act and Marine Mammal Protection Act. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. If the amount or extent of authorized take is exceeded, NMFS' Permits, Conservation and Education Division must immediately request reinitiation of section 7 consultation.

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