NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title: Biological Opinion on the Issuance of Permit No. 14097 for Research on Pinnipeds, Cetaceans, and Seat Turtles, in the Pacific, Southern, Arctic, and Indian Oceans

Action Agency: Permits, Conservation and Education Division, 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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NOAA's National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological Opinion

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

Activity Considered: Biological Opinion on the proposal to issue Permit Number 14097 to NMFS Southwest Fisheries Science Center to authorize research on pinnipeds, cetaceans, and sea turtles in the Pacific, Southern, Arctic, and Indian Oceans, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

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

Approved by: [illegible] for J. H. Lecky

Date: July 1, 2010

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

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed research on the threatened Steller sea lion and loggerhead sea turtle, the endangered olive ridley, green[1], leatherback, and hawksbill sea turtles and bowhead, sei, blue, fin, southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and these species' designated critical habitat, as has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits, Conservation, and Education Division's draft Environmental Assessment, draft

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[1] Green and olive ridley sea turtles in U.S. waters are listed as threatened except for Mexico's Pacific coast breeding population and the Florida breeding population (green only), which are listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green and olive ridley turtles are considered endangered wherever they occur in U.S. waters.

permit 14097, the permit application from NMFS Southwest Fisheries Science Center, annual reports of past research completed by the applicant, the most current marine mammal stock assessment reports, recovery plans for listed species, scientific and technical reports from government agencies, peer-reviewed literature, biological opinions on similar research, and other sources of information.

Consultation history

The NMFS' Permits, Conservation, and Education Division (Permits Division) requested consultation with the NMFS' Endangered Species Division on the proposal to issue scientific research permit authorizing studies on Steller sea lions, bowhead, sei, blue, fin, Southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and olive ridley, green, leatherback, hawksbill, and loggerhead sea turtles. Issuance of the permit constitutes a federal action, which may affect marine species listed under the ESA.

If issued, permit 14097 would replace the current permit No. 774-1714-10. Permit No. 774-1714 was originally issued in June 2004. Since then, there have been three amendments that required consultation. The first major amendment increased the take levels of humpback whales, the second included the take of Southern Resident killer whales in the permit, and the third increased the take level of several species of cetacean and also expanded the action area to include the Southern Ocean. All three consultations concluded that the amendments would not result in jeopardy to listed species. The remaining amendments were minor modifications to the permit and did not trigger reinitiation of consultation.

On December 29, 2009, the Permits Division requested initiation of Section 7 consultation to issue a new permit to NMFS Southwest Fisheries Science Center, which would replace the currently held permit. On January 27, 2010, the Endangered Species Division formally initiated consultation with the Permits Division.

Description of the proposed action

NMFS' Office of Protected Resources – Permits, Conservation, and Education Division proposes to issue a permit for scientific research pursuant to the ESA and the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq., Section 104). Issuance of permit 14097 to NMFS Southwest Fisheries Science Center would replace the current permit and authorize research on pinnipeds, cetaceans, and sea turtles in the Pacific, Southern, Arctic, and Indian Oceans.

Proposed permit 14097

The SWFSC proposes to conduct three research projects on five species of pinnipeds (one threatened), fifty-seven species of cetacean (nine endangered), and five species of sea turtles (one threatened and four endangered) in U.S. territorial and international waters. For the proposed action, the permit would be valid for five years from the date of issuance, and would expire on the date specified in the permit. The proposed actions and "take"[2] authorizations for the threatened and endangered species can be found in Tables 4-9.

Project I (Pinniped Studies) would include aerial photography, ground or vessel surveys, and photogrammetry. Pinniped research would occur in the Pacific Ocean off the coasts of California, Oregon, Washington, and Alaska.

Project II (Cetacean Studies) would include aerial photography, vessel surveys, photogrammetry, biopsy sampling, and tagging using suction-cup or dart tags. Cetacean research would occur in the Pacific, Arctic, Indian, and Southern Oceans.

Project III (Sea Turtle Studies) would include capture, collection of measurements, blood samples, and stomach contents (via lavage), tissue biopsy, and satellite tagging. Sea turtle research would occur in the North Pacific Ocean.

The numbers of pinnipeds, cetaceans, and sea turtles that could be surveyed, photographed, skin, blood, or tissue sampled, blubber biopsied, implantable or suction cup tagged, flipper tagged, satellite tagged, measured, weighed, or lavaged under the proposed permit are presented in Tables 4-9.

Project I (Pinniped Studies)

All age and sex classes of Steller sea lions (*Eumetopias jubatus*) could be disturbed by harassment during aerial photographic censuses, aerial photogrammetry, and California sea lion aerial and vessel surveys, ground censuses, and scat and spew collections. The proposed activities would take place on rookeries and haulouts located at the Channel Islands in the Southern California Bight (Santa Barbara Island, San Clemente Island, San Nicolas Island, San Miguel Island, Santa Cruz Island, Santa Catalina Island, Anacapa Island, and Santa Rosa Island), Año Nuevo Island, the Farallon Islands, and the coasts and bays of California, Oregon, Washington, and Alaska.

Aerial surveys would be conducted throughout the year, and include pup counts made at the end of the pupping season. For California sea lions, aerial, vessel, and ground surveys would be conducted throughout the year, and scat and spew samples collected in July would occur at or near the end of the California sea lion breeding/pupping season.

Aerial photographic censuses and photogrammetry would be conducted from a twin engine, high wing aircraft flying at an altitude of between 500 and 1,400 feet. A camera mounted in the belly of the aircraft would be used to collect high resolution images. Steller sea lions would normally be censused at 700 feet altitude. Lower altitudes would be flown if there are low fog ceilings.

Generally, only one photographic pass would be made over the animals. Occasionally a pass is repeated because photos are missed, or because animals were sighted too late to

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[2] Under the MMPA, "take" is defined as to "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." [16 U.S.C. 1362(18)(A)] The ESA defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The term "harm" is further defined by regulations (50 CFR §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering."

photograph. When the surface area inhabited by pinnipeds is too large for one photographic pass, multiple overlapping and slightly offset transect photo passes would be made until the entire area is photographed.

Ground or small vessel surveys and scat and spew collection would be conducted for non-listed pinniped species, such as California sea lions. Although these actions would not be directed at Steller sea lions, they could result in the disturbance of Stellers. Ground surveys are done on foot by one or two observers approaching the California sea lions close enough to observe with the naked eye or through binoculars. Approach would be between 1 to 50 meters, depending on terrain and topographical features which can hide the observer from the target animals. Vessel surveys would be conducted from a small rigid-hull or inflatable-hull boat powered with an outboard motor. Target animals would be approached quietly to within 5 meters. Vessel surveys of pinniped haulouts and rookeries would rarely be conducted, if ever. Scat and spew collection involves walking the areas where the animals have been recently, taking care to cause them the least alarm possible. Researchers would vacate the collection area as soon as the desired sample size is obtained. Collections would be made quarterly, usually during January, April, July, and October; however, they might be made during other months if a sufficient amount of scat and spew was not collected on previous trips to complete the diet analysis.

Researchers would continue to use mitigation measures currently in place:

- Potential disturbance from aerial surveys and photogrammetry would be minimized by flying at a constant speed and altitude.
- Aerial photographic passes would be limited in number to reduce the potential for harassment of individual animals.
- Pinniped ground surveys and scat collection are conducted on a routine basis throughout the year. Disturbance from research activities usually is a reaction to the researchers' presence; therefore continued presence to monitor the animals could continue the source of disturbance. On leaving the study site the researcher would monitor whether the animals are returning to their normal activities.
- If unusual patterns arise in the population status or the diet analysis that could be tied to disturbance from research activities, they would be thoroughly investigated.

Project II (Cetacean Studies)

Cetacean research activities would include aerial surveys, large and small vessel surveys, photogrammetry, photo-identification, biological sample collection, and tagging. Activities would occur during any month of the year, although vessel surveys (with concurrent aerial photogrammetry, photo-identification, biological sample collection, and tagging) would primarily be conducted July through December.

Large vessel surveys would typically occur once per year, on a roughly three-year cycle per region – for example, one year the survey would be done on the west coast of the United States, one year the survey would be done in the Eastern Tropical Pacific, and one year the survey would be done in areas around Hawaii. Survey schedules are dependent on funding, and typically start in July and end in December.

Data would be collected using line-transect methodology to estimate population abundance by species/stock. Although procedures may vary slightly depending on the specific objective of the survey, the following protocol is typically used on SWFSC research vessel surveys. The vessel (likely to be NOAA research vessel McArthur II, a 68.3 meter vessel) would traverse predetermined track lines within the study area at a constant speed (usually 10 knots). Marine mammal observers stationed on the flying bridge deck of the vessel would search the area from directly ahead to abeam of the ship using pedestal-mounted 25X binoculars. At times, depending on the species sighted and the data collection priorities, the vessel might turn off the track line and approach marine mammals to confirm species identification and to estimate group size. Photographs of bow-riding animals would also be taken on an opportunistic basis from the bow of the main research vessel.

Large vessel approaches to cetaceans would be conducted at the minimum speed needed to close the distance between ship and the animals, typically 10 knots or less, and often cease when the ship is within 500 yards of the school. Approaches would be made from behind or from the side of animals.

Other activities that might occur concurrently with large vessel surveys include:

- aerial photogrammetry,
- photo-identification from small vessels,
- collection of skin/blubber biopsy samples from small vessels,
- tagging activities from small vessels, and
- skin/blubber biopsy samples and photographs collected from the main vessel.

Small vessel approaches would be conducted from behind animals in a manner that minimizes boat noise, does not involve sudden changes in speed or course, and does not greatly exceed the animal's travel speed. Small vessels (e.g., rigid-hull inflatables or a 19' Cutty cabin cruiser with a 150 hp outboard four-stroke engine) would be used in conjunction with large vessels or for dedicated local surveys. Researchers would attempt to minimize time spent in the vicinity of target animals, as well as the number of attempts made to collect photographs or biopsy samples or to deploy tags.

Small vessel surveys conducted by SWFSC (typically local to San Diego) would occur year round. Small vessel surveys conducted by co-investigators would occur year-round or seasonally, depending on data collection needs. In Hawaii, surveys would generally occur in the winter and in Alaska they would occur in the summer.

Photo-identification activities are primarily conducted from small boats either on an opportunistic basis during large vessel surveys, or during coastal small boat surveys off California, Oregon, Washington, Hawaii, Alaska, American Samoa, Palmyra, or in international waters.

Animals would be approached closely enough to optimize photographic quality (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 would be approached within 15-20 m. Photo-identification of adult and juvenile males and females would occur. If the opportunity arises, females accompanied by calves would be approached for photo-identification, but efforts would cease immediately if there is any evidence that the activity may be interfering with pair bonding, nursing, reproduction, feeding or other vital functions.

Aerial surveys use conventional line-transect sampling and are flown at an altitude of 500-1,000 ft (generally at 700 ft) using a twin-engine, high wing Partenavia or Twin Otter aircraft. Surveys would be conducted along the U.S. west coast to determine the distribution and abundance of dolphin and whale stocks. Surveys would be flown year-round and are weather dependent. The number of survey days per year varies considerably, but generally ranges from 7 to 20. Two 4-hour fights per day would typically be conducted. Aerial surveys would occur from the coast to 150 nautical miles offshore. The aircraft would circle over animals to confirm species identification and to estimate group size. All age and sex classes would be surveyed.

Photogrammetry surveys would be conducted using twin-engine, high wing Partenavias or Twin Otter aircraft, and are separate from the aerial surveys described above. A camera, designed to collect high resolution images from high speed aircraft flying at low altitudes, is mounted in the belly of the aircraft and takes large-format, motion-compensated photographs. Photographs would generally be taken at altitudes between 500 and 700 ft. All age and sex classes would be photographed from the air**.**

Biopsy sample collection would occur during large vessel surveys or during coastal small boat surveys by collecting skin/blubber using a projectile dart. Projectile biopsies would be collected using a crossbow, adjustable-pressure modified air-gun, black powder gun, or pole. During any single encounter, no more than three biopsy sample attempts per individual would be made. Based on the researchers' experience, animals would rarely be targeted for biopsy more than twice during an encounter.

If signs of harassment (such as rapid changes in direction or prolonged diving) are observed from an individual or a group, biopsy activities would be discontinued on that individual or group. The animals to be sampled would either approach the vessel on their own or be approached using the methods described under *Large vessel surveys, Small vessel approaches,* and *Photo-identification*. The projectile biopsy sample would be collected from animals within approximately 5 to 30m of the bow of the vessel or small boat.

It is possible that the researchers would attempt to sample large whales from a large vessel, which could make dart retrieval impractical. In this case, the researchers could use a tethering method, which involves using spooled line with the spool attached to the crossbow and the other end of the line attached to the dart. In general, however, researchers would attempt to biopsy from small boats, where retrieval of the dart would not require tethering.

The tissue collected from large cetaceans (<1 gram) would be obtained from free-ranging individuals using a biopsy dart with a stainless steel tip measuring approximately 4 cm in length and 9mm in external diameter. The tip would be fitted with a 2.5 cm stop to ensure recoil and prevent penetration deeper than 1.5 cm. The same size biopsy dart would be used for all age classes. Between sampling, biopsy tips would be thoroughly cleaned and disinfected with bleach.

Biological samples would be collected from adults, juveniles, females with calves, and calves. No biological samples would be taken from large whale calves less than two months old or their mothers or 1 year old for Southern Resident killer whales. The age of a calf would be determined by biologists in the field, who would err on the side of caution to prevent biopsy of an animal that appeared too young.

Biopsy sampling would be conducted in conjunction with photo-identification surveys and tagging projects and during dedicated biopsy projects. Biopsy samples would be collected from both sexes and any reproductive status. Mothers and calves would be sampled if there is no adverse reaction to the approach of the vessel. Biopsy samples will be obtained from tagged animals when possible.

Tagging activities would be conducted during large vessel surveys and during coastal small boat surveys. Most tagging activities would be done from a small vessel platform, though the applicant would take advantage of a large ship with a good configuration that would allow a potentially high success rate (i.e., low sides allowing for a good shot of an animal swimming alongside). Animals would be approached using the methods described for large vessel surveys, small vessel approaches, and photo-identification. Approaches would be slow and steady, from behind and beside the animal, and would be timed to coincide with the individual surfacing.

All tags would be deployed with a crossbow, adjustable-pressure modified air-gun, black powder gun or pole. The tag would be attached to the dorsal fin or the dorsal surface just in front of or beside the dorsal fin so that the antenna would be exposed when the animal surfaces. Tags would be attached either by suction cup or by implanting into the skin and/or blubber.

Tags would be attached to adult and juvenile males and females. No tagging attempts would be made on dependent calves; however, mothers accompanying calves would be tagged. The minimum age of large whales that would be tagged is six months, which corresponds with the age that calves are usually weaned.

Three types of tags would be employed, and usage would depend on the primary research question being addressed:

- radio tags,
- time depth recorder (TDR) tags, and
- satellite tags.

Radio tags allow for individual animals to be tracked and dive pattern data recorded, which, for example, provides the information to estimate dive times required to establish correction factors for estimating abundance. The radio tag would consist of a radio transmitter and an antenna. The transmitter generally operates at 148 MHZ with a 30-millisecond pulse and 100 pulses/minute. The tags would be approximately 7.6 cm x 1.3 cm with a transmitting antenna approximately 40 cm. The tag with antenna would weigh approximately 30 g.

The *time-depth-recorder tag* package is a recoverable unit that provides even more detailed data on dive behavior because it records water temperature, depth and time. The TDR would provide a profile of the diving activity (e.g., sound, pitch, roll, heading, depth) of the animal. Time and depth would be recorded at a time interval specified by the user.

Satellite tags would be used to collect data on longer-term movements of animals as well as dive time and depth data.

Suction cup attached TDR tags, which generally fall off within 72 hours, would be used to study diving and foraging behavior. Two types of suction-cup tags would be used:

- DTAGs
- Acousonde tags

Table 1. Suction cup tags proposed for use on cetaceans. Tag dimensions may vary depending on the target species and advances in technology.

Tag	Dimensions	Attached using	Release	Attachment time	Attachment method	VHF frequency
DTAG	6 x 3 x 2 in	Four 1 in diameter suction cups	Programmed to release by venting suction cups	24 hr recording; longest attachment 17 hrs	15 ft pole from small boat	148-150 MHz
Acousonde tag	1.25 in diameter x 8.7 in long	Two 2.5 in diameter suction cups	Until suction cups naturally release	15 minutes to 40 hours	15 ft pole from small boat	164-165 MHz

Implantable tags would include:

- “dart” tags
- “flat implant” tags

Both types of implantable tags will be remotely attached using an adjustable-pressure modified air-gun or crossbow equipped with a 150 lb draw limb. The tag antenna will be inserted into the hollow shaft of a projectile bolt, and on contact with the whale this dart will fall away and be retrieved by a tether line.

Table 2. Implantable tags proposed for use on cetaceans. Tag dimensions may vary depending on the target species and advances in technology.

Tag	Dimensions	Weight	Attached Using	Attachment Location	Length of Attachment
“dart” tag*	6.3 cm long 3 cm wide 1.9 cm tall	40 g	Two barbed darts 4.2mm in diameter with penetration depth of 6.5 cm	Externally to the dorsal fin or dorsal surface of medium-sized cetaceans and large whales	8-9 weeks
“flat implant” tag**	7.8cm long 2cm wide 1 cm tall	77 g	Up to 7 cm of tag with penetrating tip and 4 barbs implanted into sub-dermal tissue	Dorsal fin of medium-sized cetaceans, and dorsal fin/dorsal ridge of large whales	14-24 weeks

* based on Andrews et al. (2008), Durban et al. (submitted), used successfully on killer whales in Antarctic and Alaskan waters

** based on Wildlife Computers model AM-194-01S or similarly sized packages

During any single encounter, no more than three tag deployment attempts per individual will be made. Individuals may be re-tagged after attachment of a first tag has failed, but only up to two tags per year will be placed on the same individual. On occasion, both a suction-cup tag and an implantable tag would be attached to an animal.

Exact dimensions and weights would vary with generation of tag and specific components included. Advancements in technology have consistently led to smaller and more effective tags, and this trend is expected to continue in the future. The SWFSC expects to update its tagging equipment as newer models become available, and careful consideration of the primary research objective would be given before finalizing the tag package and deployment system to ensure that the smallest, lightest package is deployed.

The SWFSC would attempt to minimize potential disturbance during cetacean research by:

- conducting aerial surveys and photogrammetry at a constant speed and altitude and limiting the number of aerial photographic passes,
- conducting small boat approaches using crew members with extensive experience handling small boats around cetaceans,
- conducting small boat approaches in a manner that minimizes boat noise, does not involve any sudden changes in speed or course, and approaches an animal from behind while not greatly exceeding the animal's travel speed,
- limiting time spent in the vicinity of target animals and the number of attempts made to collect photographs in order to minimize harassment or disturbance from the presence of the small boat or the activities, and
- not approaching animals exhibiting behaviors that indicate a negative reaction to the vessel, such as aerial behaviors or tail slaps. If at any time during these there is a negative reaction (rapidly diving, tail slapping, or rapidly swimming away), all efforts to approach the animals will cease.

Project III (Sea Turtle Studies)

Sighting data and biological samples would be collected opportunistically during cetacean studies when it would not conflict with other research priorities. During marine mammal surveys, sightings of sea turtles would be recorded and photographed for species identification. In addition, sea turtles would be captured to:

- measure, weigh, sex, and attach flipper tags,
- collect blood samples to determine sex of juveniles and reproductive status of adults,
- collect stomach contents by lavage to identify prey items,
- collect tissue biopsy and/or blood samples for genetic analyses of stock identification and stable isotope analysis, and
- attach satellite tags to collect movement and dive behavior data.

Blood, stomach contents, and tissue biopsy samples collected from sea turtles in international waters (high seas) would be imported into the United States.

Sea turtles weighing less than 100lbs would be captured from an inflatable raft to be measured, sexed, weighed, and tagged. The use of an inflatable raft would reduce the danger of physical injury during handling. After approach of the raft to target sea turtles, a swimmer would enter the water and grasp the turtle at the top and rear of its carapace to direct the turtle up and out of the water. The turtle is then handed to personnel in the raft to be processed. Researchers would not use a net to capture sea turtles.

Measuring, weighing, sexing, and flipper tagging of each turtle captured would be conducted by a minimum of 2 and a maximum of 4 researchers. Standard carapace (both straight line and curved) and tail measurements would be made as outlined in the *Manual of Sea Turtle Research and Conservation Techniques* (Pritchard et al. 1983). Each turtle would be double flipper tagged (one tag on each front flipper) with an Inconel tag (Style 681, National Band and Tag Company) issued by the SWFSC using the standard technique described in *Research and Management Techniques for the Conservation of Sea Turtles* (Eckert et al. 1999). The tags would be attached to the trailing edge of the left and right front flipper near the carapace, using an applicator similar to those used to ear-tag livestock: the pointed end of the tag goes through the flipper and connects on the underside. If a turtle with fibropapilloma is observed, a separate set of sampling equipment would be used.

Blood collection would be conducted on each turtle captured. After cleansing the site with betadine or alcohol to disinfect it, approximately 10cc of blood would be collected from each turtle by inserting a sterile needle, attached to a vacuum syringe, into the dorsal cervical sinus on the lateral dorsal region of the neck, using the technique described in Bentley and Dunbar-Cooper (1980) and Owens and Ruiz (1980). Once sampling is complete the area would be cleansed again with betadine or alcohol to avoid infection at the sample site. The samples would be kept on ice for no more than two hours until they can be centrifuged. The separated serum would then be pipetted off and frozen. Hormone assays would follow the standard procedure described by Plotkin et al. (1997). Remaining red blood cells would be used for genetic analysis.

Collection of stomach contents by gastric lavage would be conducted immediately after capture to identify prey items. The turtle would be elevated, and a length of 3/4 inch diameter soft plastic tubing would be inserted down the esophagus to the "pre-stomach" and flushed with clean seawater poured into the tubing. Contents would be collected in a separate basin. The procedure would take 5-10 minutes.

Tissue biopsy sample collection would be conducted for genetic analyses of stock identification and stable isotope studies. After cleansing the sample area with betadine or alcohol, a small disk of skin measuring 6 mm in diameter would be collected from the hind flipper (Dutton and Balazs 1995) using a sterile Acu-punch 6 mm biopsy tool (Acuderm, Fort Lauderdale, Florida).

Satellite tagging activities would follow procedures set forth in Balazs et al. (1996). Turtles would be held in a prone position after capture and kept in enclosures (such as on top of a small tire, on foam pads, or if available, in a wooden or plastic box) to prevent them from injuring themselves or other turtles. They would be kept in a natural position without the use of ropes, straps, or other means of binding in order to physically control flipper movement. They would be shaded, covered with towels, and kept wet to prevent overheating. A wet cloth would be used to block the turtle’s vision, reducing the desire to move around.

Transmitters would be attached to the carapace with thin coats of fiberglass resin as described in Balazs et al. (1996). The attachment area on the carapace would be lightly sanded to remove algae. A non-toxic elastomer compound will be used to “cushion” the transmitter and hold it in place during the attachment procedure (Sammons & Preston). A thin coat of laminating resin would be applied to the carapace and transmitter and 6-8 strips of fiberglass cloth would be pasted over the transmitter to attach it.

Table 3. Examples of satellite tags proposed for use on sea turtles. Tag dimensions may vary depending on the target species and advances in technology.

Tag	Dimensions	Weight	Use
Telonics A-1010, (formerly the ST-20)	6.0 x 12.3 x 2.8 cm	276 g	location only
Telonics A-2025	13.97 x 7.6 x 4.1 cm	595 g	location and depth
Wildlife Computers ‘Splash’ Tag	8.5 cm x 7.6 cm x 3.3 cm	65 g	location and depth
Wildlife Computers ‘Spot 5’ Tag	7.2 x 3.4 x 2.5 cm	30 g	location and depth
Wildlife Computers MK-10 GPS tag	10.2 cm x 5.7 cm x 3.1 cm	225 g	location, depth (argos-derived and GPS), water temperature, and light level

Note: a maximum of one satellite tag will be deployed per turtle.

Salvage and Import/Export/Re-export of Marine Mammal and Sea Turtle Parts, Specimens and Biological Samples: Marine mammal and turtle parts would be collected, imported, exported, or re-exported in conjunction with these activities. Salvaged parts or specimens and biological samples collected by other researchers would also be imported, exported, and re-exported.

Table 4 – Proposed actions for listed pinnipeds in the Pacific Ocean.

Species	Status	Lifestage	Sex	Annual “take” limit	“Takes” per animal	Type of “take”	Procedures	Change from Permit No. 774-1714-10
Steller sea lion East of 144° Long (Eastern US)	Threatened	All	Male and Female	30000	6	Harass	Aerial survey/count; photo-id; photogrammetry	No change
Steller sea lion East of 144° Long (Eastern US)	Threatened	All	Male and Female	3000	3	Harass	Disturbance during California sea lion aerial/ground surveys	No change

Table 5 – Proposed actions for listed cetaceans in the Pacific and Southern Oceans (international and U.S. territorial waters).

Species	Status	Lifestage	Sex	Annual “take” limit	Type of “take”	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Sei whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	23	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal.	No change; **calves new**
Sei whale (range-wide)	Endangered	All	Male and Female	2	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal. Intended for calves 6 months or older.	
Sei whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	23	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy.	No change; **calves new**
Sei whale (range-wide)	Endangered	All	Male and Female	2	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy. Intended for calves 6 months or older.	

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Sei whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	90	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change; **younger calf age**
Sei whale (range-wide)	Endangered	All	Male and Female	10	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Sei whale (range-wide)	Endangered	All	Male and Female	1000	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id	No change
Sei whale (range-wide)	Endangered	All	Male and Female	200	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	No change
Blue whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	20	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal.	No change; **calves new**
Blue whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal. Intended for calves 6 months or older.	
Blue whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	20	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy.	No change; **calves new**
Blue whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy. Intended for calves 6 months or older.	
Blue whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	175	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change; **younger calf age**
Blue whale (range-wide)	Endangered	All	Male and Female	25	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Blue whale (range-wide)	Endangered	All	Male and Female	1000	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Blue whale (range-wide)	Endangered	All	Male and Female	200	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	No change
Fin whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	20	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal.	No change; **calves new**
Fin whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal. Intended for calves 6 months or older.	
Fin whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	20	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy.	No change; **calves new**
Fin whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy. Intended for calves 6 months or older.	
Fin whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	450	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	**Increase from 100 to 500; younger calf age**
Fin whale (range-wide)	Endangered	All	Male and Female	50	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Fin whale (range-wide)	Endangered	All	Male and Female	1000	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change
Fin whale (range-wide)	Endangered	All	Male and Female	200	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	No change
Southern right whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	9	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change; **younger calf age**
Southern right whale (range-wide)	Endangered	All	Male and Female	1	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Southern right whale (range-wide)	Endangered	All	Male and Female	200	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change
North Pacific right whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	4	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal.	No change
North Pacific right whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	4	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy.	No change
North Pacific right whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	25	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	**Increase from 10 to 30; younger calf age**
North Pacific right whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
North Pacific right whale (range-wide)	Endangered	All	Male and Female	40	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change
North Pacific right whale (range-wide)	Endangered	All	Male and Female	40	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	**Increase from 20 to 40**
Humpback whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	25	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal.	**Increase from 17 to 30 total; calves new**
Humpback whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal. Intended for calves 6 months or older.	
Humpback whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	25	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy.	**Increase from 18 to 30; calves new**
Humpback whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy. Intended for calves 6 months or older.	

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Humpback whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	225	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	**Increase from 260 to 300; younger calf age**
Humpback whale (range-wide)	Endangered	All	Male and Female	75	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Humpback whale (range-wide)	Endangered	All	Male and Female	1000	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change
Humpback whale (range-wide)	Endangered	All	Male and Female	400	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	**Increase from 100 to 400**
Sperm whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	25	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal.	**Increase from 20 to 30; calves new**
Sperm whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Implantable tag; photo-id; skin and blubber biopsy. One implantable tag per animal. Intended for calves 6 months or older.	
Sperm whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	25	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy.	**Increase from 25 to 30; calves new**
Sperm whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Suction-cup tag; photo-id; skin and blubber biopsy. Intended for calves 6 months or older.	
Sperm whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	275	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	**Increase from 80 to 300; younger calf age**
Sperm whale (range-wide)	Endangered	All	Male and Female	25	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Sperm whale (range-wide)	Endangered	All	Male and Female	1000	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Sperm whale (range-wide)	Endangered	All	Male and Female	1000	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	**Increase from 900 to 1000**
Killer whale – Southern Resident stock	Endangered	Adult/ Juvenile	Male and Female	8	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change
Killer whale – Southern Resident stock	Endangered	All	Male and Female	2	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 1 year or older.	
Killer whale – Southern Resident stock	Endangered	All	Male and Female	40	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change

Table 6 – Proposed actions for listed cetaceans in the Southern Ocean (international and U.S. territorial waters)

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Humpback whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	4	Harass/ Sampling	Vessel survey	Implantable tag; suction-cup tag; photo-id, skin and blubber biopsy. One implantable tag per animal; might suction-cup tag animal that has implantable tag.	No change; **calves new**
Humpback whale (range-wide)	Endangered	All	Male and Female	1	Harass/ Sampling	Vessel survey	Implantable tag; suction-cup tag; photo-id, skin and blubber biopsy. One implantable tag per animal; might suction-cup tag animal that has implantable tag. Intended for calves 6 months or older.	

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Humpback whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	4	Harass/ Sampling	Vessel survey	Suction-cup tag (including Crittercam); photo-id; skin and blubber biopsy.	No change; **calves new**
Humpback whale (range-wide)	Endangered	All	Male and Female	1	Harass/ Sampling	Vessel survey	Suction-cup tag (including Crittercam); photo-id; skin and blubber biopsy. Intended for calves 6 months or older.	
Humpback whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	30	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change; **younger calf age**
Humpback whale (range-wide)	Endangered	All	Male and Female	10	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Humpback whale (range-wide)	Endangered	All	Male and Female	100	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change
Humpback whale (range-wide)	Endangered	All	Male and Female	100	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	No change
Sperm whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	5	Harass/ Sampling	Vessel survey	Implantable tag; suction-cup tag; photo-id, skin and blubber biopsy. One implantable tag per animal; might suction-cup tag animal that has implantable tag.	No change
Sperm whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	15	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change; **younger calf age**
Sperm whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Sperm whale (range-wide)	Endangered	All	Male and Female	100	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change
Sperm whale (range-wide)	Endangered	All	Male and Female	100	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	No change

Table 7 – Proposed actions for listed cetaceans in the Indian Ocean.

Species	Status	Lifestage	Sex	Annual “take” limit	Type of “take”	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Blue whale (range-wide)	Endangered	All	Male and Female	300	Harass	Aerial survey	Aerial survey; photo-id; photogrammetry.	**New for Indian Ocean**

Table 8 – Proposed actions for listed cetaceans in the Pacific, Southern, and Arctic Oceans.

Species	Status	Lifestage	Sex	Annual “take” limit	Type of “take”	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Bowhead whale (range-wide)	Endangered	Adult/ Juvenile	Male and Female	15	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy.	No change; **younger calf age**
Bowhead whale (range-wide)	Endangered	All	Male and Female	5	Harass/ Sampling	Vessel survey	Photo-id; skin and blubber biopsy. Intended for calves 2 months or older.	
Bowhead whale (range-wide)	Endangered	All	Male and Female	200	Harass	Vessel survey	Disturbance; collect sloughed skin and feces; photo-id.	No change

Table 9 – Proposed actions for listed sea turtles in the North Pacific Ocean.

Species	Status	Lifestage	Sex	Annual “take” limit	Type of “take”	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Olive ridley sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	15	Capture/ Handle/ Release	Hand and/or Dip Net	Instrument with epoxy; flipper tag; measure; blood and tissue sample; weigh.	No change

Species	Status	Lifestage	Sex	Annual "take" limit	Type of "take"	Observe/ collect method	Procedures	Change from Permit No. 774-1714-10
Olive ridley sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	50	Capture/ Handle/ Release	Hand and/or Dip Net	Lavage; flipper tag; measure; blood and tissue sample; weigh.	No change
Olive ridley sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	235	Capture/ Handle/ Release	Hand and/or Dip Net	Flipper tag; measure; blood and tissue sample; weigh.	No change
Green sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	10	Capture/ Handle/ Release	Hand and/or Dip Net	Instrument with epoxy; flipper tag; measure; blood and tissue sample; weigh.	No change
Green sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	10	Capture/ Handle/ Release	Hand and/or Dip Net	Lavage; flipper tag; measure; blood and tissue sample; weigh.	No change
Green sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	80	Capture/ Handle/ Release	Hand and/or Dip Net	Flipper tag; measure; blood and tissue sample; weigh.	No change
Leatherback sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	10	Capture/ Handle/ Release	Hand and/or Dip Net	Flipper tag; measure; blood and tissue sample; weigh.	No change
Hawksbill sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	5	Capture/ Handle/ Release	Hand and/or Dip Net	Instrument with epoxy; flipper tag; measure; blood and tissue sample; weigh.	No change
Hawksbill sea turtle (range-wide)	Endangered	Adult/ Subadult/ Juvenile	Male and Female	15	Capture/ Handle/ Release	Hand and/or Dip Net	Flipper tag; measure; blood and tissue sample; weigh.	No change
Loggerhead sea turtle (range-wide)	Threatened	Adult/ Subadult/ Juvenile	Male and Female	10	Capture/ Handle/ Release	Hand and/or Dip Net	Instrument with epoxy; flipper tag; measure; blood and tissue sample; weigh.	No change
Loggerhead sea turtle (range-wide)	Threatened	Adult/ Subadult/ Juvenile	Male and Female	10	Capture/ Handle/ Release	Hand and/or Dip Net	Lavage; flipper tag; measure; blood and tissue sample; weigh.	No change

Permit conditions

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

- In the event of serious injury or mortality or if the permitted "take" is exceeded, researchers must suspend permitted activities and contact the Permits Division by phone within two business days, and submit a written incident report. The Permits Division may grant authorization to resume permitted activities.
- Permit holders must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.

Pinnipeds and Cetaceans

- **Takes.** Any "approach" constitutes a take by harassment under the MMPA and must be counted and reported. Regardless of success, any attempt to tag or biopsy sample an animal, which includes the associated close approach, constitutes a take and must be counted and reported. During aerial surveys, any cetacean or pinniped observed below 1,000 ft should be counted and reported as a take. No individual animal may be "taken" more than 3 times in one day.
- **Aerial surveys**. Aerial surveys must be flown at an altitude no lower than 500 ft. If an animal responds to the presence of the aircraft, the aircraft must leave the vicinity and either resume searching or continue on the line-transect survey. Aerial surveys of cetaceans must not be conducted over pinniped haul out areas.

Cetaceans

- **Mother and calf pairs**. When females with calves are authorized to be taken, researchers must terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions; must not position the research vessel between mother and calf; must not approach when calf is actively nursing; must, if possible, sample the calf first.
- **Biopsy and Tagging.** All biopsy tips must be disinfected between and prior to each use. Researchers must follow the age limits for listed whale calves for tagging and biopsy. Researchers may make up to 3 attempts per day to biopsy or tag an individual. A biopsy sample or tagging attempt must be discontinued if an animal exhibits repetitive strong adverse reactions to the activity or the vessel. In no instance will the researcher attempt to biopsy or tag a cetacean anywhere forward of the pectoral fin. Researchers must take reasonable measures to avoid repeated sampling of an individual.

- **Locations.** This permit does not authorize research activities off the Northwest Olympic Peninsula, particularly the Cape Flattery and Neah Bay areas. This includes the waters located south of the U.S./Canada border, west of 124º W and north of 48º N. To conduct research in this area, the permit holder is required to obtain authorization from the native Makah Nations. Bowhead whale research activities authorized herein must not be conducted in a manner or at a time that will interfere with the Eskimo subsistence harvest.

Sea turtles

- **Equipment.** All equipment that comes in contact with sea turtles must be cleaned and disinfected between the processing of each turtle, and special care must be taken for animals displaying fibropapilloma tumors or legions. All turtles must be examined for existing tags before attaching or inserting new ones. If existing tags are found, the tag identification numbers must be recorded and included in the annual report.
- **Veterinary care.** Researchers must use care when handling live animals to minimize any possible injury, and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. Whenever possible, injured animals should be transferred to rehabilitation facilities and allowed an appropriate period of recovery before return to the wild. An experienced veterinarian, veterinary technician, or rehabilitation facility must be named for emergencies. If an animal becomes highly stressed, injured, or comatose during the course of the research activities the researchers must contact a veterinarian immediately. Based on the instructions of the veterinarian, if necessary, the animal must be immediately transferred to the veterinarian or to a rehabilitation facility to receive veterinary care.
- **Handling and release.** Turtles are to be protected from temperature extremes of heat and cold, provided adequate air flow, and kept moist (if appropriate) during sampling. Turtles must be placed on pads for cushioning and this surface must be cleaned and disinfected between turtles. The area surrounding the turtle must not contain any materials that could be accidentally ingested. During release, turtles must be lowered as close to the water's surface as possible to prevent potential injuries. Newly released turtles must be monitored for abnormal behavior. Extra care must be exercised when handling, sampling and releasing leatherbacks.
- **Blood sampling.** If an animal cannot be adequately immobilized for blood sampling, efforts to collect blood must be discontinued. Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side. No blood sample will be taken should conditions on the boat preclude the safety and health of the turtle. The permit includes limits on the amount of blood that can be drawn, based on the turtle's body weight and the cumulative blood volume taken from an individual over a 45-day period. Researchers must, to the best of their ability, attempt to determine if any of the turtles they blood sample may have been sampled within the past 3 months or will be sampled within the next 3 months by other researchers.
- **Gastric lavage.** The actual lavaging of an individual turtle must not exceed 3 minutes. Once the samples have been collected, water must be turned off and water and food allowed to drain until all flow has stopped. The posterior of the turtles will be elevated slightly to assist in drainage. Equipment must be cleaned and disinfected.

- **Satellite tagging and marking.** Total weight of transmitter attachments must not exceed 5% of the body mass of the animal. Each attachment must be made so that there is no risk of entanglement. Researchers must make attachments as hydrodynamic as possible. Adequate ventilation around the head of the turtle must be provided during the attachment of satellite tags or attachment of radio/sonic tags if attachment materials produce fumes. To prevent skin or eye contact with harmful chemicals used to apply tags, turtles must not be held in water during the application process.
- **Compromised or injured turtles.** Researchers may conduct the activities authorized by this permit on compromised or injured sea turtles, but only if the activities will not further compromise the animal. Care must be taken to minimize handling time and reduce further stress to the animal. Compromised or injured sea turtles must not be handled or sampled by other permit holders working under separate research permits if their activities would further compromise the animal.

Non-target species

- **Hawaiian monk seals.** The permit holder must report any opportunistic Hawaiian monk seal sightings to Thea Johanos, NMFS Pacific Islands Fisheries Science Center.
- **Sea otters.** The permit provides guidelines for avoiding interactions with sea otters and actions to take if a sea otter is injured or killed.
- This permit does not authorize takes of any protected species not identified in Tables 4-9, including those species under the jurisdiction of the USFWS (e.g. sea otters, polar bears). Should other protected species be encountered during the research activities authorized under this permit, researchers must exercise caution and remain a safe distance from the animal(s) to avoid take, including harassment.

Approach to the assessment

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

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

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

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

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

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

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

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

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

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

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

Action Area

Activities would be conducted year-round, primarily in the Pacific Ocean, but also in the Southern, Indian, and Arctic Oceans. Not all species would be affected in all action areas. Pinniped studies will take place on rookeries and haulouts located at the Channel Islands in the Southern California Bight (Santa Barbara Island, San Clemente Island, San Nicolas Island, San Miguel Island, Santa Cruz Island, Santa Catalina Island, Anacapa Island, and Santa Rosa Island), Año Nuevo Island, the Farallon Islands, and the coasts and bays of California, Oregon, Washington, and Alaska. Cetacean studies would take place throughout the Pacific and Southern Oceans; the blue whale is the only listed species for which the proposed permit would authorize research in the Indian Ocean; the bowhead whale is the only listed species for which the proposed permit would authorize research in the Arctic Ocean. Sea turtle research would take place in the North Pacific Ocean.

As stated in the Permit conditions, the permit would not authorize research activities off the Northwest Olympic Peninsula, particularly the Cape Flattery and Neah Bay areas.

Status of listed resources

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

Pinnipeds		
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Hawaiian monk seal	*Monachus schauinslandi*	Endangered
Steller sea lion – Eastern DPS	*Eumetopias jubatus*	Threatened
– Western DPS		Endangered
Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Bowhead whale	*Balaena mysticetus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Gray whale – Western N. Pacific	*Eschrichtius robustus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale - Southern Resident	*Orcinus orca*	Endangered
North Pacific right whale	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Southern right whale	*Eubalaena australis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtles		
Green sea turtle – most areas	*Chelonia mydas*	Threatened
Florida and Mexico's Pacific coast breeding colonies		Endangered
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Leatherback sea turtle	*Dermochelyts coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Olive ridley sea turtle – most areas	*Lepidochelys olivacea*	Threatened
Mexico's Pacific coast breeding colonies		Endangered
Fish		
Chinook salmon ESUs	*Oncorhynchus tshawytscha*	Threatened Endangered
Chum salmon ESUs	*Oncorhynchus keta*	Threatened
Coho salmon ESUs	*Oncorhynchus kisutch*	Threatened Endangered
Green sturgeon – Southern DPS	*Acipenser medirostris*	Threatened
Sockeye salmon ESUs	*Oncorhynchus nerka*	Threatened Endangered

Steelhead trout ESUs	*Oncorhynchus mykiss*	Threatened Endangered
Invertebrates		
Black abalone	*Haliotis cracherodii*	Endangered
White abalone	*Haliotis sorenseni*	Endangered

Species not considered further in this opinion

To refine the scope of this Opinion, NMFS used two criteria (risk factors) to determine whether any endangered or threatened species or critical habitat are not likely to be adversely affected by vessel traffic, aircraft traffic, or human disturbance associated with the proposed actions. The first criterion was *exposure*: if we conclude that particular endangered or threatened species or designated critical habitat are not likely to be exposed to vessel traffic, aircraft traffic, or human disturbance, we must also conclude that those listed species or designated critical habitat are not likely to be adversely affected by the proposed action. The second criterion is *susceptibility* upon exposure: species or critical habitat may be exposed to vessel traffic, aircraft traffic, or human disturbance, but may not be unaffected by those activities—either because of the circumstances associated with the exposure or the intensity of the exposure-- are also not likely to be adversely affected by the vessel traffic, aircraft traffic, or human disturbance. This section summarizes the results of our evaluations.

The Western DPS of Steller sea lions, Guadalupe fur seal, Hawaiian monk seal, and Western North Pacific gray whale may occur in the action area, but are not expected to be exposed to the proposed activities. If a protected whale or pinniped is observed in the action area, it would be avoided and the vessel would operate at a reduced speed, following marine mammal viewing guidelines. Given permit conditions, the manner in which activities would be conducted, and the fact that research would target other species, the Western DPS of Steller sea lions, Guadalupe fur seal, Hawaiian monk seal, and Western North Pacific gray whale are not likely to be adversely affected by the proposed action.

For ESA-listed black and white abalone, as well as green sturgeon (Southern DPS) and Pacific salmon ESUs that may be present in the action area, the proposed activities would target other species and would be conducted in a manner that is not expected to adversely affect these species. Critical habitat designated for ESA-listed Pacific salmon and the Southern DPS of green sturgeon occurs within the action area.

Designated critical habitat for several ESUs of steelhead and chinook, sockeye, and chum salmon includes nearshore marine waters contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 m (98 ft) relative to mean lower low water (70 FR 52630; September 2, 2005). The primary constituent elements (PCEs) for these habitat designations include nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; natural cover; and offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. Any potential effects to this critical habitat would be insignificant because the proposed activities would not cause obstruction or significantly affect predation, would not cause any significant changes to water quality in designated critical habitat, would not affect forage or the ability for critical habitat areas to support growth and maturation of listed salmon, and would not affect the natural cover in these areas. Therefore, the proposed activities are not expected to adversely affect the conservation value of designated critical habitat for these species.

Designated habitat for the Southern DPS green sturgeon generally includes coastal U.S. marine waters within 60 fathoms depth, from Monterey Bay, California, north to Cape Flattery, Washington, as well as certain rivers, bays, and estuaries (74 FR 52300; October 9, 2009). PCEs are designated for each of the three different systems that green sturgeon at specific life stages; the action area intersects the coastal marine critical habitat, for which the PCEs area migratory corridor, water quality, and food resources. Any potential effects to this critical habitat would be insignificant because the proposed activities would not disrupt the migratory behavior of the fish, would not cause any significant changes to water quality in designated critical habitat, and would not affect food availability. Therefore, the proposed activities are not expected to adversely affect the conservation value of designated critical habitat for these species.

Although these listed resources may occur in the action area, we believe they are either not likely to be exposed to the proposed research or are not likely to be adversely affected. Therefore, they will not be considered further in this Opinion.

Status of species considered in this opinion

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

Steller sea lion

Description of the species

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

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

Reproduction

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

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

Feeding

Steller sea lions are generalist predators that eat various fish (arrowtooth flounder, rockfish, hake, flatfish, Pacific salmon, Pacific herring, Pacific cod, sand lance, skates, cusk eel, lamprey, walleye, Atka mackerel), squids, and octopus and occasionally birds and marine mammals (Jones 1981, Pitcher and Fay 1982, Calkins and Goodwin 1988, Olesiuk et al. 1990, Daniel and Schneeweis 1992, Brown et al. 2002, Sinclair and Zeppelin 2002, McKenzie and Wynne 2008). Diet is likely strongly influenced by local and temporal changes in prey distribution and abundance (McKenzie and Wynne 2008, Sigler et al. 2009). Haulout selection appears to be driven at least in part by local prey density (Winter et al. 2009).

Status and trends

Steller sea lions were originally listed as threatened under the ESA on November 26, 1990 (55 FR 49204), following a decline in the U.S. of about 64% over previous three decades. In 1997, the species was split into two separate populations based on demographic and genetic differences (Bickham et al. 1996, Loughlin 1997), and the western population was reclassified to endangered (62 FR 24345) while the eastern population remained threatened (62 FR 30772). The Steller sea lion is also listed as endangered on the 2007 IUCN Red List (Gelatt and Lowry 2008).

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

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

Critical habitat

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

In California, the major Steller sea lion rookeries are found on: 1) Año Neuvo Island, 2) Southeast Farallon Island, 3) Sugarloaf Island and Cape Mendocino. The major rookeries in Oregon are found on the following sites: 1) Rouge Reef: Pyramid Rock, 2) Orford Reef: Long Brown Rock, and 3) Orford Reef: Seal Rock. In Southeast Alaska, the major Steller sea lion rookeries are found on: 1) Forrester Island, 2) Hazy Island, and 3 White Sisters. There are also major haul-out sites in Southeast Alaska designated as critical habitat for Steller sea lions. Some of the proposed research may occur in Steller sea lion critical habitat.

Blue whale

Description of the species

Blue whales occur primarily in the open ocean from tropical to polar waters worldwide. They are highly mobile, but their migratory patterns are not well known (Perry et al. 1999, Reeves et al. 2004). Blue whales migrate toward the warmer waters of the subtropics in fall to reduce energy costs, avoid ice entrapment, and reproduce (NMFS 1998). They typically occur alone or in groups of up to five animals, although larger foraging aggregations of up to 50 have been reported including aggregations mixed with other rorquals such as fin whales (Corkeron et al. 1999, Shirihai 2002).

Stock designations

Little is known about population and stock structure of blue whales. Studies suggest a wide range of alternative population and stock scenarios based on movement, feeding, and acoustic data. For management purposes, the International Whaling Commission (IWC) considers all Pacific blue whales as a single stock, whereas under the MMPA, the NMFS recognizes four stocks of blue whales: western North Pacific Ocean, eastern North Pacific Ocean, Northern Indian Ocean, and Southern Hemisphere.

Until recently, blue whale stock structure had not been tested using molecular or nuclear genetic analyses (Reeves et al. 1998). A recent study by Conway (2005) suggested that the global population could be divided into four major subdivisions, which roughly correspond to major ocean basins: eastern North and tropical Pacific Ocean, Southern Indian Ocean, Southern Ocean, and western North Atlantic Ocean. The eastern North/tropical Pacific Ocean subpopulation includes California, western Mexico, western Costa Rica, and Ecuador, and the western North Atlantic Ocean subpopulation (Conway 2005). This Opinion treats blue whales as four distinct populations.

North Pacific. Blue whales occur widely throughout the North Pacific. Acoustic monitoring has recorded blue whales off Oahu and the Midway Islands, although sightings or strandings in Hawaiian waters have not been reported (Northrop et al. 1971, Thompson and Friedl 1982, Barlow et al. 1997). Nishiwaki (1966) notes blue whale occurrence among the Aleutian Islands and in the Gulf of Alaska, but no one has sighted a blue whale in Alaska for sometime, despite several surveys (Leatherwood et al. 1982, Stewart et al. 1987, Forney and Brownell 1996, Carretta et al. 2005). Blue whales are thought to summer in high latitudes and move into the subtropics and tropics during the winter (Yochem and Leatherwood 1985).

North Atlantic. Blue whales are found from the Arctic to at least mid-latitude waters, and typically inhabit the open ocean with occasional occurrences in the U.S. EEZ (Yochem and Leatherwood 1985, Wenzel et al. 1988, Gagnon and Clark 1993). Yochem and Leatherwood (1985) summarized records suggesting winter range extends south to Florida and the Gulf of Mexico. The U.S. Navy’s Sound Surveillance System acoustic system has detected blue whales in much of the North Atlantic, including subtropical waters north of the West Indies and deep waters east of the U.S. Atlantic EEZ (Clark 1995). Blue whales are rare in the shelf waters of the eastern U.S. In the western North Atlantic, blue whales are most frequently sighted from the Gulf of St. Lawrence and eastern Nova Scotia and in waters off Newfoundland, during the winter (Sears et al. 1990). In the eastern North Atlantic, blue whales have been observed off the Azores, although Reiner et al. (1993) did not consider them common in that area.

Indian Ocean. There is a "resident" population of unknown taxonomic status present in the northern Indian Ocean. Blue whale sightings have occurred 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, Mikhalev 1997, Clapham et al. 1999).

Southern Hemisphere. Blue whales range from the edge of the Antarctic pack ice (40^{o}-78^{o}S) during the austral summer north to Ecuador, Brazil, South Africa, Australia, and New Zealand during the austral winter (Shirihai 2002). The IWC has designated Southern Hemisphere stock areas for management purposes based upon feeding areas. However, the overall population structure is unknown (Sears and Larsen 2002).

Reproduction

Gestation takes 10-12 months, followed by a 6-7 month nursing period. Sexual maturity occurs at 5-15 years of age and calves are born at 2-3 year intervals (Yochem and Leatherwood 1985, NMFS 1998, COSEWIC 2002). Blue whales may reach 70–80 years of age (Yochem and Leatherwood 1985, COSEWIC 2002).

Feeding

Data indicate that some summer feeding takes place at low latitudes in upwelling-modified waters, and that some whales remain year-round at either low or high latitudes (Yochem and Leatherwood 1985, Reilly and Thayer 1990, Clarke and Charif 1998, Hucke-Gaete et al. 2004). One population feeds in California waters from June to November and migrates south in winter/spring (Calambokidis et al. 1990, Mate et al. 1999). Prey availability likely dictates blue whale distribution for most of the year (Clapham et al. 1999, Burtenshaw et al. 2004). The large size of blue whales requires higher energy requirements than smaller whales and potentially prohibits fasting (Mate et al. 1999). Krill are the primary prey of blue whales in the North Pacific (Kawamura 1980, Yochem and Leatherwood 1985).

Status and trends

Blue whales (including all subspecies) were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973.

Globally, blue whale abundance has been estimated at between 5,000-13,000 animals (Yochem and Leatherwood 1985, COSEWIC 2002); a fraction of the 200,000 or more that are estimated to have populated the oceans prior to whaling (Maser et al. 1981, U.S. Department of Commerce 1983).

North Pacific. Estimates of blue whale abundance are uncertain. Prior to whaling, Gambell (1976) reported there may have been as many as 4,900 blue whales. In the eastern North Pacific, the minimum population is thought to be 1,384 whales, but no minimum population has been established (Carretta et al. 2006). Although blue whale abundance has likely increased since its protection in 1966, the possibility of unauthorized harvest by Soviet whaling vessel, incidental ship strikes, and gillnet mortalities make this uncertain.

Calambokidis and Barlow (2004) estimated roughly 3,000 blue whales inhabit waters off California, Oregon, and Washington based on line-transect surveys and 2,000 based on capture-recapture methods. Carretta et al.(2006) estimated an abundance of 1,744 for the same area, based on line-transect and capture-recapture estimates. Barlow (2003) reported mean group sizes of 1.0–1.9 during surveys off California, Oregon, and Washington. A density estimate of 0.0003 individuals/km^2 was given for waters off

Oregon/Washington, and densities off California ranged from 0.001-0.0033 individuals/km^2 (Barlow 2003).

North Atlantic. Commercial hunting had a severe effect on blue whales, such that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic (Sigurjónsson and Gunnlaugsson 1990). The actual size of the blue whale population in the north Atlantic is uncertain, but estimates range from a few hundred individuals to about 2,000 (Allen 1970, Mitchell 1974a, Sigurjónsson and Gunnlaugsson 1990, Sigurjónsson 1995). Sigurjónsson and Gunnlaugsson (1990) concluded that the blue whale population had been increasing since the late 1950s.

Southern Hemisphere. Blue whales were the mainstay of whaling in the region once the explosive harpoon was developed in the late nineteenth century (Shirihai 2002). Approximately 330,000–360,000 blue whales were harvested from 1904 to 1967 in the Antarctic alone, reducing their abundance to <3% of their original numbers (Perry et al. 1999, Reeves et al. 2003). Estimates of 4-5% for an average rate of population growth have been proposed (Yochem and Leatherwood 1985). However, a recent estimate of population growth for all blue whales throughout the Antarctic was 8.2% (Branch et al. 2007).

Critical habitat

NMFS has not designated critical habitat for blue whales.

Bowhead whale

Description of the species

Currently, five bowhead whale stocks have been identified: Sea of Okhotsk, Davis Strait, Hudson Bay, offshore waters of Spitsbergen, and the western Arctic, with only the last occurring in U.S. waters, and most stocks consist of a few dozens to hundreds of individuals (IWC 1992). Genetically, these stocks form a single population and changes in ice coverage due to global warming will likely allow free exchange of Atlantic and Pacific individuals. However, genetic analyses have thus far not clearly identified differences, particularly between Atlantic stocks (Heide-Jorgensen and Postma 2006, Postma and Cosens 2006).

Bowhead whales only occur at high latitudes in the northern hemisphere and have a disjunctive circumpolar distribution (Reeves 1980). Bowhead whales are found in the western Arctic (Bering, Chukchi, and Beaufort Seas), the Canadian Arctic and West Greenland (Baffin Bay, Davis Strait, and Hudson Bay), the Okhotsk Sea (eastern Russia), and the Northeast Atlantic from Spitzbergen westward to eastern Greenland. Historically, bowhead whale range has extended into the eastern Atlantic, in which it is estimated that 52,500 individuals once lived (Allen et al. 2006).

Reproduction

Reproductive activities for bowhead whales occur throughout the year, but conception takes place in late winter or early spring. Gestation lasts 12 to 16 months and the calving interval is between 3.5 and 7 years (Nerini et al. 1984, Tarpley et al. 1995). Bowhead whales take approximately two decades to become sexually mature, when they reach approximately 40 to 46 feet in length (Nerini et al. 1984, Schell et al. 1989, Schell and Saupe 1993, IWC 2004).

Feeding and diving

Bowhead whales in the North Pacific feed on euphausiids and copepods, which make up most of their diets (Lowry 1993). Bowhead diving behavior is situational (Stewart 2002). Calves dive for very short periods and their mothers tend to dive less frequently and for shorter durations. Feeding dives tend to last from 3 to 12 minutes and may extend to the relatively shallow bottom in the Beaufort Sea. "Sounding" dives average between 7 and 14 minutes. When individuals migrate through pack ice, dives tend to become longer and deeper, presumably to navigate through areas where breathing holes may not be accessible. However, when harassed by whalers, bowheads are known to dive for as long as 80 minutes.

Status and trends

Bowhead whales were originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973. Bowhead whale abundance prior to commercial whaling in the western Arctic has been estimated at 10,400 to 23,000 (Woodby and Botkin 1993). At the end of commercial whaling the species had declined to between 1,000 and 3,000 bowhead whales in the western Arctic. The current minimum population estimate is 9,472 whales, and in 2001 the population was estimated at 10,545 individuals (Angliss and Outlaw 2008). Also in 2001, 121 calves were counted, which is the most calves recorded in a single year. The population has been increasing at approximately 3.1% from 1978 to 1993 and more recently by about 3.5% annually (Angliss and Outlaw 2008).

This upward population trend is consistent with impressions of local hunters and western Arctic recovery may warrant delisting in the future (Gerber et al. 2007, Noongwook et al. 2007). It is also estimated that 1,229 individuals reside in the Spitsbergen stock, which also exceeds prior abundance estimates and sightings are occurring on a more regular basis (Gilg and Born 2005, Heide-Jorgensen et al. 2007).

Critical habitat

NMFS has not designated critical habitat for bowhead whales.

Fin whale

Description of the species

The fin whale is the second largest baleen whale and is widely distributed in the world's oceans. Most fin whales in the Northern Hemisphere migrate seasonally from Antarctic feeding areas in the summer to low-latitude breeding and calving grounds in winter. Fin whales tend to avoid tropical and pack-ice waters, with the high-latitude limit of their range set by ice and the lower-latitude limit by warm water of approximately 15° C (Sergeant 1977). Fin whale concentrations generally form along frontal boundaries, or mixing zones between coastal and oceanic waters, which corresponds roughly to the 200 m isobath (the shelf edge; Nasu 1974).

Stock designations

North Pacific. Fin whales undertake migrations from low-latitude winter grounds to high-latitude summer grounds and extensive longitudinal movements both within and between years (Mizroch et al. 1999). Fin whales are sparsely distributed during November-April, from 60° N, south to the northern edge of the tropics, where mating and calving may take place (Mizroch et al. 1999). However, fin whales have been sighted as far north as 60° N throughout winter (Mizroch et al. 1999).

Fin whales are observed year-round off central and southern California with peak numbers in the summer and fall (Dohl et al. 1983, Forney et al. 1995, Barlow 1997). Peak numbers of fin whales are seen during the summer off Oregon, and in summer and fall in the Gulf of Alaska and southeastern Bering Sea (Perry et al. 1999, Moore et al. 2000). Fin whales are observed feeding in Hawaiian waters during mid-May, and their sounds have been recorded there during the autumn and winter (Northrop et al. 1968, Shallenberger 1981, Thompson and Friedl 1982, Balcomb 1987). Fin whales in the western Pacific winter in the Sea of Japan, the East China, Yellow, and Philippine seas (Gambell 1985a).

North Atlantic. Fin whales are common off the Atlantic coast of the U.S. in waters immediately off the coast seaward to the continental shelf (about the 1,800 m contour).

Little is known about the winter habitat of fin whales, but in the western North Atlantic, the species has been found from off Newfoundland south to the Gulf of Mexico and Greater Antilles, and in the eastern North Atlantic the winter range extends from the Faroes and Norway south to the Canary Islands. In the Atlantic Ocean, a general migration in the fall from the Labrador and Newfoundland region, south past Bermuda, and into the West Indies has been theorized (Clark 1995).

Southern Hemisphere. Fin whales range from near 40° S (Brazil, Madagascar, western Australia, New Zealand, Colombia, Peru, and Chile) during austral winter southward to Antarctica (Rice 1998). Fin whales in the action area likely would be from the New Zealand stock, which summers from 170º E to 145º W and winters in the Fiji Sea and adjacent waters (Gambell 1985a).

Reproduction

Fin whales reach sexual maturity between 5-15 years of age (Lockyer 1972, Gambell 1985a, COSEWIC 2005). Mating and calving occurs primarily from October-January, gestation lasts approximately 11 months, and nursing occurs for 6-11 months (Hain et al. 1992, Boyd et al. 1999). The average calving interval in the North Atlantic is estimated at about 2-3 years (Christensen et al. 1992, Agler et al. 1993). The location of winter breeding grounds is uncertain but mating is assumed to occur in pelagic mid-latitude waters (Perry et al. 1999). Fin whales live 70-80 years (Kjeld et al. 2006). Aguilar and Lockyer (1987) suggested annual natural mortality rates in northeast Atlantic fin whales may range from 0.04 to 0.06.

Feeding

Fin whales in the North Atlantic eat pelagic crustaceans (mainly krill and schooling fish such as capelin, herring, and sand lance (Hjort and Ruud 1929, Ingebrigtsen 1929, Jonsgård 1966, Mitchell 1974b, Sergeant 1977, Overholtz and Nicolas 1979, Watkins et al. 1984, Christensen et al. 1992, Borobia and Béland 1995, Shirihai 2002). In the North Pacific, fin whales also prefer euphausiids and large copepods, followed by schooling fish such as herring, walleye pollock, and capelin (Nemoto 1970, Kawamura 1982a, b, Ladrón De Guevara et al. 2008, Paloma et al. 2008). Fin whales frequently forage along cold eastern boundaries of currents (Perry et al. 1999). Antarctic fin whales feed on krill, *Euphausia superba*, which occurs in dense near-surface schools (Nemoto 1959). However, off the coast of Chile, fin whales are known to feed on the euphausiid *E. mucronata* (Antezana 1970, Perez et al. 2006). Feeding may occur in waters as shallow as 10 m when prey are at the surface, but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Gaskin 1972, Sergeant 1977, Nature Conservancy Council 1979 as cited in ONR 2001).

Status and trends

Fin whales were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973. Although fin whale population structure remains unclear, various abundance estimates are available. Pre-exploitation fin whale abundance is estimated at 464,000 individuals worldwide; the estimate for 1991 was roughly 25% of this (Braham 1991). Historically, worldwide populations were severely depleted by commercial whaling, with more than 700,000 whales harvested in the twentieth century (Cherfas 1989).

North Pacific. The status and trend of fin whale populations is largely unknown. Over 26,000 fin whales were harvested between 1914-1975 (Braham 1991 as cited in Perry et al. 1999). NMFS estimates roughly 3,000 individuals occur off California, Oregon, and Washington based on ship surveys in summer/autumn of 1996, 2001, and 2005, of which estimates of 283 and 380 have been made for Oregon and Washington alone (Barlow and Taylor 2001, Barlow 2003, Forney 2007). Barlow (2003) noted densities of up to 0.0012 individuals/km^2 off Oregon and Washington and up to 0.004 individuals/km^2 off California.

North Atlantic. 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. However, over 48,000 fin whales were caught between 1860- 1970 (Braham 1991). Although protected by the IWC, from 1988-1995 there have been 239 fin whales taken from the North Atlantic. Recently, Iceland resumed whaling of fin whales despite the 1985 moratorium imposed by the IWC. The western Mediterranean fin whale population is estimated at 3,583 individuals (95% CI = 2,130- 6,027; Forcada et al. 1996).

Southern Hemisphere. The Southern Hemisphere population was one of the most heavily exploited whale populations under commercial whaling. From 1904 to 1975, over 700,000 fin whales were taken in Antarctic whaling operations (IWC 1990). Harvests increased substantially upon the introduction of factory whaling ships in 1925, with an average of 25,000 caught annually from 1953-1961 (Perry et al. 1999). Current estimates are a tiny fraction of former abundance.

Critical habitat

NMFS has not designated critical habitat for fin whales.

Humpback whale

Description of the species

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 and cooler, temperate or sub-Arctic waters in summer months (Gendron and Urban 1993). In both regions, humpback whales tend to occupy shallow, coastal waters. However, migrations are undertaken through deep, pelagic waters (Winn and Reichley 1985).

Stock designations

North Pacific. Based on genetic and photo-identification studies, NMFS currently recognizes four stocks of humpback whales in the North Pacific Ocean: two Eastern North Pacific stocks, one Central North Pacific stock, and one Western Pacific stock (Hill and DeMaster 1998). Humpback whales summer in 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 (Nemoto 1957, Tomilin 1967, Johnson and Wolman 1984). These whales migrate to Hawaii, southern Japan, the Mariana Islands, and Mexico during winter. The central North Pacific stock winters in the waters around Hawaii while the eastern North Pacific stock (also called the California-Oregon-Washington-Mexico stock) winters along Central America and Mexico. However, Calambokidis et al. (1997) identified individuals from several stocks wintering in the areas of other stocks, highlighting the paucity of knowledge on stock structure and the potential fluidity of stock structure.

Separate feeding groups of humpback whales are thought to inhabit western U.S. and Canadian waters, with the boundary between them located roughly at the U.S./Canadian border (Carretta et al. 2006). Humpback whales primarily feed along the shelf break and continental slope do not appear to frequent offshore waters in the region (Green et al. 1992, Tynan et al. 2005)

North Atlantic. Humpback whales range from the mid-Atlantic bight and the Gulf of Maine across the southern coast of Greenland and Iceland to Norway in the Barents Sea. Whales migrate to the western coast of Africa and the Caribbean Sea during the winter. Humpback whales aggregate in four summer feeding areas: Gulf of Maine and eastern Canada, west Greenland, Iceland, and Norway (Katona and Beard 1990, Smith et al. 1999).

Southern Hemisphere. Eight proposed stocks of humpback whales occur in waters off Antarctica. 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 and movements of this group are poorly known (Mikhalev 1997, Rasmussen et al. 2007).

Reproduction

Humpback whale calving and breeding generally occurs during winter at lower latitudes. Gestation takes about 11 months, followed by a nursing period of up to 1 year (Baraff and Weinrich 1993). Sexual maturity is reached at between 5-7 years of age in the western North Atlantic, but may take as long as 11 years in the North Pacific, and perhaps over 11 years of age in the North Pacific (e.g., southeast Alaska, Gabriele et al. 2007). Females usually breed every 2-3 years, although consecutive calving is not unheard of (Glockner-Ferrari and Ferrari 1985, Clapham and Mayo 1987, 1990, Weinrich et al. 1993).

In calving areas, males sing long complex songs directed towards females, other males, or both. The breeding season can best be described as a floating lek or male dominance polygamy (Clapham 1996). Calving occurs in the shallow coastal waters of continental shelves and oceanic islands worldwide (Perry et al. 1999).

Feeding

During the feeding season, humpback whales form small groups that occasionally aggregate on concentrations of food that may be stable for long-periods of times. Humpbacks use a wide variety of behaviors to feed on various small, schooling prey including krill and fish (Jurasz and Jurasz 1979, Hain et al. 1982, Weinrich et al. 1992, Hain et al. 1995). The principal fish prey in the western North Atlantic are sand lance, herring, and capelin (Kenney et al. 1985). There is good evidence of some territoriality on feeding and calving areas (Tyack 1981, Clapham 1994, Clapham 1996).

Status and trends

Humpback whales were originally listed as endangered in 1970 (35 FR 18319), and this status remains under the ESA. Winn and Reichley (1985) argued that the global humpback whale population consisted of at least 150,000 whales in the early 1900s, mostly in the Southern Ocean. In 1987, the global population of humpback whales was estimated at about 10,000 (NMFS 1987). Although this estimate is outdated, it appears that humpback whale numbers are increasing.

North Pacific. The pre-exploitation population size of North Pacific humpback whales may have been as many as 15,000 humpback whales, and current estimates are 6,000-8,000 whales (Rice 1978a, Calambokidis et al. 1997). From 1905 to 1965, nearly 28,000 humpback whales were taken in whaling operations, reducing the number of all North Pacific humpback whale to roughly 1,000 (Perry et al. 1999). Population estimates have risen over time from 1,407-2,100 in the 1980s to 6,010 in 1997 (Baker 1985, Darling and Morowitz 1986, Baker and Herman 1987, Calambokidis et al. 1997). Tentative estimates of the eastern North Pacific stock suggest an increase of 6-7% annually, but fluctuations have included negative growth in the recent past (Angliss and Outlaw 2005). Based upon surveys between 2004 and 2006, Calambokidis et al. (2008) estimated that the current population of humpback whales in the North Pacific consists of about 18,300 whales, not counting calves. Almost half of these whales likely occur in wintering areas around the Hawaiian Islands.

North Atlantic. The best available estimate of North Atlantic abundance comes from 1992-1993 mark-recapture data, which generated an estimate of 11,570 humpback whales (Stevick et al. 2003). Estimates of animals in Caribbean breeding grounds exceed 2,000 individuals (Balcomb and Nichols 1982). The rate of increase for this stock varies from 3.2-9.4%, with rates of increase slowing over the past two decades (Katona and Beard 1990, Barlow and Clapham 1997, Stevick et al. 2003). If the North Atlantic population has grown according to the estimated instantaneous rate of increase ($r = 0.0311$), this would lead to an estimated 18,400 individual whales in 2008 (Stevick et al. 2003).

Southern Hemisphere. The IWC recently compiled population data on humpback whales in the Southern Hemisphere. Approximately 42,000 Southern Hemisphere humpbacks can be found south of 60° S during the austral summer feeding season (IWC 2007).

Critical habitat

NMFS has not designated critical habitat for humpback whales.

North Pacific right whale

Description of the species

Many basic life history parameters of North Pacific right whales are unknown. All North Pacific right whales constitute a single population. Very little is known of the distribution of right whales in the North Pacific and very few of these animals have been seen in the past 20 years.

Current information on the seasonal distribution of right whales is spotty. In the eastern North Pacific, this includes sightings over the middle shelf of the Bering Sea, Bristol Bay, Aleutian and Pribilof Islands (Goddard and Rugh 1998, Hill and DeMaster 1998, Perryman et al. 1999, Waite et al. 2003, Wade et al. 2006). Some more southerly records also record occurrence along Hawaii, California, Washington, and British Columbia (Herman et al. 1980, Scarff 1986). However, records from Mexico and California may suggest historical wintering grounds in offshore southern North Pacific latitudes (Brownell et al. 2001, Gregr and Coyle 2009).

Reproduction.

While no reproductive data are known for the North Pacific, studies of North Atlantic right whales suggest calving intervals of two to seven years and growth rates that are likely dependent on feeding success (Knowlton et al. 1994, Best et al. 2001, Burnell 2001, Cooke et al. 2001, Kenney 2002, Reynolds et al. 2002). It is presumed that right whales calve during mid-winter (Clapham et al. 2004). Western North Pacific sightings have been recorded along Japan, the Yellow Sea, and Sea of Japan (Best et al. 2001, Brownell et al. 2001). Lifespans of up to 70 years can be expected based upon North Atlantic right whale data.

Feeding

Stomach contents from North Pacific right whales indicate copepods and, to a lesser extent, euphausiid crustaceans are the whales' primary prey (Omura et al. 1969). Their diet is likely more varied than North Atlantic right whales, likely due to the multiple blooms of different prey available in the North Pacific from January through August (Gregr and Coyle 2009). Based upon trends in prey blooms, it is predicted that North Pacific right whales may shift from feeding offshore to over the shelf edge during late summer and fall (Gregr and Coyle 2009). North Pacific right whales, due to the larger size of North Pacific copepods, have been proposed to be capable to exploit younger age classes of prey as well as a greater variety of species. Also as a result, they may require prey densities that are one-half to one-third those of North Atlantic right whales (Gregr and Coyle 2009).

Status and trends

The Northern right whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973. The early listing included both the North Atlantic and the North Pacific populations, although subsequent genetic studies conducted by Rosenbaum (2000) resulted in strong evidence that the North Atlantic and North Pacific right whales are separate species. Following a comprehensive status review, NMFS concluded that Northern right whales are indeed two separate species. In March 2008, NMFS published a final rule listing North Pacific and North Atlantic right whales as separate species (73 FR 12024).

Very little is known about right whales in the eastern North Pacific, which were severely depleted by commercial whaling in the 1800s (Brownell et al. 2001). Previous 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). The current population size of right whales in the North Pacific is likely fewer than 1,000 animals (NMFS 2006c).

Critical habitat

In July 2006, NMFS designated two areas as critical habitat for right whales in the North Pacific (71 FR 38277). The areas encompass about 36,750 square miles of marine habitat, which include feeding areas within the Gulf of Alaska and the Bering Sea that support the species. The primary constituent element to this critical habitat is the presence of large copepods and oceanographic factors that concentrate these prey of North Pacific right whales. At present, this PCE has not been significantly degraded due to human activity. However, significant concern has been voiced regarding the impact that oceanic contamination of pollutants may have on the food chain and consequent bioaccumulation of toxins by marine predators. Changes due to global warming have also been raised as a concern that could affect the distribution or abundance of copepod prey for several marine mammals, including right whales.

The proposed research would not take place in designated North Pacific right whale critical habitat.

Sei whale

Description of the species

The sei whale occurs in all oceans of the world except the Arctic. 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 continental shelf edges (Hain et al. 1985). This general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al. 2004). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al. 1999). When on feeding grounds, larger groupings have been observed (Gambell 1985b).

Stock designations

Information suggests that sei whale stocks are dynamic and that individuals are immigrating and emigrating between stocks. Consequently, until further information is available to suggest otherwise, we consider sei whales as forming "open" populations that are connected through the movement of individuals.

North Pacific. The IWC groups all North Pacific sei whales into one management stock (Donovan 1991). However, some mark-recapture, catch distribution, and morphological research indicate more than one population may exist, one between 155°-175° W, and another east of 155° W (Masaki 1976, Masaki 1977). Sei whales have been reported primarily south of the Aleutian Islands, in Shelikof Strait and waters surrounding Kodiak Island, in the Gulf of Alaska, and inside waters of southeast Alaska and south to California to the east and Japan and Korea to the west (Nasu 1974, Leatherwood et al. 1982). Sei whales have been occasionally reported from the Bering Sea and in low numbers on the central Bering Sea shelf (Hill and DeMaster 1998). Whaling data suggest that sei whales do not venture north of about 55°N (Gregr et al. 2000).

North Atlantic. The IWC groups North Atlantic sei whales into three stocks for management purposes: the Nova Scotia, Iceland-Denmark Strait, and Northeast Atlantic stocks, noting that identification of sei whale population structure is difficult and remains a major research problem (Donovan 1991, Perry et al. 1999).

Southern Hemisphere. Sei whales occur throughout the Southern Ocean during the austral summer, generally between 40°-50° S (Gambell 1985b). During the austral winter, sei whales occur off Brazil and the western and eastern coasts of southern Africa and Australia. However, sei whales generally do not occur north of 30º S in the Southern Hemisphere and no records exist for the action area (Reeves et al. 1999). However, confirmed sighting records exist for Papua New Guinea and New Caledonia, with unconfirmed sightings in the Cook Islands (SPREP 2007).

Reproduction

Reproductive activities for sei whales occur primarily in winter. Gestation is about 12.7 months, calves are weaned at 6-9 months, and the calving interval is about 2-3 years (Rice 1977, Gambell 1985b). Sei whales become sexually mature at about age 10 (Rice 1977).

Feeding

Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al. 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Rice 1977, Mizroch et al. 1984). In the North Pacific, sei whales appear to prefer feeding along the cold eastern currents (Perry et al. 1999), and feed on euphausiids and copepods, which make up about 95% of their diets (Calkins 1986). The dominant food for sei whales off California during June-August is northern anchovy, while in September-October whales feed primarily on krill (Rice 1977). The balance of their diet consists of squid and schooling fish, including smelt, sand lance, Arctic cod, rockfish, pollock, capelin, and Atka mackerel (Nemoto and Kawamura 1977). In the Southern Ocean, analysis of stomach contents indicates sei whales consume

Calanus spp. and small-sized euphausiids with prey composition showing latitudinal trends (Kawamura 1974).

Status and trends

The sei whale was originally listed as endangered in 1970 (35 FR 18319), and this status remained since the inception of the ESA in 1973.

North Pacific. Ohsumi and Fukuda (1975) estimated that sei whales in the north Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000-38,000 whales by 1967, and reduced again to 20,600-23,700 whales by 1973. When commercial whaling for sei whales ended in 1974, the population in the North Pacific had been reduced to an estimated 7,260-12,620 animals (Tillman 1977). There have been no direct estimates of sei whale populations for the eastern Pacific Ocean (or the entire Pacific). During aerial surveys in 1991-2001, there were two confirmed sightings of sei whales along the U.S. Pacific coast. The minimum population estimate based on transect surveys of 300 nautical miles from 1996-2001 was 35, although the actual population along the U.S. Pacific coast was estimated to be 56 (Carretta et al. 2006).

North Atlantic. No information on sei whale abundance exists prior to commercial whaling (Perry et al. 1999). In 1974, the North Atlantic population was estimated to number about 2,078 individuals, including 965 whales in the Labrador Sea group and 870 whales in the Nova Scotia group (Mitchell and Chapman 1977). The total number of sei whales in the U.S. Atlantic EEZ remains unknown (Waring et al. 2006). Rice (1977) estimated total annual mortality for adult females as 0.088 and adult males as 0.103.

Critical habitat

NMFS has not designated critical habitat for sei whales.

Southern right whale

Description of the species

Southern right whales are thought to be distributed throughout the Antarctic Ocean and north to the waters surrounding the southern portions of Australia, New Zealand, South America, and Africa, between 20° and 60° S latitude. They make annual migrations between the most southern latitudes where they feed in summer (farthest south in January) and coastal regions in more northerly latitudes where females calve and raise their young in winter and spring (June through December with a peak in September). Southern right whales winter on the southern coastlines of the African, South American, and Australian continents, along with the coast of New Zealand and oceanic islands such as the Tristan de Cunha, Auckland, and Campbell Island groups.

Reproduction

Females give birth to their first calf at an average age of 9-10 years. Gestation lasts approximately 1 year. Calves are usually weaned toward the end of their first year. Southern right whale females produce a calf every 3 to 4 years. Southern right whales seem to rely on relatively shallow water in nursery areas. Payne et al. (1986) found that cows with calves were almost never seen in waters over 10 m deep, while others occurred out to 65-70 m deep water. This preference of shallow water is attributed to maternal fidelity to particular areas as well as favorable environmental conditions (Elwen and Best 2004).

Feeding

Based on studies of diving behavior and daily movement patterns right whales are found at dense aggregations of copepods, which are found in oceanographic features such as fronts and areas of upwelling and steep topography (Croll and Tershy 2002). The primary food sources are zooplankton, including copepods, euphausiids, and cyprids. Southern right whale distribution is strongly correlated with the distribution of zooplankton (Perry et al. 1999).

Status and trends

Prior to exploitation, there were an estimated 60,000 right whales in the Southern Hemisphere, with perhaps 10,000 right whales in New Zealand waters. By the end of the 19th century (after extensive whaling), New Zealand southern right whales were considered commercially extinct. Several Southern Hemisphere populations (those off Argentina, Australia, and South Africa) are increasing at annual rates of 7-8%. There is evidence that the New Zealand sub-Antarctic population has increased (at least at the Auckland Islands) since the 1940s. However, systematic research in the area has not yet been carried out long enough to estimate whether the population is currently increasing. Nevertheless, there are other areas where major whaling operations were conducted for which there is no sign of recovery, although recent information is either absent or incomplete. For the best three known areas (Australia, Argentina, and South Africa), the current estimated total abundance is about 7,000 (Perry et al. 1999) to 7,500 (IWC 2001). Should these populations grow at 7-8%, they would double in ten years.

Critical habitat

NMFS has not designated critical habitat for Southern right whales.

Southern Resident killer whale

Description of the species

Southern Resident killer whales compose a single population that occurs primarily along Washington State and British Columbia. The listed entity consists of three family groups, identified as J, K, and L pods. They are found throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia. However, there is limited information on the range of Southern Residents along the outer Pacific Coast, with only 25 confirmed sightings of J, K, and L pods between 1982 and 2006 (Krahn et al. 2004a).

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

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

Feeding

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

Reproduction

Female Southern Resident killer whales give birth to their first surviving calf between the ages of 12 and 16 years and produce an average of 5.4 surviving calves during a reproductive life span lasting about 25 years (Olesiuk et al. 1990, Matkin et al. 2003). Females reach a peak of reproduction around ages 20-22 and decline in calf production gradually over the next 25 years until reproductive senescence (Ward et al. 2009a). Older mothers tend to have greater calving success than do their younger, less-experienced counterparts (Ward et al. 2009b). Calving success also appears to be aided by the assistance of grandmothers (Ward et al. 2009b). The mean interval between viable calves is four years (Bain 1990). Males become sexually mature at body lengths ranging from 17 to 21 feet, which corresponds to between the ages of 10 to 17.5 years, and are presumed to remain sexually active throughout their adult lives (Christensen 1984, Perrin and Reilly 1984, Duffield and Miller 1988, Olesiuk et al. 1990). Most mating is believed to occur from May to October (Nishiwaki 1972, Olesiuk et al. 1990, Matkin et al. 1997). However, conception apparently occurs year-round because births of calves are reported in all months. Newborns measure seven to nine feet long and weigh about 440 lbs (Nishiwaki and Handa 1958, Olesiuk et al. 1990, Clark et al. 2000, Ford 2002). Mothers and offspring maintain highly-stable, life-long social bonds and this natal relationship is the basis for a matrilineal social structure (Bigg et al. 1990, Baird 2000, Ford et al. 2000). Some females may reach 90 years of age (Olesiuk et al. 1990).

Status and trends

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

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

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

Critical habitat

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

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

Sperm whale

Description of the species

Sperm whales are distributed in all of the world's oceans, from equatorial to polar waters, and are highly migratory. Mature males range between 70º N in the North Atlantic and 70º S in the Southern Ocean (Reeves and Whitehead 1997, Perry et al. 1999), whereas mature females and immature individuals of both sexes are seldom found higher than 50º N or S (Reeves and Whitehead 1997). In winter, sperm whales migrate closer to equatorial waters (Kasuya and Miyashita 1988, Waring et al. 1993) where adult males join them to breed.

Stock designations

There is no clear understanding of the global population structure of sperm whales (Dufault et al. 1999). Recent ocean-wide genetic studies indicate low, but statistically significant, genetic diversity and no clear geographic structure, but strong differentiation between social groups (Lyrholm et al. 1996, Lyrholm and Gyllensten 1998, Lyrholm et al. 1999). The NMFS recognizes six stocks under the MMPA: three in the Atlantic/Gulf of Mexico and three in the Pacific (Alaska, California-Oregon-Washington, and Hawaii; (Perry et al. 1999, Waring et al. 2004).

North Pacific. Sperm whales are found throughout the North Pacific and are distributed broadly in tropical and temperate waters to the Bering Sea as far north as Cape Navarin in summer, and occur south of 40^{o} N in winter (Rice 1974, Gosho et al. 1984, Miyashita et al. 1995). Sperm whales are found year-round in Californian and Hawaiian waters (Rice 1960, Shallenberger 1981, Dohl et al. 1983, Lee 1993, Barlow 1995, Forney et al. 1995, Mobley et al. 2000), but they reach peak abundance from April-mid-June and from the end of August-mid-November (Rice 1974). They are seen in every season except winter (December-February) in Washington and Oregon (Green et al. 1992). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly towards the middle of the tropical Pacific and northward towards the tip of Baja California (Carretta et al. 2006).

North Atlantic. In the western North Atlantic, sperm whales range from Greenland south into the Gulf of Mexico and the Caribbean, where they are common, especially in deep basins north of the continental shelf (Romero et al. 2001, Wardle et al. 2001). The northern distributional limit of female/immature pods is probably around Georges Bank or the Nova Scotian shelf (Whitehead et al. 1991). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Mullin et al. 1994, Hansen et al. 1996). Sperm whales distribution follows a distinct seasonal cycle, concentrating east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight.

Mediterranean. Sperm whales are found from the Alboran Sea to the Levant Basin, primarily over steep slope and deep offshore waters. Sperm whales are rarely sighted in the Sicilian Channel, and are vagrants to the northern Adriatic and Aegean Seas (Notarbartolo di Sciara and Demma 1997). In 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.

Southern Hemisphere. All sperm whales of the Southern Hemisphere are treated as a single population with nine divisions, although this designation has little biological basis and is more in line with whaling records (Donovan 1991). Sperm whales that occur off the Galapagos Islands, mainland Ecuador, and northern Peru may be distinct from other sperm whales in the Southern Hemisphere (Rice 1977, Wade and Gerrodette 1993, Dufault and Whitehead 1995). Gaskin (1973) found females to be absent in waters south of 50º and decrease in proportion to males south of 46-47º.

Reproduction

Female sperm whales become sexually mature at an average of 9 years or 8.25-8.8 m (Kasuya 1991). Males reach a length of 10 to 12 m at sexual maturity and take 9-20 years to become sexually mature, but will require another 10 years to become large enough to successfully breed (Kasuya 1991, Würsig et al. 2000). Mean age at physical maturity is 45 years for males and 30 years for females (Waring et al. 2004). Adult females give birth after roughly 15 months of gestation and nurse their calves for 2-3 years (Waring et al. 2004). The calving interval is estimated to be every 4-6 years between the ages of 12 and 40 (Kasuya 1991, Whitehead et al. 2008).

Sperm whale age distribution is unknown, but sperm whales are believed to live at least 60 years (Rice 1978b). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980).

Feeding

Sperm whales appear to feed regularly throughout the year (NMFS 2006b). It is estimated they consume about 3-3.5% of their body weight daily (Lockyer 1981). They seem to forage mainly on or near the bottom, often ingesting stones, sand, sponges, and other non-food items (Rice 1989). A large proportion of a sperm whale's diet consists of low-fat, ammoniacal, or luminescent squids (Clarke 1980b, Martin and Clarke 1986, Clarke 1996). While sperm whales feed primarily on large and medium-sized squids, the list of documented food items is fairly long and diverse. Prey items include other cephalopods, such as octopi, and medium- and large-sized demersal fishes, such as rays, sharks, and many teleosts (Berzin 1972, Clarke 1977, 1980a, Rice 1989, Angliss and Lodge 2004).

Movement patterns of Pacific female and immature male groups appear to follow prey distribution and, although not random, movements are difficult to anticipate and are likely associated with feeding success, perception of the environment, and memory of optimal foraging areas (Whitehead et al. 2008). Sperm whales are frequently found in locations of high productivity due to upwelling or steep underwater topography, such as continental slopes, seamounts, or canyon features (Jaquet and Whitehead 1996, Jaquet et al. 1996).

Status and trends

Sperm whales were originally listed as endangered in 1970 (35 FR 18319), and this status remained with the inception of the ESA in 1973. Although population structure of sperm whales is unknown, several studies and estimates of abundance are available. Sperm whale populations probably are undergoing the dynamics of small population sizes, which is a threat itself. In particular, the loss of sperm whales to directed Soviet takes likely inhibits recovery due to the loss of adult females and their calves, leaving sizeable gaps in demographic and age structuring (Whitehead 2003).

North Pacific. There are approximately 76,800 sperm whales in the eastern tropical Pacific, eastern North Pacific, Hawaii, and western North Pacific (Whitehead 2002). Minimum population estimates in the eastern North Pacific are 1,719 individuals and 5,531 in the Hawaiian Islands (Carretta et al. 2007b). The tropical Pacific is home to approximately 26,053 sperm whales and the western North Pacific has a population of approximately 29,674 (Whitehead 2002). There was a dramatic decline in the number of females around the Galapagos Islands during 1985-1999 versus 1978-1992 levels, likely due to migration to nearshore waters of South and Central America (Whitehead 2003).

Sperm whales are sighted off Oregon in every season except winter (Green et al. 1992). However, sperm whales are found off California year-round (Dohl et al. 1983, Barlow 1995, Forney et al. 1995), with peak abundance from April to mid-June and from August to mid-November (Rice 1974). Barlow (2003) reported mean group sizes of 2.0–11.8 during surveys the western U.S. Barlow (2003) estimated that 440 and 52 sperm whales occurred in Oregonian and Washingtonian waters, depending upon year and area, supported by densities of 0.0002 to 0.0019 individuals/km^2.

North Atlantic. An estimate of 190,000 sperm whales was made for the entire North Atlantic, but CPUE data from which this estimate is derived are unreliable according to the IWC (Perry et al. 1999). The total number of sperm whales in the western North Atlantic is unknown (Waring et al. 2008). The best available current abundance estimate for western North Atlantic sperm whales is 4,804 based on 2004 data. The best available estimate for Northern Gulf of Mexico sperm whales is 1,665, based on 2003-2004 data, which are insufficient data to determine population trends (Waring et al. 2008).

Southern Hemisphere. For management purposes, the IWC recognizes sperm whales as one stock, but further subdivides whales into nine geographic divisions: Western Atlantic, Eastern Atlantic, Western Indian, Central Indian, Eastern Indian, Eastern Australia, New Zealand, Central Pacific, and Eastern Pacific (Donovan 1991).

Critical habitat

NMFS has not designated critical habitat for sperm whales.

Green sea turtle

Description of the species

Green sea turtles have a circumglobal distribution, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. Green turtles appear to prefer waters that usually remain around 20º C in the coldest month, but may be found considerably north of these regions during warm-water events, such as El Niño. Stinson (1984) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18º C. Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating Sargassum spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998b). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000).

Population designations

Populations are distinguished generally by ocean basin and more specifically by nesting location. Based upon genetic differences, two distinct regional clades are thought to exist in the Pacific: western Pacific and South Pacific islands, and eastern Pacific and central Pacific, including the rookery at French Frigate Shoals, Hawaii. In the eastern Pacific, green sea turtles forage from San Diego Bay, California to Mejillones, Chile. Individuals along the southern foraging area originate from Galapagos Islands nesting beaches, while those in the Gulf of California originate primarily from Michoacán. Green turtles foraging in San Diego Bay and along the Pacific coast of Baja California originate primarily from rookeries of the Islas Revillagigedos (Dutton 2003).

Reproduction

Estimates of reproductive longevity range from 17 to 23 years (Carr et al. 1978, Fitzsimmons et al. 1995, Chaloupka et al. 2004). Considering that mean duration between females returning to nest ranges from 2 to 5 years (Hirth 1997), these reproductive longevity estimates suggest that a female may nest 3 to 11 seasons over the course of her life. Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit 9 to 33 clutches, or about 900 to 3,300 eggs, during her lifetime.

Once hatched, sea turtles emerge and orient towards a light source, such as light shining off the ocean. They enter the sea in a "frenzy" of swimming activity, which decreases rapidly in the first few hours and gradually over the first several weeks (Ischer et al. 2009, Okuyama et al. 2009). Factors in the ocean environment have a major influence on reproduction (Limpus and Nicholls 1988, Chaloupka 2001, Solow et al. 2002). It is also apparent that during years of heavy nesting activity, density dependent factors (beach crowding and digging up of eggs by nesting females) may affect hatchling production (Tiwari et al. 2005, 2006). Precipitation, proximity to the high tide line, and nest depth can also significantly affect nesting success (Cheng et al. 2009). Precipitation can also be significant in sex determination, with greater nest moisture resulting in a higher proportion of males (Leblanc and Wibbels 2009). Green sea turtles often return to the same foraging areas following nesting migrations (Godley et al. 2002, Broderick et al. 2006). Once there, they move within specific areas, or home ranges, where they routinely visit specific localities to forage and rest (Seminoff et al. 2002, Godley et al. 2003, Makowski et al. 2006, Seminoff and Jones 2006, Taquet et al. 2006). However, it is also apparent that some green sea turtles remain in pelagic habitats for extended periods, perhaps never recruiting to coastal foraging sites (Pelletier et al. 2003).

In general, survivorship tends to be lower for juveniles and subadults than for adults. Adult survivorship has been calculated to range from 0.82-0.97 versus 0.58-0.89 for juveniles (Seminoff et al. 2003, Chaloupka and Limpus 2005, Troëng and Chaloupka 2007), with lower values coinciding with areas of human impact on green sea turtles and their habitats (Bjorndal et al. 2003, Campbell and Lagueux 2005).

Migration

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick and Limpus 1997, Plotkin 2003). The periodic migration between nesting sites and foraging areas by adults is a prominent feature of their life history. After departing as hatchlings and residing in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), green sea turtles make their way back to the same beach from which they hatched (Carr et al. 1978, Meylan et al. 1990). However, green sea turtles spend the majority of their lives in coastal foraging grounds. These areas include both open coastline and protected bays and lagoons. While in these areas, green sea turtles rely on marine algae and seagrass as their primary dietary constituents, although some populations also forage heavily on invertebrates. There is some evidence that individuals move from shallow seagrass beds during the day to deeper areas at night (Hazel 2009).

Feeding

Green sea turtle hatchlings from the southwest Pacific have been found to feed on a variety of prey, including hydras, amphipods, isopods, krill, and various gastropods (Boyle and Limpus 2008). While offshore and sometimes in coastal habitats, green sea turtles are not obligate plant-eaters as widely believed, and instead consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Godley et al. 1998, Heithaus et al. 2002, Seminoff et al. 2002, Hatase et al. 2006, Parker and Balazs 2008). However, a shift to a more herbivorous diet occurs when individuals move into neritic habitats, as vegetable mater replaces an omnivorous diet at around 59 cm in carapace length off Mauritania (Cardona et al. 2009). Localized movement in foraging areas can be strongly influenced by tidal movement (Brooks et al. 2009). Additionally, green sea turtles in Hawaii have apparently shifted their dietary preferences to more-nutritive invasive seagrass and algal species as the plants have become further established (Russell and Balazs 2009).

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and USFWS 1998b, Hazel et al. 2009). The maximum recorded dive depth for an adult green turtle was just over 106 m (Berkson 1967).

Status and trends

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered (43 FR 32800). The International Union for Conservation of Nature (IUCN) has classified the green turtle as “endangered.”

No trend data is available for almost half of the important nesting sites, where numbers are based on recent trends and do not span a full green sea turtle generation, and impacts occurring over four decades ago that caused a change in juvenile recruitment rates may have yet to be manifested as a change in nesting abundance. Additionally, these numbers are not compared to larger historical numbers. The numbers also only reflect one segment of the population (nesting females), who are the only segment of the population for which reasonably good data are available and are cautiously used as one measure of the possible trend of populations.

Current nesting abundance is known for 46 nesting sites worldwide (Tables 10). These include both large and small rookeries and are believed to be representative of the overall trends for their respective regions. Based on the mean annual reproductive effort, 108,761-150,521 females nest each year among the 46 sites. Overall, of the 26 sites for which data enable an assessment of current trends, 12 nesting populations are increasing, 10 are stable, and four are decreasing. Long-term continuous datasets of 20 years are available for 11 sites, all of which are either increasing or stable. Despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004).

Pacific Ocean. Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, from a combination of overexploitation and habitat loss (Eckert 1993, Seminoff et al. 2002). In the western Pacific, the only major (>2,000 nesting females) populations of green turtles occur in Australia and Malaysia, with smaller colonies throughout the area. Indonesian nesting is widely distributed, but has experienced large declines over the past 50 years. Hawaii green turtles are genetically distinct and geographically isolated, and the population appears to be increasing in size despite the prevalence of fibropapillomatosis and spirochidiasis (Aguirre et al. 1998).

All other areas. Nesting populations are doing relatively well in the western Atlantic and central Atlantic Ocean. In contrast, populations are doing relatively poorly in Southeast Asia, the eastern Indian Ocean, and perhaps the Mediterranean.

Critical habitat

On September 2, 1998, critical habitat for green sea turtles was designated in coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693). Aspects of these areas that are important for green sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for green sea turtle prey. The proposed research would not take place in designated green sea turtle critical habitat.

Hawksbill sea turtle

Description of the species

The hawksbill sea turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific oceans. Populations are distinguished generally by ocean basin and more specifically by nesting location. Satellite tagged turtles have shown significant variation in movement and migration patterns. In the Caribbean, distance traveled between nesting and foraging locations ranges from a few kilometers to a few hundred kilometers (Byles and Swimmer 1994, Miller et al. 1998, Hillis-Starr et al. 2000, Horrocks et al. 2001, Prieto et al. 2001, Lagueux et al. 2003). Hawksbill turtles are considered common in French Polynesian waters, but are not known to nest on the islands. Confirmed sightings have also been made near the proposed study area off Tonga, Fiji, and Niue (SPREP 2007).

Hawksbill sea turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Musick and Limpus 1997, Plotkin 2003). Small juvenile hawksbills (5-21 cm straight carapace length) have been found in association with *Sargassum* spp. in both the Atlantic and Pacific oceans (Musick and Limpus 1997) and observations of newly hatched hawksbills attracted to floating weed have been made (Hornell 1927, Mellgren et al. 1994, Mellgren and Mann 1996). Post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Musick and Limpus 1997), and mud flats (R. von Brandis, unpublished data in NMFS and USFWS 2007a). Individuals of multiple breeding locations can occupy the same foraging habitat (Bowen et al. 1996, Bass 1999, Diaz-Fernandez et al. 1999, Bowen et al. 2007, Velez-Zuazo et al. 2008). As larger juveniles, some individuals may associate with the same feeding locality for more than a decade, while others apparently migrate from one site to another (Musick and Limpus 1997, Mortimer et al. 2003, Blumenthal et al. 2009). Larger individuals may prefer deeper habitats than their smaller counterparts (Blumenthal et al. 2009).

Reproduction

Hawksbill sea turtles breed while in the water, but eggs are laid on beaches worldwide. Females typically lay 3-5 clutches at 2-week intervals during a single nesting season (Witzell 1983, Mortimer and Bresson 1999, Richardson et al. 1999, Beggs et al. 2007). Nesting for each female occurs between 1.8-7 year intervals, depending upon nesting site (Chan and Liew 1999, Garduño-Andrade 1999, Mortimer and Bresson 1999, Pilcher and Ali 1999, Richardson et al. 1999, Limpus 2004, Pita and Broderick 2005, Beggs et al. 2007). Following incubation, hatchlings emerge from sand-covered pits in which their eggs were laid and enter the sea.

Hawksbill sea turtles reach sexual maturity at >20 years in Atlantic waters (Boulon 1983, 1994, León and Diez 1999, Diez and Dam 2002). Ages of 30-38 years have been estimated for individuals from Indo-Pacific waters, with males reaching maturity later than females (Limpus and Miller 2000). Duration of reproductive potential in the Caribbean is 14-22 years (Parrish and Goodman 2006). Based on the reasonable means of 3-5 nests per season (Mortimer and Bresson 1999, Richardson et al. 1999) and 130 eggs per nest (Witzell 1983), a female may lay 9 to 55 egg clutches, or about 1,170-7,190 eggs during her lifetime. However, up to 276 eggs have been recorded in a single nest (Kamel and Delcroix 2009). In the Cayman Islands, juvenile growth has been estimated at 3.0 cm/year (Blumenthal et al. 2009).

Migration

Upon first entering the sea, neonatal hawksbills in the Caribbean are believed to enter an oceanic phase that may involve long distance travel and eventual recruitment to nearshore foraging habitat (Boulon 1994). In the marine environment, the oceanic phase of juveniles (i.e., the "lost years") remains one of the most poorly understood aspects of hawksbill life history, both in terms of where turtles occur and how long they remain oceanic.

Feeding

Dietary data from oceanic stage hawksbills are limited, but indicate a combination of plant and animal material (Bjorndal 1997). Studies have shown post-oceanic hawksbills to feed on sponges throughout their range (reviewed by Bjorndal 1997), but appear to be especially spongivorous in the Caribbean (Meylan 1988, Van Dam and Diez 1997, León and Bjorndal 2002). Jellyfish are also ingested on occasion (Blumenthal et al. 2009).

Status and trends

Hawksbill sea turtles were protected on June 2, 1970 (35 FR 8495) under the Endangered Species Conservation Act and since 1973 have been listed as endangered under the ESA. This species is currently listed as endangered throughout its range. Although no historical records of abundance are known, hawksbill sea turtles are considered to be severely depleted due to the fragmentation and low use of current nesting beaches (NMFS and USFWS 2007a). Worldwide, an estimated 21,212-28,138 hawksbills nest each year among 83 sites. Among the 58 sites for which historic trends could be assessed, all show a decline during the past 20 to 100 years. Among 42 sites for which recent trend data are available, 10 (24%) are increasing, three (7%) are stable and 29 (69%) are decreasing.

Atlantic Ocean. Atlantic nesting sites include Antigua (Jumby Bay), the Turks and Caicos, Barbados, Venezuela, Bahamas, Puerto Rico (Mona Island), Brazil, U.S. Virgin Islands, Dominican, Mexico (Yucatan Peninsula), Republic, Sao Tome, Guatemala, Guadeloupe, Trinidad and Tobago, Costa Rica (Tortuguero National Park), Jamaica, Cuba (Doce Leguas Cays), and Martinique. Population increase has been greater in the Insular Caribbean than along the Western Caribbean Mainland or the eastern Atlantic (including Sao Tomé and Equatorial Guinea).

Pacific Ocean. American Samoa and Western Samoa host fewer than 30 females annually (Tuato'o-Bartley et al. 1993, Grant et al. 1997). In Guam, only 5-10 females are estimated to nest annually (G. Balazs, NMFS, in litt. to J. Mortimer 2007; G. Davis, NMFS, in litt. to J. Mortimer 2007) and the same is true for Hawaii, but there are indications that this population is increasing (G. Balazs, pers. comm. in NMFS and USFWS 2007a). Additional populations are known from the eastern Pacific (potentially extending from Mexico through Panama), northeastern Australia, and Malaysia (Hutchinson and Dutton 2007).

Indian Ocean. The Indian Ocean hosts several populations of hawksbill sea turtles (Spotila 2004, Hutchinson and Dutton 2007). These include western Australian, Egypt, Andaman and Nicobar islands, Oman, Maldives, Saudi Arabia, Seychelles, Sudan, Burma, Yemen, and East Africa.

Critical habitat

On September 2, 1998, critical habitat was declared for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey. The proposed research would not take place in designated hawksbill sea turtle critical habitat.

Leatherback sea turtle

Description of species

Leatherbacks range farther than any other sea turtle species, having evolved physiological and anatomical adaptations that allow them to exploit cold waters (Frair et al. 1972, Greer et al. 1973, NMFS and USFWS 1995). Leatherbacks typically associate with continental shelf and pelagic environments and are sighted in offshore waters of 7-27˚ C (CETAP

1982). However, juvenile leatherbacks usually stay in warmer, tropical waters >21˚ C (Eckert 2002). Males and females show some degree of natal homing to annual breeding sites (James et al. 2005).

Population designations

Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Detailed population structure is unknown, but is likely dependent upon nesting beach location.

Atlantic Ocean. Nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida (Márquez 1990, Spotila et al. 1996, Bräutigam and Eckert 2006). Widely dispersed but fairly regular African nesting also occurs between Mauritania and Angola (Fretey et al. 2007). Many sizeable populations (perhaps up to 20,000 females annually) of leatherbacks are known to nest in West Africa (Fretey 2001).

Caribbean Sea. Nesting occurs in Puerto Rico, St. Croix, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Suriname, and French Guiana (Márquez 1990, Spotila et al. 1996, Bräutigam and Eckert 2006). Beaches bordering the action area along the western Puerto Rican coast are home to roughly 15-30 nests per year (Scharer pers. comm.).

Indian Ocean. Nesting is reported in South Africa, India, Sri Lanka, and the Andaman and Nicobar islands(Hamann et al. 2006).

Pacific Ocean. Leatherbacks are found from tropical waters north to Alaska within the North Pacific and is the most common sea turtle in the eastern Pacific north of Mexico (Stinson 1984, Eckert 1993, Wing and Hodge 2002). The west coast of Central America and Mexico hosts nesting from September-March, although Costa Rican nesting peaks during April-May (Chacón-Chaverri and Eckert 2007, LGL Ltd. 2007). Leatherback nesting aggregations occur widely in the Pacific, including Malaysia, Papua New Guinea, Indonesia, Thailand, Australia, Fiji, the Solomon Islands, and Central America (Limpus 2002, Dutton et al. 2007). Significant nesting also occurs along the Central American coast (Márquez 1990).

Migration

Leatherback sea turtles migrate throughout open ocean convergence zones and upwelling areas, along continental margins, and in archipelagic waters (Morreale et al. 1994, Eckert 1998, 1999). In a single year, a leatherback may swim more than 9,600 km to nesting and foraging areas throughout ocean basins (Eckert 1998, Ferraroli et al. 2004, Hays et al. 2004, Eckert 2006, Eckert et al. 2006, Sale et al. 2006, Benson et al. 2007a, Benson et al. 2007b). However, much of this travel may be due to movements within current and eddy features, moving individuals along (Sale and Luschi 2009). Return to nesting beaches may be accomplished by a form of geomagnetic navigation and use of local cues (Sale and Luschi 2009). Leatherback females will either remain in nearshore waters between nesting events, or range widely, presumably to feed on available prey (Byrne et al. 2009, Fossette et al. 2009).

Reproduction

Leatherback sea turtles probably mate outside of tropical waters (Eckert and Eckert 1988). Mating may occur starting at 3-6 years (Rhodin 1985). However, this is disputed at least in the western North Atlantic and may not occur until 29 years (Pritchard and Trebbau 1984, Rhodin 1985, Zug and Parham 1996, Dutton et al. 2005, Avens and Goshe 2007). Leatherback turtles tend to forage in temperate waters except for nesting females; males are generally absent from nesting areas. Females can deposit up to seven nests per season of 100 eggs or more and return to nest every 2-3 years, although this varies geographically, and some eggs in each clutch are infertile. Nesting along the Pacific coast of Mexico runs from November-February, but may occur as early as August and as late as March (Fritts et al. 1982, NMFS and USFWS 1998a, EuroTurtle 2006a). In the late 1970's, roughly one-half of the world's leatherbacks nested along these shores (Pritchard 1982). Here, females deposit from 1-11 nests per season at 9- to 10-day intervals (NMFS and USFWS 1998a). Nesting in other Pacific locations occurs in China from May-June, Malaysia from June-July, and Queensland, Australia from December-January.

Temperature is important to leatherback egg survival, with higher temperatures increasing mortality (Tomillo et al. 2009). Along Costa Rica, eggs laid earlier in the nesting season have higher hatching success than those deposited later in the season. Possibly because of this, females who nest more frequently (for more years) appear to lay their nests earlier in the season than leatherback females who nest less frequently. Survival is extremely low in early life, but greatly increases with age.

Feeding

Leatherbacks may forage in high-invertebrate prey density areas formed by favorable features (Ferraroli et al. 2004, Eckert 2006). Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al. 2003). The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (Plotkin 1995). Leatherback prey are frequently found in the deep-scattering layer in the Gulf of Alaska (Hodge and Wing 2000). North Pacific foraging grounds contain individuals from both eastern and western Pacific rookeries, although leatherbacks from the eastern Pacific generally forage in the Southern Hemisphere along Peru and Chile (Dutton et al. 1998, Dutton et al. 2000, Dutton 2005-2006). Mean primary productivity in all foraging areas of western Atlantic females is 150% greater than in eastern Pacific waters, likely resulting in twice the reproductive output of eastern Pacific females (Saba et al. 2007). Leatherbacks have been observed feeding on jellyfish in waters off Washington State and Oregon (Eisenberg and Frazier 1983, Stinson 1984).

Status and trends

Leatherback sea turtles were protected on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and since 1973 have been listed as endangered under the ESA. However, recent declines in nesting have continued worldwide. Breeding females were initially estimated at 29,000-40,000, but were later refined to ~115,000 (Pritchard 1971, 1982). Spotila et al. (1996) estimated 34,500 females, but later issued an update of 35,860 (Spotila 2004). The species as a whole is declining and local populations are in danger of extinction (NMFS 2001).

Heavy declines have occurred at all major Pacific basin rookeries, as well as Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. This includes a nesting decline of 23% between 1984-1996 at Mexiquillo, Michoacán, Mexico (Sarti et al. 1996). Fewer than 1,000 nesting females nested on the Pacific coast of Mexico from 1995-1996 and fewer than 700 females are estimated for Central America (Spotila et al. 2000). Decline in the western Pacific is equally severe. Nesting at Terengganu, Malaysia is 1% of that in 1950s (Chan and Liew 1996). The South China Sea and East Pacific nesting colonies have undergone catastrophic collapse. Overall, Pacific populations have declined from an estimated 81,000 individuals to <3,000 total adults and subadults (Spotila et al. 2000). Drastic overharvesting of eggs and mortality from fishing activities is likely responsible for this tremendous decline (Sarti et al. 1996, Eckert 1997).

Critical habitat

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, U.S.V.I. from the 183 m isobath to mean high tide level between 17° 42'12" N and 65°50'00" W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. However, studies do not currently support significant critical habitat deterioration. The proposed research would not take place in designated leatherback sea turtle critical habitat.

Loggerhead sea turtle

Description of the species

Loggerheads are circumglobal occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans. Loggerheads are the most abundant species of sea turtle found in U.S. coastal waters.

Population designations

Loggerhead sea turtles are divided into five groupings that represent major oceans or seas: Atlantic, Pacific, and Indian oceans, as well as Caribbean and Mediterranean seas. As with other sea turtles, populations are frequently divided by nesting aggregation (Hutchinson and Dutton 2007).

Atlantic Ocean. Western Atlantic nesting locations include The Bahamas, Brazil, and numerous locations from the Yucatán Peninsula to North Carolina (Addison and Morford 1996, Addison 1997, Marcovaldi and Chaloupka 2007). This group comprises five nesting subpopulations: Northern, Southern, Dry Tortugas, Florida Panhandle, and Yucatán. Additional nesting occurs on Cay Sal Bank (Bahamas), Cuba, Quintana Roo (Yucatan Peninsula), Colombia, Brazil, Venezuela, Caribbean Central America, the eastern Caribbean Islands, and the Bahamian Archipelago.

Indian Ocean. Loggerhead sea turtles are known to nest along the Indian Ocean in Oman, Yemen, Sri Lanka, Madagascar, South Africa, and possibly Mozambique.

Pacific Ocean. Pacific Ocean rookeries are limited to the western portion of the basin. These sites include Australia, Indonesia, New Caledonia, Japan, New Zealand, and the Solomon islands.

Population structure in the Pacific is comprised of a northwestern Pacific nesting aggregation in Japan and a smaller southwestern nesting aggregation in Australia and New Caledonia (NMFS and SEFSC 2001). Genetics of Japanese nesters suggest that this subpopulation is comprised of genetically distinct nesting colonies (Hatase et al. 2002). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Nesting beach fidelity reduces the likelihood of recolonization of nesting beaches with sea turtles from other subpopulations.

Reproduction

Loggerhead nesting is confined to lower latitudes temperate and subtropic zones but absent from tropical areas (NRC 1990, NMFS and USFWS 1991, Witherington et al. 2006). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small juveniles, large juveniles, subadults, novice breeders, first year emigrants, and mature breeders (Crouse et al. 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near-ultraviolet light; Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as 7-12 years. At 15-38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (Frazer and Ehrhart 1985, NMFS 2001, Witherington et al. 2006, Casale et al. 2009).

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as in offshore from nesting beaches several weeks prior to the onset of nesting (Dodd 1988, NMFS and USFWS 1998c). Females usually breed every 2-3 years, but can vary from 1-7 years (Richardson et al. 1978, Dodd 1988). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984).

Migration

Loggerhead hatchlings migrate offshore and become associated with *Sargassum* spp. habitats, driftlines, and other convergence zones (Carr 1986). After 14-32 years of age, they shift to a benthic habitat, where immature individuals forage in the open ocean and coastal areas along continental shelves, bays, lagoons, and estuaries (NMFS 2001, Bowen et al. 2004). Adult loggerheads make lengthy migrations from nesting beaches to foraging grounds (TEWG 1998). Loggerheads hatched on beaches in the southwest Pacific have been found to range widely in the southern portion of the basin, with individuals from populations nesting in Australia found as far east as Peruvian coast foraging areas still in the juvenile stage (Boyle et al. 2009).

Feeding

Loggerheads are omnivorous and opportunistic feeders (Parker et al. 2005). Hatchling loggerheads feed on macroplankton associated with *Sargassum* spp. communities (NMFS and USFWS 1991). Pelagic and benthic juveniles forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988, Wallace et al. 2009). Sub-adult and adult loggerheads prey on benthic invertebrates such as gastropods, mollusks, and decapod crustaceans in hard-bottom habitats, although fish and plants are also occasionally eaten (NMFS and USFWS 1998c).

Status and trends

Loggerhead sea turtles were listed as threatened under the ESA of 1973 on July 28, 1978 (43 FR 32800). However, NMFS recently determined that a petition to reclassify loggerhead turtles in the western North Atlantic Ocean as endangered might be warranted due to the substantial scientific and commercial information presented. Consequently, NMFS has initiated a review of the status of the species and is currently soliciting additional information on the species status and ecology, as well as areas that may qualify as critical habitat (73 FR 11849; March 5, 2008).

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). An important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates well. Adult nesting females often account for less than 1% of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320–44,560 (Spotila 2004).

Atlantic Ocean. The greatest concentration of loggerheads occurs in the Atlantic Ocean and the adjacent Caribbean Sea, primarily on the Atlantic coast of Florida, with other major nesting areas located on the Yucatán Peninsula of Mexico, Columbia, Cuba, South Africa (Márquez 1990, EuroTurtle 2006b).

Among the five subpopulations, it is estimated that 53,000-92,000 nests are laid per year in the southeastern U.S. and the Gulf of Mexico, and the total number of nesting females is 32,000-56,000. All of these are currently in decline or data are insufficient to access trends (TEWG 1998, NMFS 2001).

Pacific Ocean. Abundance has declined dramatically over the past 10-20 years, although loggerheads range widely from Alaska to Chile (NMFS and USFWS 1998c). Pacific nesting is limited to two major locations, Australia and Japan. Eastern Australia supported one of the major global loggerhead nesting assemblages until recently (Limpus 1985). Now, less than 500 females nest annually, an 86% reduction in the size of the annual nesting population in 23 years (Limpus and Limpus 2003). The status of loggerhead nesting colonies in southern Japan and the surrounding region is uncertain, but approximately 1,000 female loggerhead turtles may nest there; a 50-90% decline compared to historical estimates (Dodd 1988, Bolten et al. 1996, STAJ 2002, Kamezaki et al. 2003). In addition, loggerheads are not commonly found in U.S. Pacific waters, and there have been no documented strandings of loggerheads on the Hawaiian Islands in nearly 20 years (1982-1999 stranding data). There are very few records of loggerheads nesting on any of the many islands of the central Pacific, and the species is considered rare or vagrant in this region (NMFS and USFWS 1998c).

Indian Ocean. The largest known nesting aggregation occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani 1982). Extrapolations resulting from partial surveys and tagging in 1977-1978 provided broad estimates of 19,000-60,000 females nesting annually at Masirah Island, while a more recent partial survey in 1991 provided an estimate of 23,000 nesting females (Ross 1979, Ross and Barwani 1982, Baldwin 1992, Ross 1998).

Critical habitat

NMFS has not designated critical habitat for loggerhead sea turtles.

Olive ridley sea turtle

Description of the species

Olive ridleys are globally distributed in tropical regions (>20º C) of the Pacific (southern California to Peru, and rarely in the Gulf of Alaska; Hodge and Wing 2000), Indian (eastern Africa and the Bay of Bengal), and Atlantic oceans (Grand Banks to Uruguay and Mauritania to South Africa; Fretey 1999, Foley et al. 2003, Fretey et al. 2005, Stokes and Epperly 2006). They are not known to move between or among ocean basins. However, olive ridleys are uncommon in the western Pacific and western Indian Oceans, and most of the North Atlantic (Spotila 2004).

Population designations

Population designations are poorly known. However, populations are likely closely-tied to nesting beach location (Tables 12 and 13).

Atlantic Ocean. Olive ridley distribution in the western North Atlantic occurs mostly along the northern coast of South America and adjacent waters. In the Caribbean, non-nesting individuals occur regularly near Isla Margarita, Trinidad, and Curacao, but are rare further west, such as in Puerto Rico, the Dominican Republic, and Cuba. In rare cases, olive ridleys are known to occur as far north as Puerto Rico, the Dominican Republic, and Cuba and as far south as Brazil (Moncado-G et al. 2000). Regular nesting occurs only in Guyana, Suriname, and French Guiana, with most foraging grounds likely nearby (Reichart 1989 as cited in LGL Ltd. 2007). Nesting occurs along the north coast of Venezuela (Sternberg 1981). Olive ridleys likely occur in low numbers along western Africa.

Pacific Ocean. Typical distribution is from Peru to California, with rare Alaskan sightings. Peak arribada nesting in the eastern Pacific occurs at several beaches in Mexico, Nicaragua, Costa Rica, and Panama (NMFS and USFWS 2007c). Tagged Costa Rican nesters have been recovered as far south as Peru, as far north as Oaxaca, Mexico, and offshore to a distance of 2,000 km. Olive ridleys are the most common sea turtle in oceanic waters of the eastern tropical Pacific but move into nearshore waters prior to breeding (Pitman 1990). This species frequently basks at the surface, is accompanied by seabirds, and associates with floating debris, from logs to plastic debris to dead whales (Arenas and Hall 1991, Pitman 1992).

Southern Hemisphere. Distribution is poorly known, but nesting colonies occur in the Philippines, Papua New Guinea, and northern Australia (Spring 1982, Euroturtle 2009). Solitary nesting beaches occur in Australia, Brunei, Malaysia, Indonesia, and Vietnam (Spotila 2004). Olive ridleys have been sighted in Fiji, Vanuatu, French Polynesia, the

Solomon and Marshall islands, and Palau (SPREP 2007). The occurrence of olive ridleys in Tonga and Kiribati is suspected but unconfirmed (SPREP 2007).

Reproduction

Olive ridley sea turtles are best known for their arribada behavior (Carr 1967, Hughes and Richard 1974). Hundreds to tens of thousands of ridleys may synchronously emerge in just a few days from June-December to nest in close proximity. Courtship and mating occurs in large aggregations just offshore of arribada nesting beaches (Kalb et al. 1995). These patches fluctuate in size and location during the mating season. Mating also occurs by chance encounters in pelagic waters far from nesting beaches, possibly facilitating gene flow between populations (Pitman 1990, Kopitsky et al. 2002). Additionally, many ridleys nest solitarily (Kalb and Owens 1994). Smaller clutch sizes observed for solitary nesters might be due to energetic costs associated with undertaking inter-nesting movements among multiple beaches (Plotkin and Bernardo 2003). A third mating system may also exist, where some females switch between solitary and arribada nesting within a season (Kalb 1999, Bernardo and Plotkin 2007). Sexual maturity likely is reached at 10-18 years (Zug et al. 2006).

Arribada nesting occurs in the eastern Pacific from Nicaragua to Panama, in the Indian Ocean in the Indian State of Orissa (Gahirmatha, Robert Island, and Rushikulya, which host the largest olive ridley arribadas worldwide), and in the western Atlantic from Suriname/French Guiana to Brazil (NMFS and USFWS 2007c).

In general, individual olive ridleys may nest 1-3 times per season, but on average two clutches are produced annually, with ~100-110 eggs per clutch (Pritchard and Plotkin 1995, NMFS and USFWS 1998d, Fonseca et al. 2009). Solitary nesters ovulate on 14-day cycles whereas arribada nesters ovulate approximately every 28 days (Pritchard 1969, Kalb and Owens 1994, Kalb 1999). In the western Pacific, females lay nests every 1.1 years on average. Survivorship is low on high-density arribada nesting beaches (Cornelius et al. 1991). The sheer number of nesting turtles (1,000-500,000) means that nests are frequently disturbed by subsequent nesters in the same or following arribada (Alvarado 1990). On solitary nesting beaches, hatching rates are significantly higher, presumably due to reduced disturbance (Castro 1986, Gaos et al. 2006). Olive ridleys may experience high mortality in early life stages, but details of survivorship are poorly understood. Sexual maturity is attained at a median age of 13 years with a range of 10-18 (Kopitsky et al. 2005, Zug et al. 2006).

Migration

Olive ridleys are highly migratory and may spend most of their non-breeding life cycle in deep-ocean waters, but occupy the continental shelf region during the breeding season (Cornelius and Robinson 1986, Arenas and Hall 1991, Pitman 1992, Pitman 1993, Plotkin 1994, Plotkin et al. 1994a, Plotkin et al. 1995, Beavers and Cassano 1996). Reproductively active males and females migrate toward the coast and aggregate at nearshore breeding grounds near nesting beaches (Pritchard 1969, Hughes and Richard 1974, Cornelius 1986, Plotkin et al. 1991, Kalb et al. 1995, Plotkin et al. 1996, Plotkin et al. 1997). Other males and females may not migrate to nearshore breeding aggregations at all (Pitman 1992, Kopitsky et al. 2000). Some males appear to remain in oceanic waters, are non-aggregated, and mate opportunistically as they intercept females *en route* to near shore breeding grounds and nesting beaches (Plotkin 1994, Plotkin et al. 1994b, Plotkin et al. 1996, Kopitsky et al. 2000). Their migratory pathways vary annually (Plotkin 1994), there is no spatial and temporal overlap in migratory pathways among groups or cohorts of turtles (Plotkin et al. 1994a, Plotkin et al. 1995), and no apparent migration corridors exist. Olive ridleys may use water temperature more than any other environmental cue during migrations (Spotila 2004). Post-nesting migration routes from Costa Rica traverse more than 3,000 km out into the central Pacific (Plotkin et al. 1994a). Olive ridleys from different populations may occupy different oceanic habitats (Polovina et al. 2003, Polovina et al. 2004). Unlike other marine turtles that migrate from a breeding ground to a single feeding area, where they reside until the next breeding season, olive ridleys are nomadic migrants that swim hundreds to thousands of kilometers over vast oceanic areas (Plotkin 1994, Plotkin et al. 1994a, Plotkin et al. 1995). Olive ridleys may associate with flotsam, which could provide food, shelter, and/or orientation cues (Arenas and Hall 1991).

Feeding

Olive ridleys typically forage offshore and feed on a variety of benthic and pelagic species, such as: jellyfish, squid, salps, red crabs, acorn and gooseneck barnacles, molluscs, and algae (Márquez 1990).

Olive ridleys can dive and feed at considerable depths (80-300 meters), although ~90% of their time is spent at depths of less than 100 meters (Polovina et al. 2003). At least 25% of their total dive time is spent in the permanent thermocline, located at 20-100 meters (Parker et al. 2003). In the North Pacific Ocean, two olive ridleys tagged with satellite-linked depth recorders spent about 20% of their time in the top meter and about 10% of their time deeper than 100 meters; 70% of the dives were no deeper than 5 meters (Polovina et al. 2003).

Status and trends

Olive ridley sea turtles were listed as threatened under the ESA on July 28, 1978 (43 FR 32800), except for the Mexico breeding stock, which is listed as endangered. The olive ridley is the most abundant sea turtle in the world (Pritchard 1997). Worldwide, abundance of nesting female olive ridleys is estimated at two million (Spotila 2004).

Atlantic Ocean. Nesting centers, such as around Surinam, have declined more than 80% since 1967. However, nesting along Brazil, Nicaragua, and Costa Rica appear to be increasing, although long-term data are lacking (NMFS and USFWS 2007b).

Pacific Ocean. The eastern Pacific population is believed to number roughly 1.39 million (Eguchi et al. 2007). Abundance estimates in recent years indicate that the Mismaloya and Moro Ayuta nesting populations appear to be stable and the nesting population at La Escobilla is increasing, although less than historical levels, which was roughly 10 million adults prior to 1950 (Cliffton et al. 1982, NMFS and USFWS 2007c). By 1969, after years of adult harvest, the estimate was just over one million (Cliffton et al. 1982). Olive ridley nesting at La Escobilla rebounded from approximately 50,000 nests in 1988 to over 700,000 nests in 1994, and more than a million nests by 2000 (Márquez et al. 1996, Márquez et al. 2005).

Indian Ocean. Arribada nesting populations are still large but are either in or near decline. Solitary nesting declines have been reported from Bangladesh, Myanmar, Malaysia, Pakistan, and southwest India (NMFS and USFWS 2007b). However, solitary nesting in Indonesia may be increasing (Limpus 1995, Asrar 1999, Thorbjarnarson et al. 2000, Dermawan 2002, Islam 2002, Krishna 2005).

Critical habitat

NMFS has not designated critical habitat for olive ridley sea turtles.

Environmental baseline

By regulation, environmental baselines for Opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The *Environmental baseline* for this Opinion includes the effects of several activities affecting the survival and recovery of ESA-listed Steller sea lions, bowhead, sei, blue, fin, Southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and olive ridley, green, leatherback, hawksbill, and loggerhead sea turtles in the action area. The *Environmental baseline* focuses primarily on past and present impacts to these species.

A number of human activities have contributed to the current status of ESA-listed pinnipeds, cetaceans, and sea turtles in the action area. Although some of those activities, such as commercial whaling, occurred extensively in the past, ceased, and no longer appear to affect these whale populations, the effects of these types of exploitation persist today. Other human activities, such as commercial fishing and vessel operations, are ongoing and continue to affect these species.

The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood these species will survive and recover in the wild. These include predation, disease and parasitism, commercial and subsistence harvest, fisheries interactions, ship strikes, contaminants, marine debris, noise, habitat degradation and climate change, and scientific research.

Predation

Steller sea lions. 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). Although the number of chases or harassment events by a large predator like a killer whale or shark would outnumber the successful kills, evidence suggests losses due to predation may be significant.

Cetaceans. Bowhead and right whales have been subjects of killer whale attacks and, because of their robust size and slow swimming speed, tend to form small groups and fight killer whales when confronted and may cause killer whale mortality with their flukes (Ford and Reeves 2008).

Adult fin, sei, and blue whales engage in a flight responses (up to 40 km/h) to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Andrews (1916) suggested that killer whales attacked sei whales less frequently than fin and blue whales in the same areas. As the world's largest animals, blue whales are only occasionally known to be taken by killer whales (Tarpy 1979, Sears et al. 1990).

Based upon prevalence of tooth marks, attacks by killer whales appear to be highest among humpback whales migrating between Mexico and California, although populations throughout the Pacific Ocean appear to be targeted to some degree (Steiger et al. 2008). Juveniles appear to be the primary age group targeted. Humpback whales engage in grouping behavior, flailing tails, and rolling extensively to fight off attacks. Calves remain protected near mothers or within a group and lone calves have been known to be protected by presumably unrelated adults when confronted with attack (Ford and Reeves 2008).

Sperm whales are known to be occasionally preyed upon by killer whales (Jefferson and Baird 1991, Pitman et al. 2001) and large sharks (Best et al. 1984) and harassed by pilot whales (Arnbom et al. 1987, Rice 1989, Whitehead 1995, Palacios and Mate 1996, Weller et al. 1996).

Sea Turtles. Sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004). Predators of sea turtles, especially of eggs and hatchlings, also include dogs, pigs, rats, crabs, sea birds, reef fishes, iguanas, coyotes, raccoons, and coatis (Aprill 1994, Bell et al. 1994, Ficetola 2008).

Disease and parasitism

Steller sea lions. Steller sea lions have tested positive for several pathogens, but disease levels are unknown (FOC 2008). Similarly, parasites in this species are common, but mortality resulting from infestation is unknown. However, significant negative effects of these factors may occur in combination with stress, which reduces immune capability to resist infections and infestations. If other factors, such as disturbance, injury, or difficulty feeding occur, it is more likely that disease and parasitism can play a greater role in population reduction. Some viruses may contribute to low birth rates and reduce an individual's immunity, but the extent to which they have affected Steller sea lion populations is unclear.

Cetaceans. Urinary tract diseases and kidney failure caused by nematode *Crassicauda boopis* has been suggested to be the primary cause of natural mortality in North Atlantic fin whales and could also affect humpback whale populations (Lambertsen 1986, Lambertsen 1992), and several other species of large whale are known to carry similar parasites (Rice 1977). Endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977). Parasites and biotoxins from red-tide blooms are other potential causes of mortality of humpback whales (Perry et al. 1999).

Strandings are also relatively common events for sperm whales, with one to dozens of individuals generally beaching themselves and dying during any single event. Although several hypotheses, such as navigation errors, illness, and anthropogenic stressors, have been proposed (Goold et al. 2002, Wright 2005), direct widespread causes remain unclear. Calcivirus and papillomavirus are known pathogens of sperm whales (Smith and Latham 1978, Lambertsen et al. 1987).

Sea turtles. For unknown reasons, the frequency of a disease called fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations. Extremely high incidence has been reported in Hawaii, where affliction rates peaked at 47-69% in some foraging areas (Murakawa et al. 2000).

Commercial and subsistence harvest

Steller sea lions. Between 1959 and 1972, there were attempted by the U.S. to harvest Steller sea lions in Alaskan waters. However, harvests proved to be uneconomical (Thorsteinson and Lensink 1962, Little 1964, Merrick et al. 1987). Such harvests may have depressed recruitment in the short term and may have explained declines noted at some sites in the eastern Aleutian Islands or the Gulf of Alaska. These harvests do not appear to explain declines in other regions. According to survey data collected by Alaska Department of Fish and Game, the estimated mean annual subsistence harvest from the western stock between 2000 and 2004 was 191 animals per year (Angliss and Outlaw 2007). About 95 percent of subsistence harvest is on individuals from the Western DPS (Wolfe et al. 2005).

Cetaceans. Directed harvest has affected bowhead, sei, blue, fin, humpback, sperm, and Southern and North Pacific right whales. U.S. Commercial harvest of these large whale species no longer occurs, and the IWC has moratoriums in place to protect these species from commercial whaling internationally. Nonetheless, historical whaling significantly reduced large whale abundance, and the effects of these reductions likely still persist.

Bowhead whales began declining precipitously with directed whaling efforts in the Bering Sea between 1850 and 1870, when an estimated 60% of individuals were harvested (Braham 1984). Harvests declined after 1870, although whaling efforts continued. Native tribes take 14 to 72 individuals, or 0.1 to 0.5% of the stock population annually from the western Arctic stock. Under this system, 832 individuals are known to have been taken from 1974 to 2003. However, these hunts are closely monitored and accessed for negative impacts on population number and structure and serve to maintain tribal culture. Individuals are known to have been taken by native tribes in Canada and Russia, although in extremely low numbers.

Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales are thought to not be widely hunted, although harvest for scientific whaling or illegal harvesting may occur in some areas.

Fin whales continue to be hunted in subsistence fisheries off West Greenland. Between 2003 and 2007, the IWC set a catch limit of up to 19 fin whales in this subsistence fishery. In the Antarctic Ocean, fin whales are hunted by Japanese whalers who have been allowed to kill up to 10 fin whales each ear for the 2005-2006 and 2006-2007 seasons under an Antarctic Special Permit NMFS (2006a). The Japanese whalers plan to kill 50 whales per year starting in the 2007-2008 season and continuing for the next 12 years (IWC 2006, Nishiwaki et al. 2006).

Sperm whales historically faced severe depletion from commercial whaling operations. From 1800 to 1900, the IWC estimated that nearly 250,000 sperm whales were killed by whalers, with another 700,000 from 1910 to 1982 (IWC Statistics 1959-1983). Others have estimated 436,000 individuals taken between 1800-1987 (Carretta et al. 2005).

Sea turtles. Directed harvest of sea turtles and their eggs for food and other products has existed for years and was a significant factor causing the decline of olive ridley, green, leatherback, hawksbill, and loggerhead sea turtles. At present, despite conservation efforts such as bans and moratoriums by the responsible governments, the harvest of turtles and their eggs still occurs throughout the action area. Countries including Mexico, Peru, and the Philippines have made attempts to reduce the threats to sea turtles, but illegal harvesting still occurs. In Vietnam and Fiji, harvest of turtle meat and eggs remains unregulated.

Fisheries interactions

Steller sea lions. Steller sea lions have been caught incidentally in foreign commercial trawl fisheries in the Gulf of Alaska and Gulf of Alaska since those fisheries developed in the 1950s (Loughlin and Nelson Jr. 1986, Perez and Loughlin 1991). Alverson (1992) suggested that from 1960 to 1990, incidental take may have accounted for over 50,000 animals, or almost 40 percent of his estimated total mortality due to various fishery and subsistence activities. Perez and Loughlin (1991) reviewed fisheries and observer data and concluded that incidental take was a contributing cause of the population decline of Steller sea lions in Alaska, accounting for a decline of 16 percent in the Gulf of Alaska and 6 percent in the Gulf of Alaska. However, because the actual decline has exceeded 80 percent since 1960, fishery related mortality of Steller sea lions does not appear to be the only factor contributing to their decline.

Historically, Steller sea lions and other pinnipeds were seen as nuisances to the fishing industry and management agencies because they damaged catch and fishing gear and were thought to compete for fish (Mathisen 1959). Alverson (1992) suggested that intentional take may have reached or exceeded 34,000 animals from 1960 to 1990. Recently, British Columbia outlawed the shooting of Steller sea lions in and around the commercial farming operations. An estimated 45 animals were killed each year between 1999 and 2003 in an effort to control predation at fish farm operations in British Columbia. However, British Columbia has not authorized this activity since 2004.

Cetaceans. Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in large whale species (see Dietrich et al. 2007). These entanglements also make whales more vulnerable to additional dangers (e.g., predation and ship strikes) by restricting agility and swimming speed. There is concern that many marine mammals that die from entanglement in commercial fishing gear tend to sink rather than strand ashore thus making it difficult to accurately determine the extent of such mortalities.

Marine mammals probably consume at least as much fish as is harvested by humans (Kenney et al. 1985). Therefore, competition with humans for prey is a potential concern for whales. Reductions in fish populations, whether natural or human-caused, may affect listed whale populations and their recovery.

Sei whales consume a diverse set of prey which may allow them a greater opportunity to take advantage of variable resources (Waring et al. 2008). However, this attribute may also increase their potential for competition with commercial fisheries (Rice 1977). Similarly, humpback and fin whales are known to feed on several species of fish that are harvested by humans and fishery-caused reductions in prey resources could also have an influence on these species (Waring et al. 2008). However, the extent of competition between humans and whales is not known.

The primary prey of killer whales, salmon, has been severely reduced due to habitat loss and overfishing of salmon along the West Coast (Gregory and Bisson 1997, Lichatowich 1999, Lackey 2003). Several salmon species are currently protected under the ESA, and are generally well below their former numbers. A 50% reduction in killer whale calving has been correlated with years of low Chinook salmon abundance (Ward et al. 2009a).

Sea turtles. Although very few fisheries in the Pacific Ocean are observed or monitored for bycatch, incidental take of sea turtles, particularly by longline fisheries, has been documented for green, leatherback, loggerhead, and olive ridley sea turtles (Crognale et al. 2008, Gless et al. 2008, Fossette et al. 2009, Petersen et al. 2009). Although primarily spongivorous, hawksbill sea turtles have also been caught as bycatch in the swordfish fishery off South Africa (Petersen et al. 2009).

Fishery interactions result in large scale mortality of olive ridley sea turtles. Since 1993, more than 50,000 olive ridleys have stranded along the coast of India, at least partially because of near-shore shrimp fishing (Shanker and Mohanty 1999). Despite mandatory requirements passed in 1997 to use turtle excluder devices in their nets, none of the approximately 3,000 trawlers operating off the Orissa coast use them, and mortality due to shrimp trawling reached a record high of 13,575 ridleys during the 1997 to 1998 season (Pandav and Choudhury 1999). Shrimp trawls off of Central America are estimated capture over 60,000 sea turtles annually, most of which are olive ridleys (Arauz 1996 as cited in NMFS and USFWS 2007c). Olive ridleys in the eastern Pacific are also incidentally caught by purse seine fisheries and gillnet fisheries (Frazier et al. 2007).

Shrimp trawl fisheries account for the highest number of loggerhead sea turtles that are captured and killed. Along Baja California, it is estimated that 1,500-2,950 loggerheads are killed annually by local fishing fleets (Peckham et al. 2008). Offshore longline tuna and swordfish longline fisheries are also a serious concern for the survival and recovery of loggerhead sea turtles and appear to affect the largest individuals more than younger age classes (Bolten et al. 1994, Aguilar et al. 1995, Tomás et al. 2008, Carruthers et al. 2009, Petersen et al. 2009). In the Pacific, loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas; direct harvest and commercial fisheries off Baja California, Mexico; commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean; and California/Oregon drift gillnet fisheries.

Ship strikes

Cetaceans. Collisions with commercial ships are an increasing threat to many large whale species, particularly as shipping lanes cross important large whale breeding and feeding habitats or migratory routes. In the Eastern Pacific, the following average observed annual mortalities due to ship strike have been reported for the period 2002-2006: 1.6 fin whales, 0.6 blue whales, 0.2 sei whales, and 0 sperm and humpback whales, although it is apparent that animals struck by ships are unlikely to be reported (Carretta et al. 2009).

Ship strike is presently a concern for blue whale recovery. Dive data support a surface-oriented behavior during nighttime that would make blue whales particularly vulnerable to ship strikes. There are concerns that, like right whales, blue whales may surface when approached by large vessels, a behavior that would increase their likelihood of being struck. Protective measures are not currently in place. It is believed that the vast majority of ship strike mortalities are never identified, and that actual mortality is higher than currently documented.

Fin whales experience significant injury and mortality from fishing gear and ship strikes (Perkins and Beamish 1979, Lien 1994, Carretta et al. 2007a, Waring et al. 2007, Douglas et al. 2008). Management measures aimed at reducing the risk of ships hitting right whales have been put in place.

The proximity of the known right whale habitats to shipping lanes (e.g. Unimak Pass) suggests that collisions with vessels may also represent a threat to North Pacific right whales (Elvin and Hogart 2008).

Vessel activity also has been identified as a threat. This includes physical harm or behavioral modifications as well as habitat degradation/loss from U.S. naval vessel sonar activities, ship strike, and heavy and continuous presence by whale-watching vessels. Commercial whale-watching in the region focuses primarily on Southern Resident killer whales and has increased dramatically in the recent years (Osborne et al. 1999, Baird 2001, Erbe 2002, MMMP 2002, Koski 2004, 2006, 2007).

Sea turtles. Boat collisions can result in serious injury and death, and may pose a threat to sea turtles in the action area although the extent of this threat is unknown.

Contaminants

Steller sea lions. A number of studies (Varanasi et al. 1992, Lee et al. 1996, Krahn 1997, Krahn et al. 2004b) have indicated relatively high concentrations of organochlorine compounds in Steller sea lions in Alaska, although these levels have not yet been associated with any changes in health or vital rates (Barron et al. 2003). Low-level mercury exposure is evident in pups and females, but the long-term effect mercury or even methylmercury has on Steller sea lions is unclear (Beckmen et al. 2002).

Some Steller sea lions are likely directly exposed to oil, particularly during tanker breaches like the spill from the Exxon Valdez in 1989 and the spill from a Malaysian freighter in 2004. While, no significant adverse effects of the oil were confirmed following the Exxon spill (Calkins *et al*. 1994) ingestion and exposure of mucosal membranes may have chronic effects on an individual's health (see discussion, next section). At present, there is not enough information to determine what role, if any, exposure to contaminants plays in the health, survival and recovery of Steller sea lion populations.

Cetaceans. The accumulation of stable pollutants is a possible human-induced source of mortality in long-lived high trophic level animals (Waring et al. 2004, NMFS 2005a), and some researchers have correlated contaminant exposure to possible adverse health effects in marine mammals. Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation. Due to their large amount of blubber and fat, marine mammals readily accumulate lipid-soluble contaminants (O'Hara and Rice 1996).

Several contaminants have been isolated from bowhead whale tissues in low concentrations, including organochlorines, mercury, lead, arsenic, zinc, copper, cadmium, selenium, and silver (Dehn et al. 2006, O'Hara et al. 2006, Rosa et al. 2007). These concentrations are lower than in other studied cetaceans due to the lower level at which bowhead whales feed in the overall food chain (Dehn et al. 2006, Parrish et al. 2008).

There is a paucity of contaminant data regarding blue whales. Available information indicates that organochlorines, including DDT, PCB, HCH, HCB, chlordane, dieldrin, methoxychlor, and mirex have been isolated from blue whale blubber and liver samples (Gauthier et al. 1997b, Metcalfe et al. 2004). DDE, DDT, and PCBs have been also identified from fin and sei whale blubber, but levels are lower than in toothed whales due to the lower level in the food chain at which the baleen whales feed (Henry and Best 1983, Borrell and Aguilar 1987, Aguilar and Borrell 1988, Borrell 1993, Marsili and Focardi 1996). Humpback whale blubber has been shown to contain PCB and DDT (Gauthier et al. 1997a). Contaminant levels are relatively high in humpback whales, compared to blue whales; humpback whales feed higher on the food chain, where prey carry higher contaminant loads than the krill that blue whales feed on.

Contaminants have been identified in sperm whales, but vary widely in concentration based upon life history and geographic location, with northern hemisphere individuals generally carrying higher burdens (Evans et al. 2004). Contaminants include dieldrin, chlordane, DDT, DDE, PCBs, HCB and HCHs in a variety of body tissues (Aguilar 1983, Evans et al. 2004), as well as several heavy metals (Law et al. 1996).

Puget Sound serves as a major port and drainage for thousands of square miles of land. Contaminants entering Puget Sound and its surrounding waters accumulate in water, benthic sediments, and the organisms that live and eat here (Krahn et al. 2009). As the top marine predator, Southern Resident killer whales bioaccumulate these toxins in their tissues, potentially leading to numerous physiological changes such as skeletal deformity, lowered disease resistance, and enzyme disruption (Krahn et al. 2009). Presently, the greatest contaminant threats are organochlorines, which include PCBs, pesticides, dioxins, furans, other industrial products, and the popularized chemical DDT (Ross et al. 2000, CBD 2001, Krahn et al. 2002, Cullon et al. 2009, Krahn et al. 2009).

Sea turtles. In sea turtles, heavy metals, including arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc, have been found in a variety of tissues in levels that increase with turtle size (Godley et al. 1999, Saeki et al. 2000, Anan et al. 2001, Fujihara et al. 2003, Gardner et al. 2006, Storelli et al. 2008, Barbieri 2009, Garcia-Fernandez et al. 2009). Cadmium has been found in leatherbacks at the highest concentration compared to any other marine vertebrate (Gordon et al. 1998, Caurant et al. 1999). Newly emerged hatchlings have higher concentrations than are present when laid, suggesting that metals may be accumulated during incubation from surrounding sands (Sahoo et al. 1996). Arsenic has been found to be very high in green sea turtle eggs (van de Merwe et al. 2009).

Sea turtle tissues have been found to contain organochlorines, including chlorobiphenyl, chlordane, lindane, endrin, endosulfan, dieldrin, PFOS, PFOA, DDT, and PCB (Rybitski et al. 1995, McKenzie et al. 1999, Corsolini et al. 2000, Miao et al. 2001, Gardner et al. 2003, Keller et al. 2004a, Keller et al. 2004b, Keller et al. 2005, Alava et al. 2006, Perugini et al. 2006, Storelli et al. 2007, Monagas et al. 2008, Oros et al. 2009). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight; Davenport et al. 1990, Oros et al. 2009). Levels of PCBs found in green sea turtle eggs are considered far higher than what is fit for human consumption (van de Merwe et al. 2009).

It appears that levels of organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2004c, Keller et al. 2006, Oros et al. 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007), and are known to depress immune function in loggerhead sea turtles (Keller et al. 2006). Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation.

Exposure to sewage effluent may also result in green sea turtle eggs harboring antibiotic-resistant strains of bacteria (Al-Bahry et al. 2009).

Marine Debris

Steller sea lions. Observations of Steller sea lions entangled in marine debris have been made throughout the Gulf of Alaska and in southeast Alaska (Calkins 1985), typically incidental to other sea lion studies. Two categories of debris, closed plastic packing bands and net material, accounted for the majority of entanglements. Loughlin *et al*. (1984) surveyed numerous rookeries and haul-out sites to evaluate the nature and magnitude of entanglement in debris on Steller sea lions in the Aleutian Islands. Of 30,117 animals counted (15,957 adults; 14,160 pups) only 11 adults showed evidence of entanglement with debris, specifically, net or twine. Entanglement rates of pups and juveniles appear to be even lower than those observed for adults (Loughlin and Nelson 1986). It is possible that pups were too young during the survey to have encountered debris in the water or that pups and juveniles were unable to swim to shore once entangled and died at sea. Trites and Larkin (1992) assumed that mortalities from entanglement in marine debris were not a major factor in the observed declines of Steller sea lions and estimated that perhaps fewer than 100 animals are killed each year.

Sea turtles. Ingestion of marine debris can be a serious threat to sea turtles. When feeding, sea turtles can mistake debris (e.g., tar and plastic) for natural food items. Some types of marine debris may be directly or indirectly toxic, such as oil. Other types of marine debris, such as discarded or derelict fishing gear, may entangle and drown sea turtles. Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009).

Noise

Cetaceans. Bowhead whales have been shown to vacate areas in which drilling and seismic survey operations occur, apparently in response to sound (Richardson and Malme 1993, Richardson 1995, Davies 1997, Miller et al. 1999, Schick and Urban 2000). It is possible that migratory routes have already shifted in response to anthropogenic sound (Richardson et al. 2004).

Increasing oceanic noise may impair blue whale behavior. Although available data do not presently support traumatic injury from sonar, the general trend in increasing ambient low-frequency noise in the deep oceans of the world, primarily from ship engines, could impair the ability of blue whales to communicate or navigate through these vast expanses (Aburto et al. 1997, Clark 2006).

The increase in "background noise" resulting from vessel traffic and coastal development activities, although not directly traumatic, has the potential to influence or disrupt the acoustic system that Southern Resident killer whales use to navigate, communicate, and forage (Bain and Dahlheim 1994, Gordon and Moscrop 1996, Erbe 2002, Williams et al. 2002a, Williams et al. 2002b, NMFS 2008, Holt et al. 2009).

U.S. Navy Activities

Southern California Range Complex

The U.S. Navy has been conducting training and other activities in their Southern California Range Complex for over 70 years. Current activities include anti-submarine warfare exercises, anti-air warfare exercises, anti-surface warfare exercises, and amphibious warfare exercises, coordinated training events and research, development and evaluation activities. The U.S. Navy estimates that it currently conducts about 8 major training exercises, seven integrated exercises, and numerous unit-level training and maintenance exercises in the Southern California Range Complex each year (U.S. Navy 2008a).

Although the U.S. Navy did not estimate the number of times different listed species might be exposed to mid-frequency active sonar during these training activities, NMFS estimated about 14,000 instances in which endangered or threatened marine mammals would be exposed to Navy training activities during the cold season and another 3,600 exposure events during the warm season. The largest number of exposure events (about 70 percent or about 9,900 exposure events during the cold season and about 1,891 exposure events during the warm season) would involve blue whales, with 2,100 exposure events involving sperm whales (about 15 percent of the exposure events), and 1,900 exposure events involving fin whales (about 13.7 percent of the exposures).

Of this total number of exposure events involving mid-frequency active sonar, the U.S. Navy estimated that yearly totals for behavioral harassment events would be 480 for blue whales, 135 for fin whales, 120 for sperm whales, and 772 for Guadalupe fur seals. Because blue whales are not likely to hear mid-frequency active sonar, it is assumed that blue whales would be more likely to be harassed by vessel traffic rather than the active sonar itself.

The U.S. Navy also estimated that three blue whales would have been behaviorally harassed each year as a result of underwater detonations associated with training activities in the Southern California Range Complex and another two blue whales would have experienced temporary losses in hearing sensitivity as a result of being exposed to those detonations. Two fin whales and an additional fin whale would also have experienced temporary losses in hearing sensitivity as a result of being exposed to these detonations. Two sperm whales would have been behaviorally harassed each year and an additional two sperm whales would have experienced temporary losses in hearing sensitivity as a result of being exposed to these detonations. Two Guadalupe fur seals would have been behaviorally harassed and an additional two seals would have experienced temporary losses in hearing sensitivity as a result of being exposed to these detonations.

Hawaii Range Complex

Since 1971[3], the U.S. Navy has conducted the biennial Rim of the Pacific (RIMPAC) exercises. These exercises have historically lasted for approximately one month and have involved forces from various nations on the Pacific Rim including Australia, Canada, Chile, Japan, and the Republic of Korea. We have limited information on the timing and nature of RIMPAC Exercises prior to 2002 and we have no information on their potential effects on endangered and threatened marine animals in the Hawaii Range Complex prior to 2006, when NMFS started to consult with the U.S. Navy on the exercises.

Between June and July 2006, the U.S. Navy conducted RIMPAC exercises in the Hawaii Range Complex. Based on the U.S. Navy's 7 December 2006 After Action Report, over the 15 calendar days of the 2006 RIMPAC (U.S. Navy 2006), mid-frequency sonars were employed for a total of 472 hours. Active and passive sonobuoys were also deployed for 115 hours during these exercises but not all sonobuoys were transmitting noise.

During the 2006 RIMPAC exercises, U.S. Navy observers reported marine mammals on 29 occasions. On 12 of those 29 occasions, mid-frequency sonar was shut down for a total of eight hours. On two other occasions, marine mammals were observed more than 1,000 yards from a vessel while mid-frequency sonar was active.

The After Action Report for the 2006 RIMPAC concluded that (a) there was no evidence of any behavioral effects on marine mammals throughout the exercise; and (b) there were no reported standing events or observations of behavioral disturbance of marine mammals linked to sonar use during the exercise. The observations contained in the report do not identify or estimate the number of endangered or threatened species that might have been exposed to mid-frequency active sonar during the exercise. The Navy did not evaluate the efficacy of the mitigation measures nor did they evaluate the efficacy of the monitoring program associated with the exercises.

Between June and July 2008, the U.S. Navy conducted another set of RIMPAC exercises in the HRC, with the at-sea portions that involved mid-frequency active sonar occurring between July 7 and 31 2008. Based on the U.S. Navy's 30 November 2008 After-Action

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[3] Previous biological opinions on the 2006 Rim of the Pacific Exercises and the Undersea Warfare Exercises reported that Rim of the Pacific Exercises had occurred in the Hawaii Range Complex since 1968. U.S. Navy historians have since verified that these exercises began in 1971.

Report, over the 25 calendar days of the 2008 RIMPAC (U.S. Navy 2008d), mid-frequency active sonars and sonobuoys were employed for a total of 547 hours. Of this total, active sonar was employed between the shoreline and the 200-meter bathymetric contour for about 6 hours.

Participants in the 2008 RIMPAC exercises reported 29 sightings of marine mammal groups totaling about 200 animals; dolphins represented 72 percent of these sightings. Six whale groups were sighted during the exercise, all in waters more than 100 nm west of the Island of Hawaii. An aerial survey over a portion of the area in which the 2008 RIMPAC exercises occurred reported 24 sightings of marine mammal groups involving eight species of small odontocetes, Hawaiian monk seals, or unidentified dolphins or sea turtles. A shipboard survey that also occurred in a portion of the area in which the 2008 RIMPAC exercises occurred reported 9 sightings of marine mammal groups consisting of either bottlenose dolphins, rough-toothed dolphins, or Hawaiian spinner dolphins. None of the observers reported unusual behavior or adverse behavioral responses to active sonar exposures or vessel traffic associated with the exercises.

The U.S. Navy has also conducted Undersea Warfare Exercises in the HRC for several years, but the components of these exercises can vary widely. For example, an Undersea Warfare Exercise conducted in the HRC from 13 to 15 November 2007, involved two ships equipped and entailed a total of 77 hours of mid-frequency active sonar from all sources (U.S. Navy 2008d). An Undersea Warfare Exercise conducted in the HRC from 25 to 27 March 2008, involved a total of 169 hours of mid-frequency active sonar from all sources (U.S. Navy 2008c). An Undersea Warfare Exercise conducted in the HRC from 27 to 31 May 2008, involved four ships, and entailed a total of 204 hours of mid-frequency active sonar from all sources (hull-mounted sonars, dipping sonars, and sonobuoys; U.S. (U.S. Navy 2008b).

Monitoring surveys associated with the November 2007 Undersea Warfare Exercises reported 26 sightings of five species during exercise, including green sea turtles and Hawaiian monk seals. None of the marine animals observed from survey vessels or aircraft were reported to have exhibited unusual behavior or changes in behavior during the surveys. Monitoring surveys associated. Monitoring surveys associated with the March 2008 Undersea Warfare Exercises reported 47 sightings of five species during exercise, including humpback whales (40 sightings of 68 individuals) and an unidentified sea turtle. None of the marine animals observed from survey vessels or aircraft were reported to have exhibited unusual behavior or changes in behavior during the surveys.

Habitat degradation and climate change

Cetaceans. Climate change may have a dramatic affect on survival of North Pacific right whales. Right whale life history characteristics make them very slow to adapt to rapid changes in their habitat (see Reynolds et al. 2002). They are also feeding specialists that require exceptionally high densities of their prey (see Baumgartner et al. 2003, Baumgartner and Mate 2003). Zooplankton abundance and density in the Bering Sea has been shown to be highly variable, affected by climate, weather, and ocean processes and in particular ice extent (Napp and G.L. Hunt 2001, Baier and Napp 2003). The largest concentrations of copepods occurred in years with the greatest southern extent of sea ice (Baier and Napp 2003). It is possible that changes in ice extent, density and persistence may alter the dynamics of the Bering Sea shelf zooplankton community and in turn affect the foraging behavior and success of right whales.

Sea turtles. Coastal development can deter or interfere with nesting, affect nest success, and degrade foraging habitats for sea turtles. Many nesting beaches have already been significantly degraded or destroyed. Nesting habitat is threatened by rigid shoreline protection or "coastal armoring" such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. Nesting habitat can be reduced by beach renourishment projects, which result in altered beach and sand characteristics, affecting nesting activity and nest success. Beach nourishment also hampers nesting success of loggerhead sea turtles, but only in the first year post-nourishment, after which hatching success increases (Brock et al. 2009). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009). Because hawksbills prefer to nest under vegetation (Mortimer 1982, Horrocks and Scott 1991), they are particularly affected by beachfront development and clearing of dune vegetation (Mortimer and Donnelly 2007).

The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the sea, with up to 50% of some olive ridley hatchlings disoriented upon emergence in some years (Witherington and Bjorndal 1991, Witherington 1992, Karnad et al. 2009).

Coasts can also be threatened by contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999, Lee Long et al. 2000, Waycott et al. 2005).

At sea, there are numerous potential threats including marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction caused by fishing gear and practices, agricultural runoff, and sewage discharge (Lutcavage et al. 1997, Frazier et al. 2007). Hawksbills are typically associated with coral reefs, which are among the world's most endangered marine ecosystems (Wilkinson 2000).

Although climate change may expand foraging habitats into higher latitude waters and increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability, climate change could reduce nesting habitat due to sea level rise, as well as affect egg development and nest success. Rising temperatures may increase feminization of leatherback nests (Mrosovsky et al. 1984, James et al. 2006, McMahon and Hays 2006, Hawkes et al. 2007b). Hawksbill turtles exhibit temperature-dependent sex determination (Wibbels 2003) suggesting that there may be a skewing of future hawksbill cohorts toward strong female bias. Loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just 1º-2º C can potentially change hatchling sex ratios to all or nearly all female in tropical and subtropical areas (Hawkes et al. 2007a). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds has also been linked to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009, Schofield et al. 2009). Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). However, warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009)

Scientific research

A total of 37 permits authorize the harassment of one or more of the target pinniped, cetacean, and turtle species in the action area during research (Table 10). Permits in Table 10 are identified by ocean basin, but most permits authorize a smaller study area or region within an ocean basin, reducing the chance of repeated harassment of individual whales by researchers. Most of this research does not overlap in area or timing, although some spatial overlap exists for research on species with known feeding or breeding grounds, such as humpback whales.

Table 10 – Active Scientific Research Permits authorizing the harassment of species considered in this Opinion, in the action area.

Permit No.	Permit Holder	Ocean Basin	Expiration date	Listed species
774-1714-11 (Current Permit)	NMFS Southwest Fisheries Science Center	Southern & Pacific Ocean	6/30/2010	Humpback, blue, fin, sei, sperm, bowhead, Southern right, North Pacific right, and Southern Resident killer whale; Steller sea lion; olive ridley, green, leatherback, hawksbill, and loggerhead sea turtle
369-1757-01	Mate	Pacific Ocean	5/31/2010	Humpback, blue, fin, and sperm
1071-1770-02	The Dolphin Institute	Pacific Ocean	6/30/2010	Humpback, sperm, fin, and blue
782-1719-09*	NMFS, National Marine Mammal Laboratory	Southern & Pacific Ocean	6/30/2010	Humpback, blue, fin, sei, sperm, bowhead, Cook Inlet beluga, Southern Resident killer, and Southern right whale
473-1700-02*	Straley	Pacific Ocean	6/30/2010	Sperm, humpback, and fin whale
716-1705-02*	Sharpe	Pacific Ocean	6/30/2010	Humpback whale
1049-1718*	Wynne	Pacific Ocean	6/30/2010	Humpback, fin, sperm, and sei whale
1039-1699-01*	Zoidis	Pacific Ocean	6/30/2010	Humpback whale
731-1774-06	Baird	Pacific Ocean	8/31/2010	Sei, fin, blue, humpback, sperm, and Southern Resident killer whale; Steller sea lion
545-1761	North Gulf Oceanic Society	Pacific Ocean	9/15/2010	Humpback whale
393-1772-02	Glockner-Ferrari	Pacific Ocean	9/30/2010	Humpback whale
587-1767-01	Salden	Pacific Ocean	9/30/2010	Humpback whale
1000-1617-04	Au	Pacific Ocean	11/15/2010	Humpback whale

Table 10 – Active Scientific Research Permits authorizing the harassment of species considered in this Opinion, in the action area.

Permit No.	Permit Holder	Ocean Basin	Expiration date	Listed species
540-1811-03	Calambokidis	Pacific Ocean	4/14/2011	Blue, humpback, fin, sei, sperm, and Southern Resident killer whale; Steller sea lion
781-1824-01	NMFS, Northwest Fisheries Science Center	Pacific Ocean	4/14/2011	Blue, humpback, fin, sperm, and Southern Resident killer whale
532-1822-02	Balcomb	Pacific Ocean	4/14/2011	Southern Resident killer whale
965-1821-01	Bain	Pacific Ocean	4/14/2011	Southern Resident killer, humpback, and fin whale; Steller sea lion
1058-1733-01	Baumgartner	Southern & Pacific Oceans	5/31/2012	North Pacific right, bowhead, humpback, fin, sei, and blue whale
1120-1898	Eye of the Whale	Pacific Ocean	7/31/2012	Humpback whale
727-1915	Scripps Institute of Oceanography	Pacific Ocean	2/1/2013	Blue, sei, fin, humpback, and sperm whale;
1127-1921	Hawaii Marine Mammal Consortium	Pacific Ocean	6/30/2013	Humpback, sperm, blue, sei, and fin whale
10018	Cartwright	Pacific Ocean	6/30/2013	Humpback whale
10045	Wasser	Pacific Ocean	7/15/2013	Southern Resident killer whale
945-1776	Glacier Bay National Park and Preserve	Pacific Ocean	3/31/2011	Humpback whale
808-1735	Read	Southern Ocean	5/31/2012	Blue, humpback, fin, and sei whale
14325	Alaska Department of Fish and Game	Pacific Ocean	8/31/2014	Steller sea lion
14326	NMFS National Marine Mammal Laboratory	Pacific Ocean	8/31/2014	Steller sea lion
14336	Markus Horning	Pacific Ocean	8/31/2014	Steller sea lion
14337	Andrew Trites, Ph.D.	Pacific Ocean	8/31/2014	Steller sea lion
1514	NMFS Pacific Islands Region	Pacific Ocean	3/31/2010	Green, leatherback, loggerhead, and olive ridley sea turtle
1537	Guam Division of Aquatic and Wildlife Resources	Pacific Ocean	9/1/2010	Green and hawksbill sea turtle
1556	Commonwealth of the Northern Mariana Islands	Pacific Ocean	6/1/2011	Green and hawksbill sea turtle
1581	NMFS Pacific Islands Fisheries Science Center	Pacific Ocean	12/31/2011	Green and hawksbill sea turtle

Table 10 – Active Scientific Research Permits authorizing the harassment of species considered in this Opinion, in the action area.				
Permit No.	**Permit Holder**	**Ocean Basin**	**Expiration date**	**Listed species**
1596	NMFS Southwest Fisheries Science Center	Pacific Ocean	2/1/2012	Leatherback sea turtle
1591	NMFS Southwest Fisheries Science Center	Pacific Ocean	10/31/2012	Green, loggerhead, and olive ridley sea turtle
1512	American Samoa Dept. of Marine and Wildlife Resources	Pacific Ocean	9/23/2012	Hawksbill, green, and olive ridley sea turtle
10027	American Museum of Natural History, Center for Biodiversity and Conservation	Pacific Ocean	7/31/2013	Green and hawksbill sea turtle

* indicates that there is a one-year extension on the permit

Effects of the proposed actions

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

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

Potential stressors

The assessment for this consultation identified several possible stressors associated with the proposed permitted activities. These include:

- aerial survey;
- boat motor noise;
- oil or fuel leakage;
- ship strike due to vessel transit;
- photoidentification and photogrammetry;
- disturbance of non-target listed species;
- salvage and import/export/re-export of marine mammal and sea turtle parts, specimens and biological samples;
- stressors specific to cetaceans
    - close approach by research vessels;
    - entanglement or interaction with research equipment;
    - skin and blubber biopsy;
    - sloughed skin and feces collection;
    - tagging with suction-cup or implantable tags (including VHF transmitters);
- stressors specific to sea turtles:
    - capture;
    - handling, measuring, and weighing;
    - flipper tagging;
    - blood and tissue sample;
    - lavage; and
    - satellite tagging.

Based on a review of available information, the following stressors would be negligible: photo-identification and photogrammetry; boat motor noise; oil or fuel leakage from vessels; entanglement or interaction of the targeted species with equipment; ship strikes due to vessel transit; salvage and import/export/re-export of marine mammal and sea turtle parts, specimens and biological samples; and VHF transmitters (but not the tagging procedure, which will be assessed further in this Opinion).

Photo-identification and photogrammetry of the listed species during aerial or vessel surveys would have no effect on listed species beyond the effect of the aerial or vessel surveys themselves, which will be considered further in this Opinion. Vessel noise would add so little noise to the overall sound field as to have a discountable change to the ambient sound environment of the region. The potential for fuel or oil leakages is extremely unlikely. Due to the small size the boats and aircraft, leaks should be easily identified and contained, and the experience of the researchers in conducting aerial or vessel surveys and the availability of high-resolution bathymetric maps of the research area makes running aground unlikely. We also do not anticipate risk of interaction or entanglement in equipment associated with the proposed activities, other than permitted actions, nor do we expect any unintentional physical contact with the species during the proposed studies, such as ship strikes, given the applicant's experience of the applicant and the fact that vessels will be at sea with the primary purpose of locating these species. We expect the applicant would be able to locate, identify, and avoid these species during transit when not specifically targeting animals for research, and we do not expect vessel strike during transit.

Salvage and import/export/re-export of marine mammal and sea turtle parts, specimens, and biological samples would require no interactions with living listed species and therefore we do not expect any listed species to be affected by this action. The VHF transmitters that would be used to aid researchers in locating tags will transmit at frequencies from 148-165 MHz. This is well above the known hearing range for marine mammals and turtles, and NMFS considers anything over 200 KHz to have no effects (A. Scholik-Schlomer, NMFS, pers. comm. 2010), therefore VHF transmissions are not considered further.

The remainder of our analysis focuses on the following potential stressors. For Steller sea lions, the potential stressors are aerial surveys and disturbance due to aerial, vessel, and ground surveys of non-listed species. For cetaceans, the potential stressors are aerial surveys, close approach of vessels, skin and blubber biopsy, suction-cup and implantable tagging, sloughed skin and feces collection, and disturbance. For sea turtles, the potential stressors are capture, handling, measuring, weighing, blood and tissue sampling, flipper tagging, lavage, and satellite tagging.

Exposure analysis

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

The Permits Division proposes to issue a permit for scientific research to the Southwest Fisheries Science Center. Tables 4-9 identify the numbers of different listed species that the Southwest Fisheries Science Center would be authorized to take annually until June 30, 2015. The research would primarily occur in the Pacific Ocean, but also in the Southern, Indian, and Arctic Oceans. Not all species would be affected in all action areas. The tables also indicate which species could be exposed to the procedures included in the proposed permit, as well as if the numbers have changed from the current permit.

In our assessment of the potential exposure levels of listed species by the proposed permit, we considered the available annual reports from recent years. However, past annual reports are not necessarily good indications of future activities and levels of effort. The frequency, duration, area, and focus of research cruises vary annually, as they are dependent on funding and are planned based on the research needs of National Marine Fisheries Service. A research cruise might primarily target non-listed species and opportunistically sample listed species within the limits of the proposed permit, yet annual reports do not necessarily distinguish between targeted and opportunistic sampling. The threshold for reporting certain activities has changed over time, e.g. disturbance due to large and small vessel surveys, aerial surveys, and photo-identification activities. The proposed permit has language that instructs the permit holders specifically on what is considered a "take," with the hope that this will lead to more informative annual reports.

We believe that in any given year, not all proposed "takes" would occur. However, because of the high variability of the proposed activities by the Southwest Fisheries Science Center, we did not further refine the expected level of exposure within the proposed permit limits, and have assessed the action at the proposed levels.

Steller sea lions, bowhead, sei, blue, fin, Southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and olive ridley, green, leatherback, hawksbill, and loggerhead sea turtles could be exposed to stressors under the proposed research permit year round. All fifteen species can be present year-round in the action area (see *Status of listed resources*) and would be the target of the directed activities.

Pinnipeds

The applicant has requested to annually aerially survey up to 30,000 of all lifestages of both sexes of Steller sea lions and disturb up to 3,000 Steller sea lions during California sea lion aerial, vessel, and ground surveys. The numbers requested are the same as previously permitted. As described above, because the number of research cruises would vary from year to year, although it is unlikely that the number of requested "takes" would occur each year, we cannot better refine the number of Steller sea lions that we expect to be exposed to the proposed activities.

Generally, aerial surveys would be done with one photographic pass over animals. However, if the area occupied by the sea lions is large, multiple photographic passes might be necessary to cover the entire area. During aerial surveys, any Steller sea lion observed below 1,000 ft would be counted and reported as a "take." No individual would be surveyed more than 3 times in one day.

Cetaceans

Adults and juveniles of both sexes of cetaceans would be targeted for the suites of procedures in the proposed permit (see Tables 5-8), as would a limited number of calves, the minimum age for which would vary depending on the species and the procedure.

The total numbers of annual "takes" requested for each species are as follows:

- sei whale: 1350 (Pacific and Southern Oceans)
- blue whale: 1450 (Pacific and Southern Oceans); 300 (Indian Ocean)
- fin whale: 1750 (Pacific and Southern Oceans)
- Southern right whale: 210 (Pacific and Southern Oceans)
- North Pacific right whale: 118 (Pacific and Southern Oceans)
- humpback whale: 1760 (Pacific and Southern Oceans); 250 (Southern Ocean)
- sperm whale: 2360 (Pacific and Southern Oceans); 225 (Southern Ocean)
- Southern Resident killer whale: 50 (Pacific and Southern Oceans)
- bowhead whale: 225 (Pacific, Southern, and Arctic Oceans)

It is possible that individuals would be exposed to multiple activities (e.g. aerially surveyed whales could be disturbed during vessel surveys). As described above, because the number of research cruises would vary from year to year, although it is unlikely that the number of requested “takes” of each activity for each species would occur each year, we cannot better refine the number of listed cetaceans that we expect to be exposed to the propose activities.

The number of cetacean “takes” requested is the same as the current permit for most activities. However, Southwest Fisheries Science Center has requested authorization to increase the “take” of North Pacific right, humpback, and sperm, in the Pacific and Southern Oceans from the currently permitted levels (see Table 5) for certain procedures, including skin and blubber biopsy, implantable tags, suction-cup tags, and disturbance. The applicants have also requested that the permit include aerial surveys of 30 blue whales in the Indian Ocean.

Additionally, for some activities, certain takes are now intended specifically for calves, or the minimum age for a calf has been lowered. For instance, in the current permit, the Southwest Fisheries Science Center is authorized to suction-cup tag, skin and blubber biopsy, and photo-identify 25 sei whales in the Pacific and Southern Oceans. The applicants have requested that they be permitted to use 2 of those 25 “takes” for calves 6 months or older, and the remaining 23 for adults and juveniles. Therefore, the total number of sei whales in the Pacific and Southern Oceans that would be exposed to this particular suite of procedures would not increase. Similar changes were made for several other species, and these changes to the existing permit are denoted in the right column of Tables 5-8.

Blubber and skin biopsies would be taken from adults, juveniles, females with calves, and calves. Biopsies would not be taken from calves under 2 months or their mothers, with the exception of Southern Resident killer whale calves, which would not be biopsied if less than a year old. During any single encounter, no more than three biopsy attempts per individual would be made, and the applicants have reported that they typically are able to successfully biopsy a whale with a maximum of two attempts. Biopsies, including the approach, would typically take 30 minutes, and would not take more than an hour.

Implantable and suction-cup tags would be deployed for adult and juvenile males and females. No tagging attempts would be made on dependent calves; however, mothers accompanying calves would be tagged. Tagging would not be performed on calves less than 6 months for any cetacean species for which calf tagging is permitted. During any single encounter, no more than three tag deployment attempts per individual would be made. Individuals may be re-tagged after attachment of a first tag has failed, but only up to two tags per year would be placed on the same individual. On occasion, both a suction-cup tag and an implantable tag would be attached to an animal.

Tagging activities, including the approach, would typically take 30 minutes, and would not take more than an hour. There are two types of suction-cup tags that are proposed for use: DTAG and Acousonde tag. The DTAG can record for 24 hours, and is programmed to release by venting suction cups. The longest attachment time for a DTAG is 17 hours. Acousonde tags release naturally as suction is lost, and can remain attached for 15 minutes to 40 hours. The two types of implantable tags proposed for use on cetaceans are the “dart” tag and the “flat implant” tag. The former typically remains attached for 8-9 weeks, the latter for 14-24 weeks. For both types of implantable tags, the attachment would eventually out-migrate from the tissue.

Sea turtles

Adults, subadults, and juveniles weighing less than 100 pounds of both sexes of all five species of sea turtles would be captured and handled under the proposed permit (see Table 9). The number of sea turtle “takes” requested is the same as previously permitted: 300 olive ridley, 100 green, 10 leatherback, 20 hawksbill, and 20 loggerhead sea turtles. As described above, because the number of research cruises would vary from year to year, although it is unlikely that the number of requested “takes” of each activity for each species would occur each year, we cannot better refine the number of sea turtles that we expect to be exposed to the propose activities.

All species would be flipper tagged and have blood and tissue collection. Olive ridley, green, hawksbill, and loggerhead sea turtles would be instrumented with satellite tags; leatherback sea turtles would not be. Olive ridley, green, and loggerhead sea turtles would have their stomach contents collected by gastric lavage; hawksbill and leatherback sea turtles would not. Turtles would be held on board for approximately 15-20 minutes, and the gastric lavage procedure (if performed) would typically take 5-10 minutes, although the actual lavaging would not exceed 3 minutes.

Response analysis

As discussed in the *Approach to the assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action’s effects on the environment or directly on listed species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Evidence indicates that wild animals respond to human disturbance in the same way they respond to predators (Lima 1998, Gill et al. 2001, Frid and Dill 2002, Frid 2003, Beale and Monaghan 2004, Romero 2004). These responses may manifest themselves as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal’s time budget, or some combinations of these responses (Sapolsky et al. 2000, Frid and Dill 2002, Romero 2004, Walker et al. 2005).

Pinnipeds

Response to aerial, vessel, and ground surveys

Steller sea lions would only be surveyed aerially. However, Steller sea lions could also be disturbed during California sea lion aerial, vessel, and ground surveys. Although low levels of occasional disturbance is thought to have little long-term effects, disturbance of sea lions from aircraft and vessel traffic have been observed to have highly variable effects (Calkins and Pitcher 1982). For Steller sea lions, reactions to occasional disturbances ranged from none to complete and immediate departure from the haulout, i.e. a stampede. In most cases, the potential impact to the animal is limited mainly to disturbance with the animal still remaining at the haulout site. However, when Steller sea lions and other pinnipeds are frightened off rookeries, pups may be trampled, or even abandoned. Juvenile and adult animals can also be injured during stampedes as animals run over each other or slide or crash into cliff facings or underwater rocks in their haste to escape the researchers. The flight response in pinnipeds has been described as "unrelenting and reckless" such that animals that are chased before capture (or which flee in response to the presence of low-flying aircraft) are placed in significant danger, not only from the excessive metabolic heat generated from the flight itself, but also from a variety of potentially dangerous situations encountered in their escape attempts (Sweeney 1990). For these reasons, the proposed permit would include mitigation measures to be implemented in any research involving aerial surveys or small vessel or ground surveys. Because aerial surveys have the potential to flush animals or create stampedes, researchers would not normally conduct aerial surveys below 700 feet above Steller sea lions, and no aerial surveys would be flown lower than 500 feet. Additionally, to minimize disturbance, if an animal shows a response to the presence of the aircraft, the aircraft must leave the vicinity and either resume searching or continue on the line-transect survey.

We would expect that the relative risk perceived by animals of disturbance on the ground is far greater than that of distant activities like aerial surveys and to a lesser extent vessel disturbance, and the more times a single site is exposed, the greater chance an animal may have of injury, but more importantly the greater chance that an animal may abandon a site. Recent studies by a graduate student at the University of British Columbia, confirm this assumption. Kucey (2005) recorded disturbance events from aircraft, birds, sea lions, humans, boats, and researchers collecting scat across 8 sites used by Steller sea lions in the summer and 6 sites used in the winter/spring season. Kucey (2005) observed more than 1,000 disturbance events of which slightly more than 40 percent caused animals to leave the site. She found that scat collection disturbances caused all animals to enter the water when researchers went ashore, whereas she recorded about 5 percent of the animals leaving the haulout sites in response to aircraft disturbance (n=20). Boat disturbance, however, evoked greater responses than aerial disturbances with more than 15 percent of the animals leaving the haulout in response to watercraft (n=36). Kucey (2005) observed that the nature of the vessel approach (i.e., speed, noise, fumes, combined with other variables like weather) influenced the magnitude of the response.

In some instances, sea lions have temporarily abandoned haulouts after repeated disturbance (Thorsteinson and Lensink 1962, Kucey 2005), but in other situations they have continued using areas after repeated and severe harassment. Kenyon (1962) noted permanent abandonment of areas in the Pribilof Islands that were subjected to repeated disturbance. A major sea lion rookery at Cape Sarichef was abandoned after the construction of a light house at that site, but the sea lions used the site as a haulout after the light house was no longer inhabited by humans.

The permit applicants report that only a small percentage of animals are observed to respond to aerial and vessel surveys; higher numbers respond to ground surveys, and half of the individuals respond during scat and spew collections (which Steller sea lions would not be targeted for, but could be disturbed by). The applicants have also observed sea lions returning to the area after the departure of researchers following scat collection, but it is not known if they are the same individuals that were present before the arrival of the researchers. The following reactions from pinnipeds (including but not limited to Steller sea lions) have been observed by the SWFSC, followed by the percentage of individuals:

- Aerial surveys: no response (~99%); awaken (unknown %); look up and around (0.001%); vocalize (unknown %); stop nursing (unknown %); move to the water (<0.1%); enter the water (<0.1%).
- Vessel surveys: no response (~99%); awaken (0%); look up and around (0%); vocalize (0%); stop nursing (0%); move to the water (0%); enter the water (0%).
- Ground surveys: no response (~90%); awaken (1%); look up and around (10%); vocalize (1 %); stop nursing (1%); move to the water 5%); enter the water (5%).
- Scat and spew collections: no response (~50%); awaken (5%); look up and around (10%); vocalize (20%); stop nursing (20%); move to the water (50%); enter the water (50%).

However, there are limitations to these reports. For instance, unless someone is monitoring from a blind on the ground or a nearby vessel, it would be difficult for researchers in the aircraft to detect the response of pinnipeds to aircraft noise, particularly since the aircraft is in the area for very short duration.

Although aerial, vessel, and ground surveys conducted under the proposed permit might still be stressful for some individuals, and could cause a temporary response, evidence from investigators and in the literature suggests that responses would be short-lived. Given the permit conditions, we do not expect a negative fitness consequence for the individuals approached.

Cetaceans

Response to aerial and vessel surveys (including close approaches) for cetaceans

For all research activities, the presence of vessels can lead to disturbance of marine mammals, although the animals' reactions are generally short term and low impact. Reactions range from little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation; diving; time spent submerged; foraging; and respiratory patterns. Responses may also include aerial displays like tail flicks and lobtailing and may possibly influence distribution (Watkins et al. 1981, Baker et al. 1983, Bauer and Herman 1986, Clapham et al. 1993, Jahoda et al. 2003). The degree of disturbance by vessel approaches is highly varied. Whales may respond differently depending upon what behavior the individual or pod is engaged in before the vessel approaches (Wursig et al. 1998, Hooker et al. 2001) and the degree to which they have become accustomed to vessel traffic (Lusseau 2004, Richter et al. 2006); reactions may also vary by species or individuals within a species (Gauthier and Sears 1999). In addition, Baker et al. (1988) reported that changes in whale behavior corresponded to vessel speed, size, and distance from the whale, as well as the number of vessels operating in the proximity. Based on experiments conducted by Clapham and Mattila

(1993), experienced, trained personnel approaching whales slowly would result in fewer whales exhibiting responses that might indicate stress.

For humpback whales, studies found patterns of disturbance in response to vessel activity that indicate such approaches are probably stressful to the humpback whales, but the consequences of this stress on the individual whales remains unknown (Baker et al. 1983, Baker and Herman 1989). Baker et al. (1983) described two responses of whales to vessels: "horizontal avoidance" of vessels 2,000 to 4,000 meters away characterized by faster swimming and fewer long dives; and "vertical avoidance" of vessels from 0 to 2,000 meters away during which whales swam more slowly, but spent more time submerged.

Hall (1982) reported that humpback whales closely approached by survey vessels in Prince William Sound, Alaska, often reacted by diving and surfacing further from the vessel or with an altered direction of travel. The author noted that whale feeding activity and social behavior did not appear to be disturbed by the approaches; however, cow-calf pairs appeared to be wary and avoided the vessel. Other studies have found that humpbacks respond to the presence of boats by increasing swimming speed, with some evidence that swimming speed then decreased after boats left the area (Au and Green 2000, Scheidat et al. 2004). A number of studies involving the close approach of humpback whales by research vessels for biopsying and tagging indicate that responses are generally minimal to non-existent when approaches were slow and careful.

When more pronounced behavioral changes occur, the responses appear to be short-lived (Weinrich et al. 1991, Weinrich et al. 1992, Clapham and Mattila 1993, Gauthier and Sears 1999). The slow and careful approach to humpback whales is important and is supported by studies conducted by Clapham and Mattila (1993) on the reactions of humpback whales to close approaches for biopsy sampling in Caribbean breeding areas. The investigators concluded that the way a vessel approached a group of whales had a major influence on the whale's response to the approach, particularly for cow and calf pairs. Barrett-Lennard et al. (1996) also found that experienced, trained personnel approaching killer whales slowly would result in fewer whales exhibiting behavioral responses indicative of stress. Smaller pods of whales and pods with calves also seem more responsive to approaching vessels (Bauer and Herman 1986, Bauer 1986). Based on their experiments with different approach strategies, researchers concluded that experienced, trained personnel approaching humpback whales slowly would result in fewer whales exhibiting responses that might indicate stress.

For fin whales, Jahoda et al. (2003) studied responses of fin whales feeding in the Ligurian Sea to vessels approaching with sudden speed and directional changes. Fin whales were approached repeatedly by a small speedboat to within 5-10 m (16-33 ft) for approximately one hour of photoidentification and biopsy sampling; a larger vessel used for observations was also present. Fin whales responded by suspending feeding through the end of the study and changing their swimming, diving, and respiratory behavior. The fin whales tended to reduce the time they spent at surface and increased their blow rates, suggesting an increase in their metabolic rates and possibly a stress response to the approach. In the study, fin whales that had been disturbed while feeding had not resumed feeding when the exposure ended, although the presence or absence of prey after the disturbance was unknown. Jahoda et al. (2003) noted the potential for long-term responses of whales to vessel disturbance cannot be ruled out, but concluded that approaching vessels maneuvering at low speeds were less likely to cause visible reactions in fin whales.

Studies of other baleen whales, specifically bowhead (*Balaena mysticetus*) and gray (*Eschrichtius robustus*) whales, document similar responses to close vessel approaches and the results help inform this Opinion. Both species exhibit a pattern of short-term, behavioral disturbance in response to a variety of actual and simulated vessel activity and noise (Malme et al. 1984, Richardson et al. 1985, Malme et al. 1989). Studies of bowhead whales found these animals oriented themselves in relation to a vessel with its engine on, and a significant avoidance response was invoked by simply turning on the engine – even at a distance of approximately 3,000 ft (900 m). Sei and blue whales are thought to respond to approaching vessels in a similar manner as other baleen whales, with responses depending on whale behavior and the speed and direction of the approaching vessel (Perry et al. 1999). Sei whales are also reported to exhibit more avoidance behavior than fin whales during close approaches (Gunther 1949 as cited in Perry et al. 1999).

Although close approaches conducted under the proposed permit might still be stressful for some individuals, and might temporarily interrupt behaviors such as foraging, evidence from investigators and in the literature suggests that responses would be short-lived. Assuming an animal is no longer disturbed after it returns to pre-approach behavior, we do not expect a negative fitness consequence for the individuals approached.

Response to skin and biopsy sampling for cetaceans

The likelihood of significant responses by whales to biopsy sampling is low and any responses that may occur are expected to be minor and temporary. Gauthier and Sears (1999) studied the behavioral responses of fin, blue, and humpback whales to crossbow deployed biopsy sampling activities similar to those proposed. Of these, roughly 45% of successful biopsies elicited no response. Those that did resulted in behaviors such as tail flicking and the animals submerging. Most whales returned to normal activities and exhibited normal behavior after a few minutes. Whales reacted similarly when biopsied more than once.

Weinrich (1992) noted that, although rare, biopsy attempts on humpback whales may result in vigorous responses which can lead to near physical exhaustion. Strong reactions in humpback whales occurred in only 3.3% of biopsy attempts and were always associated with unusual occurrences such as the entanglement of retrieval lines on the flukes or fins of the target animal (Weinrich et al. 1991). More common reactions included decreased time at the surface, a reduction in movement and an increase in tail flicks.

A study by Clapham and Mattila (1993) showed that 67% of humpback whales exhibited either no reaction or only a low-level reaction in response to biopsy procedures. Brown et al. (1994) reported that detectable reactions to biopsy sampling occurred in 41.6 % of humpback whales sampled, and that females responded more than males. No long-term effects were observed in any of these studies and no significant age or gender differences in whale responses to biopsy procedures were reported. Similar short-term responses in killer whales were observed by Barrett-Lennard et al. (1996), such as momentary shakes or accelerations, whether the procedure resulted in a hit or a miss. This study also found no indication that darted whales became more evasive of the research boat in either the long or short term. Hooker et al. (2001) found that reactions in northern bottlenose whales to biopsy darting were weak and short lived and that target animals did not avoid the research vessel following biopsy procedures and often re-approached the vessel within several minutes.

Mother/calf pairs of humpbacks appeared to be no more sensitive to biopsy activities than were other whales, although mothers tended to be more evasive of approaching boats (Weinrich et al. 1992, Clapham and Mattila 1993). In southern right whales, Best et al. (2005) found that cows with calves exhibited the strongest reactions (10% had no response, 26% startled, 45% responded with a fluke move; 17% responded with a fluke slap), but that calf reactions were indistinguishable from the reactions of other classes of whales when biopsied in pairs. Because of the observed reactions from mothers, as well as the possible tendency for sensitization following repeated sampling, the authors recommended that sampling of cow-calf pairs should be done with extra care.

A maximum of three attempts to obtain a single biopsy sample would be made per animal and investigators would take reasonable measures to avoid repeated sampling of any individual. Based on the researchers' experience, animals would rarely be targeted for biopsy more than twice during an encounter. Strong responses to biopsy darting in past studies usually resulted when whales became entangled in retrieval lines. Because the researchers would rarely, if ever, use tethered biopsy darts, these responses are expected to be unlikely. Furthermore, approaches would be aborted if animals are observed to display unusual behavior, aggravation or distress. These mitigation methods should further reduce the likelihood of any significant disturbance occurring.

There is a risk of infection and disease transfer from biopsy procedures. However, the biopsy tips are to be disinfected between and prior to each use. Therefore, the possibility of infection or disease transfer is not expected to be significant. The proposed biopsy sampling is not expected to result in any long term adverse affects to listed whales. No reduction in fitness is expected to any individual listed animal from the proposed biopsy procedures.

Response to tagging for cetaceans

Tagging involves physical contact with the animal, and is generally categorized as having the potential to injure. A variety of scientific instruments, such as VHF tags and satellite-linked time depth recorders can be attached to marine mammals for collection of a wide-range of data including location, dive and movement patterns, and ambient noise levels. The duration of the tag placement can be from a few hours to several weeks, depending on the mode of attachment, and ultimately the tag is released from the animal and retrieved by the researcher. Information is then used to infer habitat use, migratory and foraging behavior, and habitat quality, which are in turn used to make management decisions for the conservation and recovery of a species. Tags do not contain any hazardous materials.

Effects of attached devices may range from subtle, short-term behavioral responses to long-term changes that affect survival and reproduction; attached devices may cause effects not detectable in observed behaviors, such as increased energy expenditure by the tagged animal (White and Garrot 1990, Wilson and McMahon 2006). Walker and Boveng (1995) concluded the effects of devices on animal behavior are expected to be greatest when the device-to-body size ratio is large. Although the weight and size of the device may be of less concern for larger animals such as cetaceans, there is still the potential for significant effects – for example, behavioral effects that may cause reduced biological performance, particularly during critical periods such as lactation (White and Garrot 1990, Walker and Boveng 1995).

Although several tagging studies have been conducted on marine mammals, few have systematically investigated or recorded the effects on cetaceans from tagging, and available investigations into instrument effects on marine species are often limited to visual assessments of behavior (Walker and Boveng 1995). In addition, reactions to tagging are difficult to differentiate from reactions to close vessel approaches, because in all cases it is necessary to closely approach the whale to ensure proper tag placement.

Evidence available on the short-term effects of tagging whales indicates that responses vary from little to no observable change in behavior to momentary changes such as skin twitching, startle reactions or flinching, altered swimming speed and orientation, diving, rolling, head lifts, high back arching, fluking, and tail swishing (Goodyear 1981, Watkins et al. 1981, Watkins et al. 1984, Goodyear 1989, 1993, Baird 1994, Mate et al. 1997, Mate et al. 1998, Hooker et al. 2001, Mate et al. 2007, Andrews et al. 2008). Infrequently, aerial displays like breaching are also noted (Goodyear 1989); and Mate et al. (2007) reported other infrequent behavioral responses of cetaceans as including fluke slaps and swishes, head lunges, defecation, decreased surfacing rates, disaffiliation with a group of whales, evasive swimming behavior, or cessation of singing (in the case of humpback whales).

Cetaceans frequently react when hit by tags delivered by remote devices such as tagging poles, but are also known to react when tags miss and hit the water. Behavioral responses are noted to be short-term (Mate et al. 2007), with the likelihood of a reaction possibly depending on an individual's behavioral state at the time of tagging (Hooker et al. 2001). Mate et al. (1998) concluded the responses observed were usually the same as those elicited by close vessel approaches alone.

Hanson et al. (2008) tagged four species of Hawaiian odontocetes (Blainville's and Cuvier's beaked whales, short-finned pilot whale, and false killer whale). Eight days after tagging, one short-finned pilot whale had evidence of swelling of the dermis around the base of a dart, and it and anther pilot whale had bumps on the opposite side of the dorsal fin from the darts, with clear signs of chronic inflammation at the dart site. In both cases, the tags had not been flush with skin at deployment. For the 13 tagged whales re-sighted after tagging, all the tags out-migrated through tag attachment holes, and did not migrate backwards through the fin, with no evidence of major tissue damage or disfigurement, nor the previously observed bumps. Four whales had minor depression at tag site, four had slightly raised tissue, and seven had depigmentation around the tag site. Hanson et al. (2008) suggested that tags that are not deployed to sit flush on fin surface will increase drag, which can lead to increasing load (as the tag pulls away from skin), tissue breakdown, and earlier tag loss. Chronic inflammation and the formation of granulation tissue were observed, but no indication of infection, cutaneous erythema, ulceration, discoloration, or necrosis.

Behavioral responses of whales to the use of non-invasive suction cup tags are also noted by a few researchers. Goodyear (1981) attached a suction cup tag to one humpback whale and found behaviors of the tagged whale and a closely associated whale did not appear to change due to tagging. More recently, Goodyear (1989) tagged 12 humpback whales with suction cup tags and found responses to tagging were minimal with no long-term changes in behavior detected. Of the tagged whales, 69 percent showed no immediate reaction to tagging, and 31 percent exhibited a detectable reaction including quickened dive, high back arch, and tail swish. One breach was seen in over 100 tagging attempts (i.e., <1%). After all tagging attempts the author noted that pre-tagging behavior resumed within a few minutes and that some whales curiously approached the tagging vessel. Additionally, the suction cup did not appear to harm whales' skin. Baird et al. (2000) deployed 15 suction-cup tags in 31 tagging attempts. No strong reactions were observed, all reactions appeared to be short-term and whales returned to pre-tagging behavior, and no reactions from non-target whales were observed.

Long-term effects from tagging remain largely unknown. Goodyear (1989) noted that humpback whales monitored several days after being suction cup tagged did not appear to exhibit altered behavior. In addition, Mate et al. (2007) found that tagged whales re-sighted up to three years later did not appear in poor health and did not appear to behave differently than untagged whales. Hanson et al. (2008) observed a Cuvier's beaked whale with a young calf after tag loss, suggesting that tagging does not adversely affect reproduction.

After reviewing available information on the responses of large whales to both dart and suction-cup tagging procedures, we do not expect any mortality to occur due to the tagging under permit 14097. Injury from the dart tags would be small and localized on the dorsal fin of targeted whales and is expected to heal completely and not result in any permanent scarring or other long-term physical damage. Rates of wound healing are expected to vary across regions and are not easily predicted in advance of the proposed tagging studies; however, photo monitoring would be conducted to determine healing or infection rates during the proposed study. Resighting of tagged whales is expected to occur multiple times during the year and cover a range of healing times.

Although tags have the potential to create hydrodynamic drag, which may have an effect on the tagged animal (Hooker et al. 2007), the proportion of the proposed tags to be used under permit 14097 relative to the size and weight of the targeted whales is such that the energetic demand on the animal would likely be insignificant. We also believe there is minimal risk of non-target whales being hit with a dart tag given the close proximity of researchers to the targeted whale, the experience of researchers in positioning the vessel around this species, and the very low likelihood that a non-target whale would surface between the vessel and the target animal during a tagging attempt. Some tags could fail soon after deployment (within 1-2 days) due to poor attachments, electronic failure due to impact, or damage to the electronics due to pressure from deep dives, resulting in an individual being retagged unintentionally in one year, but the retagging would not be expected to result in a different behavioral response.

Based on the evidence available, the experience of researchers; the proposed research protocol including the limited number of tags to be deployed, and the limited number of whales that would be re-tagged; as well as the permit conditions to be implemented with the proposed tagging studies, we expect all whales tagged under permit 14097 would exhibit either no visible reaction or short-term behavioral responses to tagging. Strong behavioral responses are not expected during the proposed tagging studies, nor are significant bleeding or infection. We assume short-lived stress responses are possible in a few individuals as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging or reproduction for tagged individuals. Because any responses to tagging are expected to be short-lived, and assuming an animal is no longer disturbed after it returns to its pre-tagging behavior, we do not expect a negative fitness consequence for the tagged individuals.

Response to sloughed skin and feces collection for cetaceans

The collection of sloughed skin and feces would not involve contact with the whale and would not be invasive. Collections could potentially be done in the vicinity of a whale, but we would not expect this to have any impact beyond the effect of the close approaches to whales assessed earlier.

Sea turtles

Response to capture for sea turtles

Capture of sea turtles can result in raised levels of stressor hormones. The harassment of individual turtles during capture and handling could disrupt their resting or foraging cycles. The main source of concern for capturing sea turtles is the risk of entanglement in nets or other gear used to capture the individuals; however, the researchers would not be permitted to perform net captures. Sea turtles would be captured as described in the description of the proposed action: a swimmer would enter the water and grasp the turtle at the top and rear of its carapace to direct the turtle up and out of the water. The turtle would then be handed to personnel in the raft to be processed. This capture method is simple and not invasive. The turtles would be held in a manner to minimize the stress to them. NMFS does not expect that individual turtles would experience more than short-term stresses during this type of capture activity. No injury or mortality would be expected.

Response to handling, measuring, and weighing for sea turtles

Handling, measuring, and weighing can result in raised levels of stress hormones in sea turtles. However, the procedures are simple and not invasive. NMFS expects that individual turtles would normally experience no more than short-term stresses as a result of these activities. No injury would be expected from these activities, and turtles would be measured and weighed as quickly as possible to minimize stresses resulting from their capture. The applicant would also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals.

Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to handling, NMFS expects that the activities would have minimal and insignificant effects on the animals. All animals would be handled with care, kept moist, protected from temperature extremes and later returned to the sea.

Response to flipper tagging for sea turtles

Tagging activities are minimally invasive and all tag types have negatives associated with them, especially concerning tag retention. Plastic tags can become brittle, break and fall off underwater, and titanium tags can bend during implantation and thus not close properly, leading to tag loss. Tag malfunction can result from rusted or clogged applicators or applicators that are worn from heavy use (Balazs 1999). Turtles that have lost external tags would be re-tagged if captured again at a later date, which subjects them to additional effects of tagging. Turtles would experience some discomfort during the tagging procedures and these procedures would produce some level of pain. The discomfort would usually be short and highly variable between individuals (Balazs 1999). Most barely seem to notice, while a few others exhibit a marked response. However, NMFS expects the stresses to be minimal and short-term and that the small wound-site resulting from a tag would heal completely in a short period of time. Similarly, turtles that must be re-tagged would also experience minimal short-term stress and heal completely in a short period of time. Re-tagging would not be expected to appreciably affect these turtles. The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999).

Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to handling, NMFS expects that the activities would have minimal and insignificant effects on the animals. All animals would be handled with care, kept moist, protected from temperature extremes and later returned to the sea.

Response to blood and tissue sampling for sea turtles

Taking a blood sample from the sinuses in the dorsal side of the neck is now a routine procedure (Owens 1999). According to Owens (1999), with practice it is possible to obtain a blood sample 95% of the time and the sample collection time would be expected to be about 30 seconds in duration. Sample collection sites would be disinfected with alcohol or other antiseptic prior to sampling. Blood sampling volume would be conditioned to only allow a conservative amount of blood (conditioned in the permit) to be drawn. Blood hormones and heart rate have been measured in animals that have had this amount of blood drawn from them and no stress has been observed (E. Stabenau, pers. comm. to P. Opay, NMFS, 2005).

NMFS expects that individual turtles would experience no more than short-term stresses during a tissue biopsy. NMFS expects that the collection of a tissue sample would not cause any additional significant stress or discomfort to the turtle beyond what was experienced during the other research activities. Sterile techniques would help prevent infection from pathogens. All tissue biopsy samples would be collected, handled, stored, and shipped in such a manner as to ensure human safety from injury or zoonotic disease transmission as well as provide for the protection of the sea turtles that are sampled.

Response to collection of stomach contents by gastric lavage for sea turtles

This technique has been successfully used on green, hawksbill, olive ridley, and loggerhead turtles ranging in size from 25 to 115 inches curved carapace length. Many individual turtles have been lavaged more than three times without any known detrimental effect (Forbes 1999). Individuals have been recaptured from the day after the procedure up to three years later and appear healthy and feeding normally. Laparoscopic examination following the procedure has not detected any swelling or damage to the intestines. While individual turtles are likely to experience discomfort during this procedure, NMFS does not expect individual turtles to experience more than short-term stress. Injuries and mortalities are not anticipated.

Response to satellite tagging for sea turtles

Transmitters attached to the carapace of turtles have the potential to increase hydrodynamic drag and affect lift and pitch (Watson and Granger 1998). It is possible that transmitter attachments would negatively affect the swimming energetics of the turtle. During a study of sonic-tracked turtles by Seminoff et al. (2002), green turtles returned to areas of initial capture, suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns. In a study of video camera-equipped green turtles, telemetered turtles exhibit normal diving behavior, and sufficient swimming speeds (Seminoff et al. 2006). However, none of the instruments in the proposed research are as large as the video cameras, and so lesser potential impacts would be expected.

The short-term stresses resulting from transmitter attachment and tracking would be expected to be minimal and not add significantly to any stress that turtles have already experienced from capture or other the research activities. The permit would contain conditions to mitigate adverse impacts to turtles from the transmitters. Turtles would be satellite tagged as quickly as possible to minimize stresses resulting from the research. Total weight of any transmitter or tag attachment for any one turtle must not exceed 5% of the body mass of the animal. The attachment must be made so that there is minimal risk to the turtle of entanglement and the attachment is as hydrodynamic as possible.

Based on past experience with these techniques used by turtle researchers and the documented effects of transmitter attachments, we expect that the turtles would experience some small additional stress from attaching transmitters during this research, but would not experience significant increases in stress or discomfort beyond what was experienced during capture and other research activities, and that the transmitters would not result in any serious injury. We expect that the transmitters would not significantly interfere with the turtles' normal activities after they are released.

Effects of the action on Critical Habitat

Some of the proposed research activities could occur within designated critical habitat for Steller sea lions. Ground surveys would be conducted on rookeries and haulouts for California sea lions, including Año Neuvo Island and the Farallon Islands, where critical habitat has been designated for Steller sea lions. Aerial surveys, typically conducted at 800 feet, could also pass through critical habitat, which extends 3,000 feet into the air. Incremental and transient disturbances are anticipated from increased human presence and noise from aircraft.,The proposed research would not affect population ecology or population dynamics of prey species, predators, or competitors of Steller sea lions. We do not expect that changes in prey distribution would be measurable even for the short period of time researchers may be in designated critical habitat. Additionally, we do not expect the physical, chemical, and biotic features that form and maintain the critical habitat to be changed, including the space needed for population growth, cover or shelter, sites for breeding, and habitats that are protected from disturbance. As a result, the proposed permits are not likely to result in an appreciable reduction in the conservation value of the critical habitat for Steller sea lions.

Cumulative effects

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered by this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Sources queried include state legislature websites and Nexis. We reviewed bills passed from 2008-2010 and pending bills under consideration were included as further evidence that actions "are reasonably certain to occur."

The Southern, Indian, and Arctic Ocean portions of the action area are outside of territorial waters of the United States, which precludes the possibility of future state, tribal, or local action in the action area that would not require some form of federal funding or authorization. Therefore we limited our assessment of cumulative effects to the effects of future actions in the Pacific, specifically for the states of California, Oregon, Washington, Alaska, and Hawaii. State regulation is critical for future anthropogenic impacts in a region. Legislation from California, Oregon, Washington, Alaska, and Hawaii address climate change and sea level rise; oil spill prevention and response; off-shore oil drilling; alternative energy development; water supply concerns; ecosystem, natural resource, and endangered species recovery and protection; controlling contaminants in agricultural, stormwater, and municipal effluents; promotion of policies to decrease greenhouse gas emission; prevention of invasive species; and regulation of commercial and recreational use of ocean waters.

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

Integration and synthesis of the effects

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise

(Brandon 1978, Mills and Beatty 1979, Stearns 1992, Anderson 2000). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment.

The NMFS Permits Division proposes to issue a scientific research permit to the Southwest Fisheries Science Center authorizing studies on Steller sea lions, bowhead, sei, blue, fin, Southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and olive ridley, green, leatherback, hawksbill, and loggerhead sea turtles in the Pacific, Arctic, Southern, and Indian Oceans.

The *Status of listed resources* described the factors that have contributed to the reduction in population size for the 15 listed species considered in this Opinion. Fisheries, subsistence harvest, climate change, increased predation by killer whales and sharks, historic legal and now illegal shooting, and altered prey base (e.g., reduced biomass, changes in availability and nutritional value) are a few of the factors that may have led to current low levels of Steller sea lions from both populations, and some of the factors that continue to affect current populations. Commercial whaling is a primary reason for the reduction in population size for the nine species of cetaceans. Other worldwide threats to the survival and recovery of listed whale species include ship strike, entanglement in fishing gear, toxic chemical burden and biotoxins, and ship noise. Sea turtle populations have been affected by human-induced factors such as commercial fisheries, direct harvest, and modification or degradation of habitat.

NMFS expects that the current natural anthropogenic threats described in the *Environmental Baseline* will continue, including predation, disease and parasitism, commercial and subsistence harvest, fisheries interaction, ship strikes, contaminants, marine debris, noise, and habitat degradation and climate change, as well as ongoing scientific research. Reasonably likely future actions described in the *Cumulative effects* section include state legislation to address climate change and sea level rise; oil spill prevention and response; off-shore oil drilling; alternative energy development; water supply concerns; ecosystem, natural resource, and endangered species recovery and protection; controlling contaminants in agricultural, stormwater, and municipal effluents; promotion of policies to decrease greenhouse gas emission; prevention of invasive species; and regulation of commercial and recreational use of ocean waters.

Steller sea lions would be exposed to aerial surveys and disturbance during California sea lion ground and small vessel surveys (including scat and spew collection). Cetaceans would be exposed to aerial and vessel surveys (including close approaches), skin and blubber biopsy, suction-cup and implantable tagging, and sloughed skin and feces collection. Sea turtles would be exposed to capture, handling, flipper tagging, blood and tissue collection, stomach contents collection by gastric lavage, and satellite tagging.

Each year of the five-year proposed permit, up to 33,000 of Steller sea lions, 1350 sei, 1750 blue, 1750 fin, 210 Southern right, 118 North Pacific right, 2010 humpback, 10 Southern Resident killer, and 225 bowhead whales, and 300 olive ridely, 100 green, 10 leatherback, 20 hawksbill, and 20 loggerhead sea turtles could be affected by this permit. However, the details of individual research cruises would vary from year to year, and it is not possible to further refine how many individuals would be affected by the proposed actions.

We believe that the aerial surveys targeting Steller sea lions might be stressful for a small number of individuals, and could cause a temporary response, but do not expect a negative fitness consequence for the individual. We expect that the vessel and ground surveys for California sea lions could be more stressful for individuals and could cause a greater response, such as moving to or entering the water; however, given the care that the researchers would take to avoid disturbance of Steller sea lions, we believe this action would not confer a negative fitness consequence for individuals, and therefore no fitness consequence would be experienced at a population or species level.

For cetaceans, we believe short-lived stress responses due to close approach, skin and blubber biopsies, and suction-cup and implantable tagging are possible for a few individuals, as are short-term interruptions in behaviors such as foraging; however, we do not expect these responses to lead to reduced opportunities for foraging or reproduction for targeted individuals. Infection or disease transfer from biopsy procedures is unlikely given the practice of disinfecting biopsy tips. Injury from the dart tags would be small and localized on the dorsal fin of targeted whales and is expected to heal completely and not result in any permanent scarring or other long-term physical damage. Resighting and photo monitoring of biopsied or tagged whales (including after tag has detached) would add to our understanding of the effects of these actions. Overall, no individual whale is expected to experience a fitness reduction, and therefore no fitness consequence would be experienced at a population or species level.

Due to the expected effectiveness of research protocols proposed by the applicant to minimize harm and special conditions placed on the permit, it is anticipated that the turtles would experience only short-term, non-lethal increases in stress during the research activities. The proposed research actions would not affect the turtles' ability to reproduce and contribute to the maintenance or recovery of the species. Turtles could experience some discomfort during research activity procedures. Based on past observations of similar research, these effects are expected to dissipate within approximately a day or so. Overall, no individual turtle is expected to experience a fitness reduction, and therefore no fitness consequence would be experienced at a population or species level.

Research activities could take place within designated critical habitat for Steller sea lions. However, the proposed research would not affect population ecology, or population dynamics of prey species, predators, or competitors of Steller sea lions. Therefore, the proposed permits are not likely to adversely affect critical habitat that has been designated for Steller sea lions.

Conclusion

After reviewing the current *Status of listed resources*; the *Environmental baseline* for the *Action area*; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is NMFS' Opinion that the activities authorized by the proposed issuance of scientific research permit 14097, as proposed, is not likely to jeopardize the continued existence of Steller sea lions, green, loggerhead, leatherback, olive ridley, and hawksbill sea turtles, and bowhead, sei, blue, fin, southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and we do not anticipated the destruction or adverse modification of the designated critical habitat of Steller sea lions within the action area.

Incidental take statement

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

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

Conservation recommendations

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

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

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

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

3. *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.

4. *Effects of dart tags.* The Permits Division should assess information reported by researchers to determine the healing rates of tag sites, characterize the short-term responses to tagging, and assess whether and to what extent any long-term effects are observed in tagged whales. The results of this assessment should be provided to the Endangered Species Division for use during future consultations involving dart tagging of whales.

5. *Consistency in reporting*. The Permits Division should continue to work with the permit holders to ensure consistency in the method of recording and reporting takes among co-investigators. The Permits Division should hold workshops on a regular basis to educate researchers on reporting takes, for example at international symposia and conferences and at regionally based meetings.

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

Reinitiation notice

This concludes formal consultation on the proposal to issue scientific research permit No. 14097 to the Southwest Fisheries Science Center for studies of Steller sea lions, bowhead, sei, blue, fin, Southern right, North Pacific right, humpback, sperm, and Southern Resident killer whales, and olive ridley, green, leatherback, hawksbill, and loggerhead sea turtles in the Pacific, Arctic, Southern, and Indian Oceans. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, the NMFS Permits Division must immediately request reinitiation of Section 7 consultation.

References

Aburto, A. D., J. Rountry, and J. L. Danzer. 1997. Behavioral response of blue whales to active signals. Naval Command, Control, and Ocean Surveillance Center, RDT&E Division, San Diego, CA.

Addison, D. S. 1997. Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996. Bahamas Journal of Science **5**:34-35.

Addison, D. S. and B. Morford. 1996. Sea turtle nesting activity on the Cay Sal Bank, Bahamas. Bahamas Journal of Science **3**:31-36.

Agler, B. A., R. L. Schooley, S. E. Frohock, S. K. Katona, and I. E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. Journal of Mammalogy **74**:577-587.

Aguilar, A. 1983. Organochlorine pollution in sperm whales, Physeter macrocephalus, from the temperate waters of the eastern North Atlantic. Marine Pollution Bulletin **14**:349-352.

Aguilar, A. and A. Borrell. 1988. Age- and sex-related changes in organochlorine compound levels in fin whales (Balaenoptera physalus) from the eastern North Atlantic. Marine Environmental Research **25**:195-211.

Aguilar, A. and C. H. Lockyer. 1987. Growth, physical maturity, and mortality of fin whales (*Balaenoptera physalus*) inhabiting the temperate waters of the northeast Atlantic. Canadian Journal of Zoology **65**:253-264.

Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the western Mediterranean.Pp. 1-9 *In:* Richardson, J.I. and T.H. Richardson (compilers), Proceedings of the Twelfth Annual Workshop on Sea Turtle Biology and Conservation. 25-29 February 1992, Jekyll Island, Georgia. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-1361.

Aguirre, A. A., T. R. Spraker, G. H. Balazs, and B. Zimmerman. 1998. Spirochidiasis and fibropapillomatosis in green turtles of the Hawaiian Islands. Journal of Wildlife Diseases **34**:91-98.

Al-Bahry, S., I. Mahmoud, A. Elshafie, A. Al-Harthy, S. Al-Ghafri, I. Al-Amri, and A. Alkindi. 2009. Bacterial flora and antibiotic resistance from eggs of green turtles Chelonia mydas: An indication of polluted effluents. Marine Pollution Bulletin **58**:720-725.

Alava, J. J., J. M. Keller, J. R. Kucklick, J. Wyneken, L. Crowder, and G. I. Scott. 2006. Loggerhead sea turtle (*Caretta caretta*) egg yolk concentrations of persistent organic pollutants and lipid increase during the last stage of embryonic development. Science of the Total Environment **367**:170-181.

Allen, J. M., P. T. Stevick, and C. Carlson. 2006. The Antarctic humpback whale catalogue: Description, and summary. The Workshop on the Comprehensive Assessment of Southern Hemisphere humpback whales, 4–7 April 2006, Hobart, Tasmania.

Allen, K. R. 1970. A note on baleen whale stocks of the North West Atlantic. Report of the International Whaling Commission **Annex I, 20**:112-113.

Alvarado, M. A. 1990. The results of more than two years of turtle egg harvests at Ostional, Costa Rica. Pp.175-178 *In*: T.H. Richardson, J.I. Richardson, and M. Donnelly (Compilers), Proceedings of the Tenth Annual Worksho pon Sea Turtle Biology and Conservation. Department of Commerce, NOAA Technical Memorandum NMFS-SEFC-278 286p.

Alverson, D. L. 1992. A review of commercial fisheries and the Steller sea lion (*Eumetopias jubatus*): the conflict area. Reviews in Aquatic Sciences **6**:203-256.

Anan, Y., T. Kunito, I. Watanabe, H. Sakai, and S. Tanabe. 2001. Trace element accumulation in hawksbill turtles (Eretmochelys imbricata) and green turtles (Chelonia mydas) from Yaeyama Islands, Japan. Environmental Toxicology and Chemistry **20**:2802-2814.

Anderson, J. J. 2000. A vitality-based model relating stressors and environmental properties to organism survival. Ecological Monographs **70**:445-470.

Andrews, R. C. 1916. The sei whale (*Balaenoptera borealis* Lesson). Memoirs of the American Museum of Natural History, New Series **1**:291-388.

Andrews, R. D., R. L. Pitman, and L. T. Balance. 2008. Satellite tracking reveals distinct movement patterns for Type B and Type C killer whales in the southern Ross Sea, Antarctica. Polar Biology **31**:1461-1468.

Angliss, R. P. and K. L. Lodge. 2004. Alaska Marine Mammal Stock Assessments - 2003. NOAA Technical Memorandum NMFS-AFSC-144:U.S. Department of Commerce, 230p.

Angliss, R. P. and R. B. Outlaw. 2005. Alaska marine mammal stock assessments, 2005. U.S. Department of Commerce, NOAA Technical Memorandum NMFSAFSC-161, 250 p.
Angliss, R. P. and R. B. Outlaw. 2007. Alaska marine mammal stock assessments, 2006. NMFS-TM-AFSC-168, U.S. Department of Commerce.
Angliss, R. P. and R. B. Outlaw. 2008. Alaska marine mammal stock assessments, 2007. NMFS-TM-AFSC-180, U.S. Department of Commerce.
Antezana, T. 1970. Eufáusidos de la costa de Chile. Su rol en la Economía del mar. . Revista de Biología Marina **14**:19-27.
Aprill, M. L. 1994. Visitation and predation of the olive ridley sea turtle, *Lepidochelys olivacea*, at nest sites in Ostional, Costa Rica. Pp.3-6 *In*: K.A. Bjorndal, A.B. Bolten, D.A. Johnson, and P.J. Eliazer (Compilers), Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-351 323p.
Arenas, P. and M. Hall. 1991. The association of sea turtles, and other pelagic fauna with floating objects in the eastern tropical Pacific Ocean. Pages 7-10 *in* The Eleventh Annual Workshop on Sea Turtle Biology and Conservation.
Arnbom, T., V. Papastavrou, L. S. Weilgart, and H. Whitehead. 1987. Sperm whales react to an attack by killer whales. Journal of Mammalogy **68**:450-453.
Asrar, F. F. 1999. Decline of marine turtle nesting populations in Pakistan. Marine Turtle Newsletter **83**:13-14.
Au, W. W. L. and M. Green. 2000. Acoustic interaction of humpback whales and whale-watching boats. Marine Environmental Research **49**:469-481.
Avens, L. and L. R. Goshe. 2007. Skeletochronological analysis of age and growth for leatherback sea turtles in the western North Atlantic. P.223 in: Frick, M.; A. Panagopoulou; A.F. Rees; K. Williams (compilers), 27th Annual Symposium on Sea Turtle Biology and Conservation [abstracts]. 22-28 February 2007, Myrtle Beach, South Carolina. 296p.
Baier, C. T. and J. M. Napp. 2003. Climate-induced variability in Calanus marshallae populations. Journal of Plankton Research **25**:771-782.
Bain, D. 1990. Examining the validity of inferences drawn from photo-identification data, with special reference to studies of the killer whale (Orcinus orca) in British Columbia. Report of the International Whaling Commission, Special Issue **12**:93-100.
Bain, D. E. and M. E. Dahlheim. 1994. Effects of masking noise on detection thresholds of killer whales. Pages 243-256 *in* T. R. Loughlin, editor. Marine mammals and the Exxon Valdez. Academic Press, San Diego, California.
Baird, R. W. 1994. Foraging behavior and ecology of transient killer whales (*Orcinus orca*). Ph.D. Thesis, Simon Fraser University, Burnaby, British Columbia.
Baird, R. W. 2000. The killer whale: foraging specializations and group hunting. Pages 127-153 *in* J. Mann, R. C. Connor, P. L. Tyack, and H. Whitehead, editors. Cetacean societies: Field studies of dolphins and whales. University of Chicago Press, Chicago, Illinois.
Baird, R. W. 2001. Status of killer whales, Orcinus orca, in Canada. Canadian Field-Naturalist **115**:676-701.
Baird, R. W., A. D. Ligon, and S. K. Hooker. 2000. Sub-surface and night-time behavior of humpback whales off Maui, Hawaii: A preliminary report. Report prepared under Contract # 40ABNC050729 from the Hawaiian Islands Humpback Whale National Marine Sanctuary, Kihei, HI, to the Hawaii Wildlife Fund, Paia, HI. 19p.
Baker, C. S. 1985. The behavioral ecology and populations structure of the humpback whale (*Megaptera novaeangliae*) in the central and eastern Pacific. Unpublished Dissertation. University of Hawaii at Manoa.
Baker, C. S. and L. M. Herman. 1987. Alternative population estimates of humpback whales in Hawaiian waters. Canadian Journal of Zoology **65**:2818-2821.
Baker, C. S. and L. M. Herman. 1989. Behavioral responses of summering humpback whales to vessel traffic: Experimental and opportunistic observations. Kewalo Basin Marine Mammal Lab, Univ HI, Honolulu. Final Report for the U.S. NPS, Anchorage, Alaska. 50p.
Baker, C. S., L. M. Herman, B. G. Bays, and G. B. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in southeast Alaska: 1982 season. Report submitted to the National Marine Mammal Laboratory, Seattle, WA. 78pp.

Baker, C. S., A. Perry, and G. Vequist. 1988. Conservation update-- humpback whales of Glacier Bay, Alaska. Whalewatcher **22**:13-17.
Balazs, G. H. 1999. Factors to Consider in the Tagging of Sea Turtles in Research and Management Techniques for the Conservation of Sea Turtles. K. L. Eckert, K. A. Bjourndal, F. A. Abreu-Grobois and M. Donnelly (editors). IUCN/SSC Marine Turtle Specialist Group Publication No 4, 1999.
Balazs, G. H., R. K. Miya, and S. C. Beaver. 1996. Procedures to attach a satellite transmitter to the carapace of an adult green turtle, *Chelonia mydas*. Proceedings of the 15th Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-387, 355p.
Balcomb, K. C. 1987. The whales of Hawaii, including all species of marine mammals in Hawaiian and adjacent waters.Marine Mammal Fund Publication, San Francisco, CA. 99p.
Balcomb, K. C. and G. Nichols, Jr. 1982. Humpback whale censuses in the West Indies. Report of the International Whaling Commission **32**:401-406.
Baldwin, R. M. 1992. Nesting turtles on Masirah Island: Management issues, options, and research requirements. Ministry of Regional Municipalities and Environment, Oman.
Ban, S. 2005. Modelling, and characterization of Steller sea lion haulouts and rookeries using oceanographic and shoreline type data. Thesis. University of British Columbia, Vancouver, British Columbia.
Baraff, L. and M. T. Weinrich. 1993. Separation of humpback whale mothers and calves on a feeding ground in early autumn. Marine Mammal Science **9**:431-434.
Barbieri, E. 2009. CONCENTRATION OF HEAVY METALS IN TISSUES OF GREEN TURTLES (CHELONIA MYDAS) SAMPLED IN THE CANANEIA ESTUARY, BRAZIL. Brazilian Journal of Oceanography **57**:243-248.
Barlow, J. 1995. The abundance of cetaceans in California waters. Part I: Ship surveys in summer and fall of 1991. Fishery Bulletin **93**:1-14.
Barlow, J. 1997. Preliminary estimates of cetacean abundance off California, Oregon, and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Admin. Rept. LJ-97- 11, Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, CA.
Barlow, J. 2003. Preliminary estimates of the abundance of cetaceans along the U.S. West Coast: 1991-2001. Southwest Fisheries Science Center Administrative Report LJ-03-03:Available from SWFSC, 8604 La Jolla Shores Dr., La Jolla CA 92037. 92031p.
Barlow, J. and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology **78**:535-546.
Barlow, J., K. A. Forney, P. S. Hill, J. Brownell, R.L., J. V. Carretta, D. P. DeMaster, F. Julian, M. S. Lowry, T. Ragen, and R. R. Reeves. 1997. U.S. Pacific marine mammal stock assessment -1996. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-248.:Southwest Fisheries Science Center; La Jolla, California.
Barlow, J. and B. L. Taylor. 2001. Estimates of large whale abundance off California, Oregon, Washington, and Baja California based on 1993 and 1996 ship surveys. Southwest Fisheries Science Center, National Marine Fisheries Service, La Jolla, California.
Barrett-Lennard, L., K. Heise, E. Saulitis, G. Ellis, and C. Matkin. 1995. The Impact of Killer Whale Predation on Steller Sea Lion Populations in British Columbia and Alaska. North Pacific Universities Marine Mammal Research Consortium Fisheries Centre, University of British Columbia, Vancouver, BC.
Barrett-Lennard, L. G., T. G. Smith, and G. M. Ellis. 1996. A cetacean biopsy system using lightweight pneumatic darts, and its effect on the behavior of killer whales. Marine Mammal Science **12**:14-27.
Barron, M. G., R. Heintz, and M. M. Krahn. 2003. Contaminant exposure and effects in pinnipeds: implications for Steller sea lion declines in Alaska. The Science of the Total Environment **311**:111-133.
Bass, A. L. 1999. Genetic analysis to elucidate the natural history and behavior of hawksbill turtles (Eretmochelys imbricata) in the wider Caribbean: a review and re-analysis. Chelonian Conservation and Biology **3**:195-199.
Bauer, G. and L. M. Herman. 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. National Marine Fisheries Service, Honolulu, Hawaii.
Bauer, G. B. 1986. The behavior of humpback whales in Hawaii and modification of behavior induced by human interventions. Ph.D. dissertation:University of Hawaii, Honolulu.

Baumgartner, M. F., T. V. N. Cole, P. J. Clapham, and B. R. Mate. 2003. North Atlantic right whale habitat in the lower Bay of Fundy and on the SW Scotian Shelf during 1999-2001. Marine Ecology Progress Series **264**:137-154.

Baumgartner, M. F. and B. R. Mate. 2003. Summertime foraging ecology of North Atlantic right whales. Marine Ecology Progress in Series **264**:123–135.

Beale, C. M. and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology **41**:335-343.

Beavers, S. C. and E. R. Cassano. 1996. Movements and dive behavior of a male sea turtle (Lepidochelys olivacea) in the eastern tropical Pacific. Journal of Herpetology **30**:97-104.

Beggs, J. A., J. A. Horrocks, and B. H. Krueger. 2007. Increase in hawksbill sea turtle Eretmochelys imbricata nesting in Barbados, West Indies. Endangered Species Research **3**:159–168.

Bell, L. A. J., U. Fa'Anunu, and T. Koloa. 1994. Fisheries resources profiles: Kingdom of Tonga. Honiara, Solomon Islands.

Benson, S. R., P. H. Dutton, C. Hitipeuw, B. Samber, J. Bakarbessy, and D. Parker. 2007a. Post-nesting migrations of leatherback turtles (*Dermochelys coriacea*) from Jamursba-Medi, Bird's Head Peninsula, Indonesia. Chelonian Conservation and Biology **6**:150-154.

Benson, S. R., K. M. Kisokau, L. Ambio, V. Rei, P. H. Dutton, and D. Parker. 2007b. Beach use, internesting movement, and migration of leatherback turtles, *Dermochelys coriacea*, nesting on the north coast of Papua New Guinea. Chelonian Conservation and Biology **6**:7-14.

Bentley, T. B. and A. Dunbar-Cooper. 1980. A blood sampling technique for sea turtles. Report for National Marine Fisheries Service. Sept. 1980. Contract No. Na-80-GE-A-00082

Berkson, H. 1967. Physiological adjustments to deep diving in the Pacific green turtle (Chelonia mydas agassizi). Comparative Biochemistry and Physiology **21**:507-524.

Bernardo, J. and P. T. Plotkin. 2007. An evolutionary perspective on the arribada phenomenon, and reproductive behavioral polymorphism of olive ridley sea turtles (*Lepidochelys olivacea*). Pages 59-87 *in* P. T. Plotkin, editor. Biology and conservation of Ridley sea turtles. Johns Hopkins University Press, Baltimore, Maryland.

Berzin, A. A. 1972. The sperm whale. Pacific Scientific Research Institute of Fisheries and Oceanography, Moscow. (Translated from Russian 1971 version by Israel Program for Scientific Translation, Jerusalem).

Berzin, A. A. and A. V. Yablokov. 1978. Abundance and population structure of important exploited cetacean species of the world ocean. Zoologichesky Zhurnal:1771-1785.

Best, P. B., J. Bannister, R. L. Brownell, and G. Donovan. 2001. Right whales: Worldwide status.

Best, P. B., P.A.S. Canham, and N. Macleod. 1984. Patterns of reproduction in sperm whales, *Physeter macrocephalus*. Report of the International Whaling Commission **Special Issue 8**:51-79.

Best, P. B., D. Reeb, M. B. Rew, P. Palsboll, J., C. Schaeff, and A. Brandao. 2005. Biopsying Southern right whales: Their reactions and effects on reproduction. Journal of Wildlife Managment **69**:1171-1189.

Bickham, J. W., J. C. Patton, and T. R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lions (Eumetopias jubatus). Journal of Mammalogy **77**:95-108.

Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford, and I. K. C. Balcomb. 1990. Social organization and genealogy of resident killer whales (Orcinus orca) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commission, Special Issue **12**:383-405.

Bjorndal, K. A. 1997. Foraging ecology, and nutrition of sea turtles. Pages 199-232 *in* P. L. Lutz and J. A. Musick, editors. The biology of sea turtles. CRC Press, Boca Raton, Florida.

Bjorndal, K. A. and A. B. Bolten. 2000. Proceedings on a workshop on accessing abundance and trends for in-water sea turtle populations. NOAA Technical Memorandum NMFS-SEFSC-445.

Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2003. Survival probability estimates for immature green turtles Chelonia mydas in the Bahamas. Marine Ecology Progress Series **252**:273-281.

Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2005. Evaluating trends in abundance of immature green turtles, *Chelonia mydas*, in the greater Caribbean. Ecological Applications **15**:304-314.

Blumenthal, J. M., T. J. Austin, C. D. L. Bell, J. B. Bothwell, A. C. Broderick, G. Ebanks-Petrie, J. A. Gibb, K. E. Luke, J. R. Olynik, M. F. Orr, J. L. Solomon, and B. J. Godley. 2009. Ecology of Hawksbill Turtles, Eretmochelys imbricata, on a Western Caribbean Foraging Ground. Chelonian Conservation and Biology **8**:1-10.

Bolten, A. B., K.A. Bjorndal, and H. R. Martins. 1994. Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. . Pp.48-55 *In:* Balazs, G.J. and S.G. Pooley (eds), Research Plan to Assess Marine Turtle Hooking Mortality: Results of an Expert Workshop Held in Honolulu, Hawaii, November 16-18, 1993. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-201, pp.48-55.

Bolten, A. B., J. A. Wetherall, G. H. Balazs, and S. J. Pooley. 1996. Status of marine turtles in the Pacific Ocean relevant to incidental take in the Hawaii-based pelagic longline fishery. NOAA-TM-NMFS-SWFSC-230.

Borobia, M. P. J. G. Y. S. J. N. G. and P. Béland. 1995. Blubber fatty acids of finback, and humpback whales from the Gulf of St. Lawrence. Marine Biology **122**:341-353.

Borrell, A. 1993. PCB and DDTs in blubber of cetaceans from the northeastern North Atlantic. Marine Pollution Bulletin **26**:146-151.

Borrell, A. and A. Aguilar. 1987. Variations in DDE percentage correlated with total DDT burden in the blubber of fin and sei whales. Marine Pollution Bulletin **18**:70-74.

Boulon, R. H., Jr. 1983. Some notes on the population biology of green (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricata*) turtles in the northern U.S. Virgin Islands; 1981-83.

Boulon, R. H., Jr. 1994. Growth rates of wild juvenile hawksbill turtles, *Eretmochelys imbricata*, in St. Thomas, United States Virgin Islands. Copeia **1994**:811-814.

Bourgeois, S., E. Gilot-Fromont, A. Viallefont, F. Boussamba, and S. L. Deem. 2009. Influence of artificial lights, logs and erosion on leatherback sea turtle hatchling orientation at Pongara National Park, Gabon. Biological Conservation **142**:85-93.

Bowen, B. W., A. L. Bass, S.-M. Chow, M. Bostrom, K. A. Bjorndal, A. B. Bolten, T. Okuyama, B. M. Bolker, S. Epperly, E. LaCasella, D. Shaver, M. Dodd, S. R. Hopkins-Murphy, J. A. Musick, M. Swingle, K. Rankin-Baransky, W. Teas, W. N. Witzell, and P. H. Dutton. 2004. Natal homing in juvenile loggerhead turtles (*Caretta caretta*). Molecular Ecology **13**:3797–3808.

Bowen, B. W., A. L. Bass, A. Garcia Rodriguez, C. E. Diez, R. Van Dam, A. B. Bolten, K. A. Bjorndal, M. M. Miyamoto, and R. J. Feri. 1996. Origin of hawksbill turtles in a Caribbean feeding area as indicated by genetic markers. Ecological Applications **6**:566-572.

Bowen, B. W., W. S. Grant, Z. Hillis-Starr, D. J. Shaver, K. A. Bjorndal, A. B. Bolten, and A. L. Bass. 2007. Mixed stock analysis reveals the migrations of juvenile hawksbill turtles (Eretmochelys imbricata) in the Caribbean Sea. Molecular Ecology **16**:49-60.

Boyd, I. L., C. Lockyer, and H. D. Marsh. 1999. Reproduction in marine mammals.*in* J. E. Reynolds III and S. A. Rommel, editors. Biology of Marine Mammals. Smithsonian Institution Press, Washington, D.C.

Boyle, M. C., N. N. FitzSimmons, C. J. Limpus, S. Kelez, X. Velez-Zuazo, and M. Waycott. 2009. Evidence for transoceanic migrations by loggerhead sea turtles in the southern Pacific Ocean. Proceedings of the Royal Society B-Biological Sciences **276**:1993-1999.

Boyle, M. C. and C. J. Limpus. 2008. The stomach contents of post-hatchling green and loggerhead sea turtles in the southwest Pacific: an insight into habitat association. Marine Biology **155**:233-241.

Braham, H. W. 1984. The status of endangered whales: An overview. Marine Fisheries Review **46**:2-6.

Braham, H. W. 1991. Endangered Whales: A Status Update. A report on the 5-year status of stocks review under the 1978 amendments to the U.S. Endangered Species Act.:National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service. Seattle, Washington. 56p.

Braham, H. W. and D. W. Rice. 1984. The right whale, Balaena glacialis. Marine Fisheries Review **46**:38-44.

Branch, T. A., K. M. Stafford, D. M. Palacios, C. Allison, J. L. Bannister, C. L. K. Burton, E. Cabrera, C. A. Carlson, B. G. Vernazzani, P. C. Gill, R. Hucke-Gaete, K. C. S. Jenner, M.-N. M. Jenner, K. Matsuoka, Y. A. Mikhalev, T. Miyashita, M. G. Morrice, S. Nishiwaki, V. J. Sturrock, D. Tormosov, R. C. Anderson, A. N. Baker, P. B. Best, P. Borsa, J. R. L. Brownell, S. Childerhouse, K. P. Findlay, T. Gerrodette, A. D. Ilangakoon, M. Joergensen, B. Kahn, D. K. Ljungblad, B. Maughan, R. D. McCauley, S. McKay, T. F. Norris, Oman Whale and Dolphin Research Group, S. Rankin, F. Samaran, D. Thiele, K. V. Waerbeek, and R. M. Warneke. 2007. Past and present distribution, densities and movements of blue whales *Balaenoptera musculus* in the Southern Hemisphere and northern Indian Ocean. Mammal Review **37**:116-175.

Brandon, R. 1978. Adaptation and evolutionary theory. Studies in the History and Philosophy of Science **9**:181-206.

Bräutigam, A. and K. L. Eckert. 2006. Turning the tide: Exploitation, trade, and management of marine turtles in the Lesser Antilles, Central America, Colombia, and Venezuela. TRAFFIC International, Cambridge, United Kingdom.

Brock, K. A., J. S. Reece, and L. M. Ehrhart. 2009. The Effects of Artificial Beach Nourishment on Marine Turtles: Differences between Loggerhead and Green Turtles. Restoration Ecology **17**:297-307.

Broderick, A., C. R. Frauenstein, F. Glen, G. C. Hays, A. L. Jackson, T. Pelembe, G. D. Ruxton, and B. J. Godley. 2006. Are green turtles globally endangered? Global Ecology and Biogeography **15**:21-26.

Brooks, L. B., J. T. Harvey, and W. J. Nichols. 2009. Tidal movements of East Pacific green turtle Chelonia mydas at a foraging area in Baja California Sur, Mexico. Marine Ecology-Progress Series **386**:263-274.

Brown, M. R., P. J. Corkeron, P. T. Hale, K. W. Schultz and M. M. Bryden. 1994. Behavioral responses of east Australian humpback whales (Megaptera novaeangliae) to biopsy sampling. Marine Mammal Science **10**:391-400.

Brown, R. F., S. D. Riemer, and B. E. Wright. 2002. Population status and food habits of Steller sea lions in Oregon. Oregon Department of Fish and Wildlife.

Brownell, R. L., Jr., P. J. Clapham, T. Miyashita, and T. Kasuya. 2001. Conservation status of North Pacific right whales. Journal of Cetacean Research and Management, Special Issue **2**:269-286.

Burnell, S. R. 2001. Aspects of the reproductive biology, movements, and site fidelity of right whales off Australia. Journal of Cetacean Research and Management (Special issue) **2**:89-102.

Burtenshaw, J. C., E. M. Oleson, J. A. Hildebrand, M. A. McDonald, R. K. Andrew, B. M. Howe, and J. A. Mercer. 2004. Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. Deep-Sea Research II **51**:967-986.

Byles, R. A. and Y. B. Swimmer. 1994. Post-nesting migration of *Eretmochelys imbricata* in the Yucatan Peninsula. Page 202 *in* Fourteenth Annual Symposium on Sea Turtle Biology and Conservation.

Byrne, R., J. Fish, T. K. Doyle, and J. D. R. Houghton. 2009. Tracking leatherback turtles (Dermochelys coriacea) during consecutive inter-nesting intervals: Further support for direct transmitter attachment. Journal of Experimental Marine Biology and Ecology **377**:68-75.

Calambokidis, J. and J. Barlow. 2004. Abundance of blue and humpback whales in the eastern North Pacific estimated by capture-recapture and line-transect methods. Marine Mammal Science **20**:63-85.

Calambokidis, J., E. A. Falcone, T. J. Quinn II, A. M. Burdin, P. J. Clapham, J. K. B. Ford, C. M. Gabriele, R. G. LeDuc, D. K. Mattila, L. Rojas-Bracho, J. M. Straley, B. L. Taylor, J. Urbân, R. D. W. Weller, B. H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. R. Flynn, A. Havron, J. Huggins, and N. Maloney. 2008. SPLASH: Structure of populations, levels of abundance, and status of humpback whales in the North Pacific. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, Washington.

Calambokidis, J., G. H. Steiger, J. C. Cubbage, K. C. Balcomb, C. Ewald, S. Kruse, R. Wells, and R. Sears. 1990. Sightings and movements of blue whales off central California 1986-88 from photo-identification of individuals. Report of the International Whaling Commission:343-348.

Calambokidis, J., G. H. Steiger, J. M. Straley, T. Quinn, L. M. Herman, S. Cerchio, D. R. Salden, M. Yamaguchi, F. Sato, J. R. Urban, J. Jacobson, O. von Zeigesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, N. Higashi, S. Uchida, J. K. B. Ford, Y. Miyamura, P. Ladrón de Guevara, S. A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific basin. Final Report under contract No. 5ABNF500113. NMFS Southwest Fisheries Science Center; La Jolla, California.

Calkins, D. G. 1986. Marine Mammals. In The Gulf of Alaska, Physical Environment and Biological Resources, :D.W. Hood and S.T. Zimmerman (editors), Government Printing Office, Washington, D.C. p.527–558.

Calkins, D. G. and E. Goodwin. 1988. Investigation of the declining sea lion population in the Gulf of Alaska. Unpublished Report. Alaska Department of Fish and Game, Anchorage, Alaska.

Calkins, D. G. and K. W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. 19, U.S. Department of the Interior OCSEAP

Call, K. A. and T. R. Loughlin. 2005. An ecological classification of Alaskan Steller sea lion (Eumetopias jubatus) rookeries: A tool for conservation/management. Fisheries and Oceanography **14**:212-222.

Campbell, C. L. and C. J. Lagueux. 2005. Survival probability estimates for large juvenile and adult green turtles (Chelonia mydas) exposed to an artisanal marine turtle fishery in the western Caribbean. Herpetologica **61**:91-103.

Cardona, L., A. Aguilar, and L. Pazos. 2009. Delayed ontogenic dietary shift and high levels of omnivory in green turtles (Chelonia mydas) from the NW coast of Africa. Marine Biology **156**:1487-1495.
Carr, A. 1967. So excellent a fishe. Natural History Press, Garden City, New York.
Carr, A., M. H. Carr, and A. B. Meylan. 1978. The ecology and migration of sea turtles, 7. the west Caribbean turtle colony. Bulletin of the American Museum of Natural History, New York **162**:1-46.
Carr, A. F. 1986. RIPS, FADS, and little loggerheads. Bioscience **36**:92-100.
Carretta, J. V., K. A. Forney, M. Lowry, J. Barlow, J. Baker, D. Johnston, B. Handson, M. M. Muto, D. Lynch, and L. Carswell. 2009. U.S. Pacific marine mammal stock assessments: 2008. NOAA-TM-NMFS-SWFSC-434.
Carretta, J. V., K. A. Forney, M. S. Lowry, J. Barlow, J. Baker, B. Hanson, and M. M. Muto. 2007a. U.S. Pacific marine mammal stock assessments: 2007.
Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. S. Lowry. 2005. U.S. Pacific Marine Mammal Stock Assessments: 2004. U.S. Department of Commerce, NOAA-TM-NMFS-SWFSC-375, 322p.
Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. S. Lowry. 2006. U.S. Pacific Marine Mammal Stock Assessments: 2005. U.S. Department of Commerce NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-388. 325p.
Carretta, J. V., K. A. Forney, M. M. Muto, J. Barlow, J. Baker, B. Hanson, and M. S. Lowry. 2007b. U.S. Pacific Marine Mammal Stock Assessments: 2006. U.S. Department of Commerce NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-398. 321p.
Carruthers, E. H., D. C. Schneider, and J. D. Neilson. 2009. Estimating the odds of survival and identifying mitigation opportunities for common bycatch in pelagic longline fisheries. Biological Conservation **142**:2620-2630.
Casale, P., A. D. Mazaris, D. Freggi, C. Vallini, and R. Argano. 2009. Growth rates and age at adult size of loggerhead sea turtles (Caretta caretta) in the Mediterranean Sea, estimated through capture-mark-recapture records. Scientia Marina **73**:589-595.
Castro, J. C. 1986. Contribución de las tortugas loras solitarias (Lepidochelys olivacea Eschscholtz) en el mantenimiento de las poblaciones de esta especie. Licenciatura de Tesis. Universidad de Costa Rica.
Caurant, F., P. Bustamante, M. Bordes, and P. Miramand. 1999. Bioaccumulation of cadmium, copper and zinc in some tissues of three species of marine turtles stranded along the French Atlantic coasts. Marine Pollution Bulletin **38**:1085-1091.
CBD. 2001. Petition to list the southern resident killer whale (*Orcinus orca*) as an endangered species under the Endangered Species Act. Center for Biological Diversity, Berkeley, California.
CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf.Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT558-548 to the Bureau of Land Management, Washington, DC, 538 pp.
Chacón-Chaverri, D. and K. L. Eckert. 2007. Leatherback sea turtle nesting at Gandoca Beach in Caribbean Costa Rica: Management recommendations from fifteen years of conservation. Chelonian Conservation and Biology **6**:101-110.
Chaloupka, M. 2001. Historical trends, seasonality, and spatial synchrony in green sea turtle egg production. Biological Conservation **101**:263-279.
Chaloupka, M. and C. Limpus. 2005. Estimates of sex- and age-class-specific survival probabilities for a southern Great Barrier Reef green sea turtle population. Marine Biology **146**:1251-1261.
Chaloupka, M., C. Limpus, and J. Miller. 2004. Green turtle somatic growth dynamics in a spatially disjunct Great Barrier Reef metapopulation. Coral Reefs **23**:325-335.
Chan, E. H. and H. C. Liew. 1996. Decline of the leatherback population in Terengganu, Malaysia, 1956-1995. Chelonian Conservation and Biology **2**:196-203.
Chan, E. H. and H. C. Liew. 1999. Hawksbill turtles, Eretmochelys imbricata, nesting on Redang Island, Terengganu, Malaysia, from 1993 to 1997. Chelonian Conservation and Biology **3**:326-329.
Cheng, I. J., C. T. Huang, P. Y. Hung, B. Z. Ke, C. W. Kuo, and C. L. Fong. 2009. Ten Years of Monitoring the Nesting Ecology of the Green Turtle, Chelonia mydas, on Lanyu (Orchid Island), Taiwan. Zoological Studies **48**:83-94.
Cherfas, J. 1989. The hunting of the whale. Viking Penguin Inc., N.Y., 248p.
Christensen, I. 1984. Growth and reproduction of killer whales, Orcinus orca, in Norwegian coastal waters. Report of the International Whaling Commission, Special Issue **6**:253-258.

Christensen, I., T. Haug, and N. Øien. 1992. A review of feeding, and reproduction in large baleen whales (Mysticeti) and sperm whales Physeter macrocephalus in Norwegian and adjacent waters. Fauna Norvegica Series A **13**:39-48.

Clapham, P., C. Good, S. Quinn, R. R. Reeves, J. E. Scarff, and R.L. Brownell, Jr. 2004. Distribution of north Pacific right whales (Eubalaena japonica) as shown by 19th, and 20th century whaling catch and sighting records. Journal of Cetacean Research and Management **6**:1-6.

Clapham, P. J. 1994. Maturational changes in patterns of association among male and female humpback whales. Journal of Zoology **71**:440-443.

Clapham, P. J. 1996. The social and reproductive biology of humpback whales: an ecological perspective. Mammal Review **26**:27-49.

Clapham, P. J., L. S. Baraff, C. A. Carlson, M. A. Christian, D. K. Mattila, C. A. Mayo, M. A. Murphy, and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, Megaptera novaeangliae, in the southern Gulf of Maine. Canadian Journal of Zoology **71**:440-443.

Clapham, P. J. and D. K. Mattila. 1993. Reactions of humpback whales to skin biopsy sampling on a West Indies breeding ground. Marine Mammal Science **9**:382-391.

Clapham, P. J. and C. A. Mayo. 1987. Reproduction and recruitment of individually identified humpback whales, *Megaptera novaeangliae*, observed in Massachusetts Bay, 1979-1985. Canadian Journal of Zoology **65**:2853-2863.

Clapham, P. J. and C. A. Mayo. 1990. Reproduction of humpback whales (*Megaptera novaeangliae*) observed in the Gulf of Maine. Report of the International Whaling Commission **Special Issue 12**:171-175.

Clapham, P. J., S. B. Young, and R. L. Brownell Jr. 1999. Baleen whales: conservation issues and the status of the most endangered populations. Mammal Review **29**:35-60.

Clark, C. 2006. Acoustic communication in the great whales: The medium and the message. Presentation at the 86th Annual Conference of the American Society of Mammalogists.

Clark, C. W. 1995. Matters arising out of the discussion of blue whales. Annex M1. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Report of the International Whaling Commission, Annex M **45**:210-212.

Clark, S. T., D. K. Odell, and C. T. Lacinak. 2000. Aspects of growth in captive killer whales (Orcinus orca). Marine Mammal Science **16**:110-123.

Clarke, C. W. and R. A. Charif. 1998. Acoustic monitoring of large whales to the west of Britain and Ireland using bottom mounted hydrophone arrays, October 1996-September 1997. JNCC Report No. 281.

Clarke, M. R. 1977. Beaks, nets and numbers. Symposium of the Zoological Society of London **38**:89-126.

Clarke, M. R. 1980a. Cephalopods in the diet of sperm whales of the Southern Hemisphere and their bearing on sperm whale biology. Discovery Reports 37.

Clarke, M. R. 1996. Cephalopods as prey. III. Cetaceans. Philosophical Transactions of the Royal Society of London B **351**:1053-1065.

Clarke, R. 1980b. Catches of sperm whales and whalebone whales in the southeast Pacific between 1908 and 1975. Report of the International Whaling Commission **30**:285-288.

Cliffton, K. D., O. Cornejo, and R. S. Felger. 1982. Sea turtles of the Pacific coast of Mexico. Pages 199-209 *in* K. A. Bjorndal, editor. Biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D.C.

Conway, C. A. 2005. Global population structure of blue whales, *Balaenoptera musculus* spp., based on nuclear genetic variation. University of California, Davis.

Cooke, J. G., V. J. Rowntree, and R. Payne. 2001. Estimates of demographic parameters for southern right whales (Eubalaena australis) observed off Península Valdés, Argentina. Journal of Cetacean Research and Management (Special issue) **2**:125-132.

Corkeron, P., P. Ensor, and K. Matsuoka. 1999. Observations of blue whales feeding in Antarctic waters. Polar Biology **22**:213-215.

Cornelius, S. E. 1986. The sea turtles of Santa Rosa National Park. Fundacion Parques Nacionales, San José, Costa Rica.

Cornelius, S. E. and D. C. Robinson. 1986. Post-nesting movements of female olive ridley turtles tagged in Costa Rica. Vida Silvestre Neotropical **1**:12-23.

Cornelius, S. E., M. A. Ulloa, J. C. Castro, M. M. D. Valle, and D. C. Robinson. 1991. Management of olive ridley sea turtles Lepidochelys olivacea nesting at Playas Nancite, and Ostional, Costa Rica.

Pages 111-135 *in* J. G. Robinson and K. H. Redford, editors. Neotropical Wildlife Use and Conservation. The University of Chicago Press, Chicago, IL.
Corsolini, S., A. Aurigi, and S. Focardi. 2000. Presence of polychlorobiphenyls (PCBs), and coplanar congeners in the tissues of the Mediterranean loggerhead turtle Caretta caretta. Marine Pollution Bulletin **40**:952-960.
COSEWIC. 2002. COSEWIC assessment and update status report on the blue whale *Balaenoptera musculus* (Atlantic population, Pacific population) in Canada. COSEWIC, Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada.
COSEWIC. 2005. COSEWIC assessment and update status report on the fin whale *Balaenoptera physalus* (Pacific population, Atlantic population) in Canada., COSEWIC, Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada.
Crognale, M. A., S. A. Eckert, D. H. Levenson, and C. A. Harms. 2008. Leatherback sea turtle Dermochelys coriacea visual capacities and potential reduction of bycatch by pelagic longline fisheries. Endangered Species Research **5**:249-256.
Croll, D. and B. Tershy. 2002. Filter feeding. Pages 428-432 *in* W. F. Perrin, B. Wursig, and J. G. Thewissen, editors. Encyclopedia of Marine Mammals. Academic Press, San Diego, CA.
Crouse, O. T., L. B. Crowder, and H. Caswell. 1987. A site based population model for loggerhead sea turtles and implications for conservation. Ecology **68**:1412-1423.
Cullon, D. L., M. B. Yunker, C. Alleyne, N. J. Dangerfield, S. O'Neill, M. J. Whiticar, and P. S. Ross. 2009. Persistent organic pollutants in Chinook salmon (Oncorhynchus tshawytscha): Implications for resident killer whales of British Columbia and adjacent waters. (Orcinus orca). Environmental Toxicology and Chemistry **28**:148-161.
Daniel, D. O. and J. C. Schneeweis. 1992. Steller sea lion, *Eumetopias jubatus*, predation on glaucous-winged gulls, Larus glaucescens. Canadian Field Naturalist **106**:268.
Darling, J. D. and H. Morowitz. 1986. Census of Hawaiian humpback whales (*Megaptera novaeangliae*) by individual identification. Canadian Journal of Zoology **64**:105-111.
Davenport, J., J. Wrench, J. McEvoy, and V. Carnacho-Ibar. 1990. Metal and PCB concentrations in the "Harlech" leatherback. Marine Turtle Newsletter **48**:1-6.
Davies, J. R. 1997. The impact of an offshore drilling platform on the fall migration path of bowhead whales: A GIS-based assessment. Western Washington University, Bellingham, Washington.
Dehn, L., E. H. Follmann, C. Rosa, L. K. Duffy, D. L. Thomas, G. R. Bratton, R. J. Taylor, and T. M. O. Hara. 2006. Stable isotope, and trace element status of subsistence-hunted bowhead, and beluga whales in Alaska, and gray whales in Chukotka. Marine Pollution Bulletin **52**:301-319.
Dermawan, A. 2002. Marine turtle management, and conservation in Indonesia. Pages 67-75 *in* Western Pacific Sea Turtle Cooperative Research and Management Workshop, February 5-8, 2002, , Honolulu, Hawaii.
Diaz-Fernandez, R., T. Okayama, T. Uchiyama, E. Carrillo, G. Espinosa, R. Marquez, C. E. Diez, and H. Koike. 1999. Genetic sourcing for the hawksbill turtle, Eretmochelys imbricata, in the Northern Caribbean Region. Chelonian Conservation and Biology **3**:296-300.
Dietrich, K. S., V. R. Cornish, K. S. Rivera, and T. A. Conant. 2007. Best practices for the collection of longline data to facilitate research and analysis to reduce bycatch of protected species., NOAA Technical Memorandum NMFS-OPR-35. 101p. Report of a workshop held at the International Fisheries Observer Conference Sydney, Australia, November 8,.
Diez, C. E. and R. P. v. Dam. 2002. Habitat effect on hawksbill turtle growth rates on feeding grounds at Mona and Monito Islands, Puerto Rico. Marine Ecology Progress Series **234**:301-309.
Dodd, C. K. 1988. Synopsis of the biological data on the loggerhead sea turtle: *Caretta caretta* (Linnaeus 1758). Fish and Wildlife Service Biological Report **88**:110.
Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-83: Status, abundance, and distribution. Contract No. 14-12-0001-29090, Final Report to the Minerals Management Service.
Donovan, G. P. 1991. A review of IWC stock boundaries. Report of the International Whaling Commission (Special Issue 13).
Douglas, A. B., J. Calambokidis, S. Raverty, S. J. Jeffries, D. M. Lambourn, and S. A. Norman. 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association of the United Kingdom.

Dufault, S. and H. Whitehead. 1995. The geographic stock structure of female and immature sperm whales in the South Pacific. Report of the International Whaling Commission **45**:401-405.

Dufault, S., H. Whitehead, and M. Dillon. 1999. An examination of the current knowledge on the stock structure of sperm whales (*Physeter macrocephalus*) worldwide. Journal of Cetacean Research and Management **1**:1-10.

Duffield, D. A. and K. W. Miller. 1988. Demographic features of killer whales in oceanaria in the United States and Canada, 1965-1987. Rit Fiskideildar **11**:297-306.

Dutton, D. L., P. H. Dutton, M. Chaloupka, and R. H. Boulon. 2005. Increase of a Caribbean leatherback turtle *Dermochelys coriacea* nesting population linked to long-term nest protection. Biological Conservation **126**:186-194.

Dutton, P. 2005-2006. Building our knowledge of the leatherback stock structure. SWOT Report **1**:10-11.

Dutton, P., G. Balazs, A. Dizon, and A. Barragan. 2000. Genetic stock identification and distribution of leatherbacks in the Pacific: potential effects on declining populations. Pages 38-39 *in* Eighteenth International Sea Turtle Symposium.

Dutton, P. and G. H. Balazs. 1995. Simple biopsy technique for sampling skin for DNA analysis of sea turtles. Marine Turtle Newsletter **69**:6-9.

Dutton, P. H. 2003. Molecular ecology of *Chelonia mydas* in the eastern Pacific Ocean.*in* J. A. Seminoff, editor. Proceedings of the 22nd annual symposium on sea turtle biology and conservation

Dutton, P. H., G. H. Balazs, and A. E. Dizon. 1998. Genetic stock identification of sea turtles caught in the Hawaii-based pelagic longline fishery. Pages 45-46 *in* Seventeenth Annual Symposium on Sea Turtle Biology and Conservation.

Dutton, P. H., C. Hitipeuw, M. Zein, S. R. Benson, G. Petro, J. Pita, V. Rei, L. Ambio, and J. Bakarbessy. 2007. Status and genetic structure of nesting populations of leatherback turtles (*Dermochelys coriacea*) in the western Pacific. Chelonian Conservation and Biology **6**:47-53.

Eckert, K. L. 1993. The biology and population status of marine turtles in the North Pacific Ocean. Final Report to NOAA, NMFS, SWFSC. Honolulu, HI.

Eckert, K. L., K. A. Bjorndal, F. A. Abreu, and M. A. Donnelly, editors. 1999. Research and management techniques for the conservation of sea turtles, USN/SSC Marine Turtle Speicalist Group Publication No. 4. Washington DC. (235 pp.).

Eckert, K. L. and S. A. Eckert. 1988. Pre-reproductive movements of leatherback turtles (Dermochelys coriacea) nesting in the Caribbean. Copeia **1988**:400-406.

Eckert, S. A. 1997. Distant fisheries implicated in the loss of the world's largest leatherback nesting population. Marine Turtle Newsletter **78**:2-7.

Eckert, S. A. 1998. Perspectives on the use of satellite telemetry and electronic technologies for the study of marine turtles, with reference to the first year long tracking of leatherback sea turtles. Pages 44-46 *in* 17th Annual Symposium on Sea Turtle Biology and Conservation.

Eckert, S. A. 1999. Data acquisition systems for monitoring sea turtle behavior and physiology. Pages 88-93 *in* K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly, editors. Research and Management Techniques for the Conservation of Sea Turtles. UCN/SSC Marine Turtle Specialist Group Publication No. 4.

Eckert, S. A. 2002. Distribution of juvenile leatherback sea turtle *Dermochelys coriacea* sightings. Marine Ecology Progress Series **230**:289-293.

Eckert, S. A. 2006. High-use oceanic areas for Atlantic leatherback sea turtles (*Dermochelys coriacea*) as identified using satellite telemetered location and dive information. Marine Biology **149**:1257-1267.

Eckert, S. A., D. Bagley, S. Kubis, L. Ehrhart, and C. Johnson. 2006. Internesting and postnesting movements and foraging habitats of leatherback sea turtles (Dermochelys coriacea) nesting in Florida. Chelonian Conservation and Biology **5**:239–248.

Eguchi, T., T. Gerrodette, R. L. Pitman, J. A. Seminoff, and P. H. Dutton. 2007. At-sea density and abundance estimates of the olive ridley turtle (Lepidochelys olivacea) in the Eastern Tropical Pacific. Endangered Species Research **2**:191-203.

Eisenberg, J. F. and J. Frazier. 1983. A leatherback turtle (Dermochelys coriacea) feeding in the wild. Journal of Herpetology **17**:81-82.

Elvin, S. S. and C. T. Hogart. 2008. Right whales and vessels in Canadian waters. Marine Policy **32**:379-386.

Elwen, S. H. and P. B. Best. 2004. Female southern right whales *Eubalaena australis*: are there reproductive benefits associated with their coastal distribution off South Africa? Marine Ecology Progress Series **269**:289-295.
Erbe, C. 2002. Underwater noise of whale-watching boats and potential effects on killer whales (Orcinus orca), based on an acoustic impact model. Marine Mammal Science **18**:394-418.
Erickson, A. W. 1978. Population studies of killer whales (*Orcinus orca*) in the Pacific Northwest: A radio-marking and tracking study of killer whales. U.S. Marine Mammal Commission, Washington, D.C.
EuroTurtle. 2006a. Leatherback sea turtle, *Dermochelys coriacea*. http://www.euroturtle.org/outline/leather.htm.
EuroTurtle. 2006b. Loggerhead sea turtle, *Caretta caretta*. http://www.euroturtle.org/outline/logger.htm.
Euroturtle. 2009. Hawksbill Sea Turtle, Eretmochelys imbricata.
Evans, K., M. A. Hindell, and G. Hince. 2004. Concentrations of organochlorines in sperm whales (Physeter macrocephalus) from Southern Australian waters. Marine Pollution Bulletin **48**:486-503.
Felleman, F., J. R. Heimlich-Boran, and R. W. Osborne. 1991. The feeding ecology of killer whales (*Orcinus orca*) in the Pacific Northwest. Pages 113-148 *in* K. Pryor and K. Norris, editors. Dolphin Societies, discoveries, and puzzles. University of California Press, Berkeley, California.
Ferraroli, S., J. Y. Georges, P. Gaspar, and Y. L. Maho. 2004. Where leatherback turtles meet fisheries. Nature **429**:521-522.
Ficetola, G. F. 2008. Impacts of human activities and predators on the nest success of the hawksbill turtle, Eretmochelys imbricata, in the Arabian Gulf. Chelonian Conservation and Biology **7**:255-257.
Fitzsimmons, N. N., A. D. Tucker, and C. J. Limpus. 1995. Long-term breeding histories of male green turtles and fidelity to a breeding ground. Marine Turtle Newsletter **68**:2-4.
FOC. 2008. Draft management plan for the Steller sea lion (*Eumetopias jubatus*) in Canada. Species at Risk Act management plan series. Fisheries and Oceans Canada, Ottawa, Canada.
Foley, A. M., P. H. Dutton, K. E. Singel, A. E. Redlow, and W. G. Teas. 2003. The first records of olive ridleys in Florida, USA. Marine Turtle Newsletter **101**:23-25.
Fonseca, L. G., G. A. Murillo, L. Guadamuz, R. M. Spinola, and R. A. Valverde. 2009. Downward but Stable Trend in the Abundance of Arribada Olive Ridley Sea Turtles (Lepidochelys olivacea) at Nancite Beach, Costa Rica (1971-2007). Chelonian Conservation and Biology **8**:19-27.
Forbes, G. A. 1999. Diet Sampling and Diet Component Analysis. Research and Managment Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication.
Ford, J. K. B. 2002. Killer whale *Orcinus orca*. Pages 669-676 *in* W. F. Perrin, B. Würsig, and J. G. M. Thewissen, editors. Encyclopedia of marine mammals. Academic Press, San Diego, California.
Ford, J. K. B. and G. M. Ellis. 2005. Prey selection and food sharing by fish-eating 'resident' killer whales (Orcinus orca) in British Columbia. Department of Fisheries and Oceans, Canada, Canadian Science Advisory Secretariat 2005/041.
Ford, J. K. B. and G. M. Ellis. 2006. Selective foraging by fish-eating killer whales Orcinus orca in British Columbia. Marine Ecology Progress Series **316**:185-199.
Ford, J. K. B., G. M. Ellis, and K. C. Balcomb. 2000. Killer whales: The natural history and genealogy of *Orcinus orca* in British Columbia and Washington State, 2nd Edition. UBC Press, Vancouver, British Columbia.
Ford, J. K. B., G. M. Ellis, L. G. Barrett-Lennard, A. B. Morton, R. S. Palm, and K. C. Balcomb III. 1998. Dietary specialization in two sympatric populations of killer whale (*Orcinus orca*) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology **76**:1456-1471.
Ford, J. K. B. and R. R. Reeves. 2008. Fight or flight: antipredator strategies of baleen whales. Mammal Review **38**:50-86.
Forney, K. A. 2007. Preliminary estimates of cetacean abundance along the U.S. west coast and within four National Marine Sanctuaries during 2005. NOAA Technical Memorandum NMFS-SWFSC-406. U.S. Department of Commerce.
Forney, K. A., J. Barlow, and J. V. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fishery Bulletin **93**:15-26.
Forney, K. A. and R. L. Brownell, Jr. 1996. Preliminary report of the 1994 Aleutian Island marine mammal survey. Paper SC/48/011, South West Fisheries Science Center, La Jolla, CA.
Fossette, S., C. Girard, T. Bastian, B. Calmettes, S. Ferraroli, P. Vendeville, F. Blanchard, and J.-Y. Georges. 2009. Thermal and trophic habitats of the leatherback turtle during the nesting season in French Guiana. Journal of Experimental Marine Biology and Ecology.

Frair, W. R., G. Ackman, and N. Mrosovsky. 1972. Body temperature of Dermochelys coriacea: warm turtle from cold water. Science **177**:791-793.
Francour, P., A. Ganteaume, and M. Poulain. 1999. Effects of boat anchoring in Posidonia oceanica seagrass beds in the Port-Cros National Park (north-western Mediterranean Sea). Aquatic Conservation: Marine and Freshwater Ecosystems **9**:391-400.
Frazer, N. B. and L. M. Ehrhart. 1985. Preliminary growth models for green, *Chelonia mydas*, and loggerhead, *Caretta caretta*, turtles in the wild. Copeia **1985**:73-79.
Frazier, J., R. Arauz, J. Chevalier, A. Formia, J. Fretey, M. H. Godfrey, R. M.-. M., B. Pandav, and K. Shanker. 2007. Human-turtle interactions at sea. Pages 253-295 *in* P. T. Plotkin, editor. Biology and conservation of Ridley sea turtles. Johns Hopkins University Press, Baltimore, Maryland.
Fretey, J. 1999. Distribution of the turtles of the genus Lepidochelys Fitzinger, 1843. I. The western Atlantic. Biogeographica **75**:97-11.
Fretey, J. 2001. Biogeography and conservation of marine turtles of the Atlantic coast of Africa. CMS Technical Series Publication, No. 6, UNEP/CMS Secretariat, Bonn, Germany.
Fretey, J., A. Billes, and M. Tiwari. 2007. Leatherback, *Dermochelys coriacea*, nesting along the Atlantic coast of Africa. Chelonian Conservation and Biology **6**:126-129.
Fretey, J., A. Formia, J. Tomas, J. F. Dontaine, A. Billes, and H. Angoni. 2005. Presence, nesting, and conservation of Lepidochelys olivacea in the Gulf of Guinea. Page 172 *in* Twenty-first Annual Symposium on Sea Turtle Biology and Conservation.
Frid, A. 2003. Dall's sheep responses to overflights by helicopter and fixed-wing aircraft. Biological Conservation **110**:387-399.
Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology **6**:11.
Fritts, T. H., M. L. Stinson, and R. Márquez-M. 1982. Status of sea turtle nesting in southern Baja California, México. Bulletin of the Southern California Academy of Sciences **81**:51-60.
Fritz, L. W. and C. Stinchcomb. 2005. Aerial and ship-based surveys of Steller sea lions (Eumetopias jubatus) in the western stock in Alaska, June and July 2003 and 2004. U.S. Department of Commerce, NOAA.
Fujihara, J., T. Kunito, R. Kubota, and S. Tanabe. 2003. Arsenic accumulation in livers of pinnipeds, seabirds and sea turtles: Subcellular distribution and interaction between arsenobetaine and glycine betaine. Comparative Biochemistry and Physiology C-Toxicology & Pharmacology **136**:287-296.
Gabriele, C. M., J. M. Straley, and J. L. Neilson. 2007. Age at first calving of female humpback whales in southeastern Alaska. Marine Mammal Science **23**:226-239.
Gagnon, C. J. and C. W. Clark. 1993. The use of U.S. Navy IUSS passive sonar to monitor the movement of blue whales.Abstracts of the 10th Biennial Conference on the Biology of Marine Mammals, Galveston, TX. November 1993.
Gambell, R. 1976. World whale stocks. Mammal Review **6**:41-53.
Gambell, R. 1985a. Fin whale *Balaenoptera physalus* (Linnaeus, 1758). Pages 171-192 *in* S. H. Ridgway and R. Harrison, editors. Handbook of marine mammals, Volume 3: The sirenians and baleen whales. Academic Press, London, UK.
Gambell, R. 1985b. Sei whale *Balaenoptera borealis* (Lesson, 1828). Pages 193-240 *in* S. H. Ridgway and R. Harrison, editors. Handbook of Marine Mammals. Vol. 3: The sirenians and baleen whales. Academic Press, London, United Kingdom.
Gaos, A. R., I. L. Yañez, and R. M. Arauz. 2006. Sea turtle conservation and research on the Pacific coast of Costa Rica.
Garcia-Fernandez, A. J., P. Gomez-Ramirez, E. Martinez-Lopez, A. Hernandez-Garcia, P. Maria-Mojica, D. Romero, P. Jimenez, J. J. Castillo, and J. J. Bellido. 2009. Heavy metals in tissues from loggerhead turtles (Caretta caretta) from the southwestern Mediterranean (Spain). Ecotoxicology and Environmental Safety **72**:557-563.
Gardner, S. C., S. L. Fitzgerald, B. A. Vargas, and L. M. Rodriguez. 2006. Heavy metal accumulation in four species of sea turtles from the Baja California peninsula, Mexico. Biometals **19**:91-99.
Gardner, S. C., M. D. Pier, R. Wesselman, and J. A. Juarez. 2003. Organochlorine contaminants in sea turtles from the Eastern Pacific. Marine Pollution Bulletin **46**:1082-1089.
Garduño-Andrade, M. 1999. Nesting of the hawksbill turtle, Eretmochelys imbricata, in Río Lagartos, Yucatán, Mexico, 1990-1997. Chelonian Conservation and Biology **3**:281-285.

Gaskin, D. E. 1972. Whales, dolphins, and seals; with special reference to the New Zealand region.Heinemann, London. 200 pp.
Gaskin, D. E. 1973. Sperm whales in the western South Pacific. New Zealand Journal of Marine and Freshwater Research **7**:1-20.
Gauthier, J. and R. Sears. 1999. Behavioral response of four species of balaenopterid whales to biopsy sampling. Marine Mammal Science **15**:85-101.
Gauthier, J. M., C. D. Metcalfe, and R. Sears. 1997a. Chlorinated organic contaminants in blubber biopsies from Northwestern Atlantic Balaenopterid whales summering in the Gulf of St Lawrence. Marine Environmental Research **44**:201-223.
Gauthier, J. M., C. D. Metcalfe, and R. Sears. 1997b. Validation of the blubber biopsy technique for monitoring of organochlorine contaminants in Balaenopterid whales. Marine Environmental Research **43**:157-179.
Gelatt, T. and L. Lowry. 2008. *Eumetopias jubatus*. IUCN 2010. IUCN Red List of Threatened Species.
Gendron, D. and J. Urban. 1993. Evidence of feeding by humpback whales (Megaptera novaeangliae) in the Baja California breeding ground, Mexico. Marine Mammal Science **9**:76-81.
Gentry, R. L. 1970. Social behavior of the Steller sea lion. Doctoral dissertation. University of California at Santa Cruz, Santa Cruz, California.
Gerber, L. R., A. C. Keller, and D. P. DeMaster. 2007. Ten thousand, and increasing: Is the western Arctic population of bowhead whale endangered? Biological Conservation **137**:577-583.
Gilg, O. and E. W. Born. 2005. Recent sightings of the bowhead whale (Balaena mysticetus) in northeast Greenland and the Greenland Sea. Polar Biology **28**:796-801.
Gill, J. A., K. Norris, and W. J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation **97**:265-268.
Gless, J. M., M. Salmon, and J. Wyneken. 2008. Behavioral responses of juvenile leatherbacks Dermochelys coriacea to lights used in the longline fishery. Endangered Species Research **5**:239-247.
Glockner-Ferrari, D. A. and M. J. Ferrari. 1985. Individual identification, behavior, reproduction, and distribution of humpback whales, Megaptera novaeangliae, in Hawaii. U.S. Marine Mammal Commission, Washington, D.C.; National Technical Information Service, Springfield, Virginia: 36p.
Goddard, P. C. and D. J. Rugh. 1998. A group of right whales seen in the Bering Sea in July 1996. Marine Mammal Science **14**:344-349.
Godley, B., J. S. Richardson, A. C. Broderick, M. S. Coyne, F. Glen, and G. C. Hays. 2002. Long-term satellite telemetry of the movements and habitat utilization by green turtles in the Mediterranean. Ecography **25**:352-362.
Godley, B. J., D. R. Thompson, and R. W. Furness. 1999. Do heavy metal concentrations pose a threat to marine turtles from the Mediterranean Sea? Marine Pollution Bulletin **38**:497-502.
Godley, B. J., D. R. Thompson, S. Waldron, and R. W. Furness. 1998. The trophic status of marine turtles as determined by stable isotope analysis. Marine Ecology Progress Series **166**:277-284.
Godley, B. J. E., H. S. M. Lima, S. Akesson, A. C. Broderick, F. Glen, M. H. Godfrey, P. Luschi, and G. C. Hays. 2003. Movement patterns of green turtles in Brazilian coastal waters described by satellite tracking and flipper tagging. Marine Ecology Progress Series **253**:279-288.
Goodman, D. 2006. A PVA model for evaluating recovery criteria for the Western Steller sea lion population. National Marine Fisheries Service, Silver Spring, Maryland.
Goodyear, J. 1981. "Remora" tag effects the first tracking of an Atlantic humpback. P.46 In: Abstracts of the 4th Biennial Conference on the Biology of Marine Mammals, San Francisco, CA.
Goodyear, J. D. 1989. Night behavior and ecology of humpback whales (*Megaptera novaeangliae*) in the western North Atlantic. M.Sc. Thesis San Jose State University, San Jose, CA. 70p.
Goodyear, J. D. 1993. A sonic/radio tag for monitoring dive depths and underwater movements of whales. Journal of WIldlife Management **57**:503-513.
Goold, J. C., H. Whitehead, and R. J. Reid. 2002. North Atlantic Sperm Whale, *Physeter macrocephalus*, strandings on the coastlines of the British Isles and Eastern Canada. Canadian Field-Naturalist **116**:371-388.
Gordon, A. N., A. R. Pople, and J. Ng. 1998. Trace metal concentrations in livers and kidneys of sea turtles from south-eastern Queensland, Australia. Marine and Freshwater Research **49**:409-414.
Gordon, J. and A. Moscrop. 1996. Underwater noise pollution, and its significance for whales, and dolphins. Pages 281-319 *in* M. P. Simmonds and J. D. Hutchinson, editors. The conservation of whales and dolphins: Science and practice. John Wiley & Sons, Chichester, United Kingdom.

Gosho, M. E., D. W. Rice, and J. M. Breiwick. 1984. The sperm whale, *Physeter macrocephalus*. Marine Fisheries Review **46**:54-64.

Grant, G. S., P. Craig, and G. H. Balazs. 1997. Notes on juvenile hawksbill and green turtles in American Samoa. Pacific Science **51**:48-53.

Green, G. A., J. J. Brueggerman, R. A. Grotefendt, C. E. Bowlby, M. L. Bonnell, and K. C. Balcomb III. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Oregon and Washington Marine Mammal and Seabird Surveys. Minerals Management Service Contract Report 14-12-0001-30426.

Greer, A. E., J. D. Lazell Jr., and R. M. Wright. 1973. Anatomical evidence for counter-current heat exchanger in the leatherback turtle (*Dermochelys coriacea*). Nature **244**:181.

Gregory, S. V. and P. A. Bisson. 1997. Degradation and loss of anadromous salmonid habitat in the Pacific Northwest. Pages 277-314 *in* D. J. Stouder, P. A. Bisson, and R. J. Naiman, editors. Pacific salmon and their ecosystems: Status and future options. Chapman & Hall, New York, NY.

Gregr, E. J. and K. O. Coyle. 2009. The biogeography of the North Pacific right whale (*Eubalaena japonica*). . Progress in Oceanography **20-Mar**:188-198.

Gregr, E. J., L. Nichol, J. K. B. Ford, G. Ellis, and A. W. Trites. 2000. Migration and population structure of northeastern Pacific whales off coastal British Columbia: an analysis of commercial whaling records from 1908-1967. Marine Mammal Science **16**:699-727.

Hain, J. H. W., G. R. Carter, S. D. Kraus, C. A. Mayo, and H. E. Winn. 1982. Feeding behavior of the humpback whale, *Megaptera novaeangliae,* in the western North Atlantic. Fishery Bulletin **80**:259-268.

Hain, J. H. W., S. L. Ellis, R. D. Kenney, P. J. Clapham, B. K. Gray, M. T. Weinrich, and I. G. Babb. 1995. Apparent bottom feeding by humpback whales on Stellwagen Bank. Marine Mammal Science **11**:464-479.

Hain, J. H. W., W. A. M. Hyman, R. D. Kenney, and H. E. Winn. 1985. The role of cetaceans in the shelf-edge region of the U.S. Marine Fisheries Review **47**:13-17.

Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Report of the International Whaling Commission **42**:653-669.

Hall, J. D. 1982. Prince William Sound, Alaska: Humpback whale population and vessel traffic study. Final Report, Contract No. 81-ABG-00265. NMFS, Juneau Management Office, Juneau, Alaska. 14p.

Hamann, M., C. Limpus, G. Hughes, J. Mortimer, and N. Pilcher. 2006. Assessment of the conservation status of the leatherback turtle in the Indian Ocean and South East Asia, including consideration of the impacts of the December 2004 tsunami on turtles and turtle habitats. IOSEA Marine Turtle MoU Secretariat, Bangkok.

Hansen, L. J., K. D. Mullin, T. A. Jefferson, and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. In: R. W. Davis and G. S. Fargion (eds). Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report:OCS Study MMS 96- 0027, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. p.0055-0132.

Hanson, M. B., R. Andrews, D., G. S. Schorr, R. W. Baird, D. Webster, L., and D. J. McSweeney. 2008. Re-sightings, healing, and attachment performance of remotely-deployed dorsal fin-mounted tags on Hawaiian odontocetes. Document PSRG-2008-10 submitted to the Pacific Scientific Review Group, Kihei, HI, November 2008.

Hanson, M. B., R. W. Baird, and G. S. Schorr. 2005. Focal behavioral observations and fisheating killer whales: improving our understanding of foraging behavior and prey selection.*in* 16th Biennial Conference on the Biology of Marine Mammals.

Hatase, H., M. Kinoshita, T. Bando, N. Kamezaki, K. Sato, Y. Matsuzawa, K. Goto, K. Omuta, Y. Nakashima, H. Takeshita, and W. Sakamoto. 2002. Population structure of loggerhead turtles, *Caretta caretta,* nesting in Japan: bottlenecks on the Pacific population. Marine Biology **141**:299-305.

Hatase, H., K. Sato, M. Yamaguchi, K. Takahashi, and K. Tsukamoto. 2006. Individual variation in feeding habitat use by adult female green sea turtles (Chelonia mydas): Are they obligately neritic herbivores? Oecologia **149**:52-64.

Hauser, D. D. W., M. G. Logsdon, E. E. Holmes, G. R. Vanblaricom, and R. W. Osborne. 2007. Summer distribution patterns of southern resident killer whales *Orcinus orca*: Core areas and spatial segregation of social groups. Marine Ecology Progress Series **351**:301-310.

Hawkes, L. A., A. Broderick, M. H. Godfrey, and B. J. Godley. 2007a. The potential impact of climate change on loggerhead sex ratios in the Carolinas - how important are North Carolina's males? P.153 *in*: Frick, M.; A. Panagopoulou; A.F. Rees; K. Williams (compilers), 27th Annual Symposium on Sea Turtle Biology and Conservation [abstracts]. 22-28 February 2007, Myrtle Beach, South Carolina. 296p.
Hawkes, L. A., A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2007b. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology **13**:1-10.
Hays, G. C., J. D. R. Houghton, and A. E. Myers. 2004. Pan-Atlantic leatherback turtle movements. Nature **429**:522.
Hazel, J. 2009. Evaluation of fast-acquisition GPS in stationary tests and fine-scale tracking of green turtles. Journal of Experimental Marine Biology and Ecology **374**:58-68.
Hazel, J., I. R. Lawler, and M. Hamann. 2009. Diving at the shallow end: Green turtle behaviour in near-shore foraging habitat. Journal of Experimental Marine Biology and Ecology **371**:84-92.
Heide-Jorgensen, M. P., K. L. Laidre, D. Borchers, F. Samarra, and H. Stern. 2007. Increasing abundance of bowhead whales in West Greenland. Biology Letters **3**:577-580.
Heide-Jorgensen, M. P. K. L. L. M. V. J. L. D. and L. D. Postma. 2006. Dissolving stock discreteness with satellite tracking: Bowhead whales in Baffin Bay. Marine Mammal Science **22**:34-45.
Heimlich-Boran, J. R. 1988. Behavioral ecology of killer whales (Orcinus orca) in the Pacific Northwest. Canadian Journal of Zoology **66**:565-578.
Heithaus, M. R., J. J. McLash, A. Frid, L. M. Dill, and G. J. Marshall. 2002. Novel insights into green sea turtle behaviour using animal-borne video cameras. Journal of the Marine Biological Association of the United Kingdom **82**:1049-1050.
Henry, J. and P. B. Best. 1983. Organochlorine residues in whales landed at Durban, South Africa. Marine Pollution Bulletin **14**:223-227.
Heppell, S. S., M. L. Snover, and L. B. Crowder. 2003. Sea turtle population ecology. Chapter 11 In: Lutz, P.L., J.A. Musick, and J. Wyneken (eds), The Biology of Sea Turtles: Volume II. CRC Press. Pp.275-306.
Herman, L. M., C. S. Baker, P. H. Forestell, and R. C. Antinoja. 1980. Right whale, Balaena glacialis, sightings near Hawaii: A clue to the wintering grounds? Marine Ecology Progress Series **2**:271-275.
Hill, P. S. and D. P. DeMaster. 1998. Alaska marine mammal stock assessments, 1998.
Hillis-Starr, Z. M. Coyne, and M. Monaco. 2000. Buck Island and back: Hawksbill turtles make their move. Page 159 *in* Nineteenth Annual Symposium on Sea Turtle Biology and Conservation.
Hirth, H. F. 1997. Synopsis of the biological data on the green turtle, Chelonia mydas (Linnaeus 1758).
Hjort, J. and J. T. Ruud. 1929. Whaling and fishing in the North Atlantic. Permanent International pour l'Exploration de la Mer. Rapports et Proces-Verbaux des Reunions **56**:1-123.
Hodge, R. P. and B. L. Wing. 2000. Occurrences of marine turtles in Alaska waters: 1960-1998. Herpetological Review **31**:148-151.
Holt, M. M., D. P. Noren, V. Veirs, C. K. Emmons, and S. Veirs. 2009. Speaking up: Killer whales (Orcinus orca) increase their call amplitude in response to vessel noise. Journal of the Acoustical Society of America **125**:El27-El32.
Hooker, S. K., R. W. Baird, S. Al-Omari, S. Gowans, and H. Whitehead. 2001. Behavioral reactions of northern bottlenose whales (*Hyperoodon ampullatus*) to biopsy darting and tag attachment procedures. Fishery Bulletin **99**:303-308.
Hooker, S. K., M. Biuw, B. J. McConnell, P. J. O. Miller, and C. E. Sparling. 2007. Bio-logging science: Logging and relaying physical and biological data using animal-attached tags. Deep-Sea Research II **54**:177-182.
Hornell, J. 1927. The turtle fisheries of the Seychelles Islands. H.M. Stationery Office, London, UK.
Horrocks, J. A. and N. Scott. 1991. Nest site location, and nest success in the hawksbill turtle Eretmochelys imbricata in Barbados, West Indies. Marine Ecology Progress Series **69**:1-8.
Horrocks, J. A., L. A. Vermeer, B. Krueger, M. Coyne, B. A. Schroeder, and G. H. Balazs. 2001. Migration routes and destination characteristics of post-nesting hawksbill turtles satellite-tracked from Barbados, West Indies. Chelonian Conservation and Biology **4**:107-114.
Hucke-Gaete, R., L. Osman, C. Moreno, K. P. Findlay, and D. Ljungblad. 2004. Discovery of a blue whale feeding and nursing ground in southern Chile. Proceedings of the Royal Society of London Series B-Biological Sciences **271**:S170-S173.

Hughes, D. A. and J. D. Richard. 1974. The nesting of the Pacific ridley turtle Lepidochelys olivacea on Playa Nancite, Costa Rica. Marine Biology **24**:97-107.

Hulin, V., V. Delmas, M. Girondot, M. H. Godfrey, and J. M. Guillon. 2009. Temperature-dependent sex determination and global change: are some species at greater risk? Oecologia **160**:493-506.

Hutchinson, B. J. and P. Dutton. 2007. Modern genetics reveals ancient diversity in the loggerhead.

Ingebrigtsen, A. 1929. Whales caught in the North Atlantic and other seas. Conseil Permanent International pour l'Exploration de la Mer. Rapports et Proces-Verbaux des Reunions **56**:123–135.

Ischer, T., K. Ireland, and D. T. Booth. 2009. Locomotion performance of green turtle hatchlings from the Heron Island Rookery, Great Barrier Reef. Marine Biology **156**:1399-1409.

Islam, M. Z. 2002. Marine turtle nesting at St. Martin's Island, Bangladesh. Marine Turtle Newsletter **96**:19-21.

IWC. 1980. Sperm Whales. Report of the International Whaling Commission:245p.

IWC. 1990. Report of the Scientific Committee. Report of the International Whaling Commission **40**:39-179.

IWC. 1992. Chairman's report of the forty-third annual meeting. Reports of the International Whaling Commission **42**:11-50.

IWC. 2001. Report of the workshop on status and trends in Western North Atlantic right whales: a worldwide comparison. Journal of Cetacean Research and Management **Special Issue 2**:1-60.

IWC. 2004. Report of the sub-committee on bowhead, right, and gray whales. International Whaling Commission.

IWC. 2006. Scientific permit whaling: Information on scientific permits, review procedure guidelines, and current permits in effect. International Whaling Commission, http://www.iwcoffice.org/conservation/permits.htm Accessed: 3/14/2007.

IWC. 2007. Whale Population Estimates. International Whaling Commission. Accessed 02/07/2007 online at: http://www.iwcoffice.org/conservation/estimate.htm.

Jahoda, M., C. L. Lafortuna, N. Biassoni, C. Almirante, A. Azzellino, S. Panigada, M. Zanardelli, and G. N. Di Sciara. 2003. Mediterranean fin whale's (*Balaenoptera physalus*) response to small vessels and biopsy sampling assessed through passive tracking and timing of respiration. Marine Mammal Science **19**:96-110.

James, M. C., S. A. Eckert, and R. A. Myers. 2005. Migratory and reproductive movements of male leatherback turtles (*Dermochelys coriacea*). Marine Biology **147**:845-853.

James, M. C., C. A. Ottensmeyer, S. A. Eckert, and R. A. Myers. 2006. Changes in the diel diving patterns accompany shifts between northern foraging and southward migration in leatherback turtles. . Canadian Journal of Zoology **84**:754-765.

Jaquet, N. and H. Whitehead. 1996. Scale-dependent correlation of sperm whale distribution with environmental features and productivity in the South Pacific. Marine Ecology Progress Series **135**:1-9.

Jaquet, N., H. Whitehead, and M. Lewis. 1996. Coherence between 19th century sperm whale distributions and satellite-derived pigments in the tropical Pacific. Marine Ecology Progress Series **145**:1-10.

Jefferson, T. A. P. J. S. and R. W. Baird. 1991. A review of killer whale interactions with other marine mammals: Predation to co-existence. Mammal Review **21**:151-180.

Johnson, J. H. and A. A. Wolman. 1984. The humpback whale, *Megaptera novaeangliae.* Marine Fisheries Review **46**:30-37.

Jones, R. E. 1981. Food habits of smaller marine mammals from northern California. Proceedings of the California Academy of Science **42**:409-433.

Jonsgård, A. 1966. Biology of the North Atlantic fin whale Balaenoptera physalus (L.): Taxonomy, distribution, migration, and food. Hvalrdets Skrifter **49**:1-62.

Jurasz, C. M. and V. Jurasz. 1979. Feeding modes of the humpback whale, Megaptera novaeangliae, in southeast Alaska. Scientific Reports of the Whales Research Institute, Tokyo **31**:69-83.

Kalb, H. and D. Owens. 1994. Differences between solitary and arribada nesting olive ridley females during the internesting period. Page 68 *in* Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351.

Kalb, H., R. A. Valverde, and D. Owens. 1995. What is the reproductive patch of the olive ridley sea turtle? Pages 57-60 *in* Twelfth Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-361.

Kalb, H. J. 1999. Behavior and physiology of solitary and arribada nesting olive ridley sea turtles (*Lepidochelys olivacea*) during the internesting period. Doctoral dissertation. Texas A&M University, College Station, Texas.

Kamel, S. J. and E. Delcroix. 2009. Nesting Ecology of the Hawksbill Turtle, Eretmochelys imbricata, in Guadeloupe, French West Indies from 2000-07. Journal of Herpetology **43**:367-376.

Kamezaki, N., Y. Matsuzawa, O. Abe, H. Asakawa, T. Fujii, K. Goto, S. Hagino, M. Hayami, M. Ishii, T. Iwamoto, T. Kamata, H. Kato, J. Kodama, Y. Kondo, I. Miyawaki, K. Mizobuchi, Y. Nakamura, Y. Nakashima, H. Naruse, K. Omuta, M. Samejima, H. Suganuma, H. Takeshita, T. Tanaka, T. Toji, M. Uematsu, A. Yamamoto, T. Yamato, and I. Wakabayashi. 2003. Loggerhead turtles nesting in Japan. Pages 210-217 *in* A. B. Bolten and B. E. Witherington, editors. Loggerhead sea turtles. Smithsonian Books, Washington D.C.

Karnad, D., K. Isvaran, C. S. Kar, and K. Shanker. 2009. Lighting the way: Towards reducing misorientation of olive ridley hatchlings due to artificial lighting at Rushikulya, India. Biological Conservation **142**:2083-2088.

Kasuya, T. 1991. Density dependent growth in North Pacific sperm whales. Marine Mammal Science **7**:230-257.

Kasuya, T. and T. Miyashita. 1988. Distribution of sperm whale stocks in the North Pacific. Scientific Reports of the Whales Research Institute, Tokyo **39**:31-75.

Katona, S. K. and J. A. Beard. 1990. Population size, migrations and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic Ocean. Report of the International Whaling Commission:295-306.

Kawamura, A. 1974. Food and feeding ecology of the southern sei whale. Scientific Reports of the Whales Research Institute, Tokyo **26**:25-144.

Kawamura, A. 1980. A review of food of balaenopterid whales. Scientific Reports of the Whales Research Institute **32**:155-197.

Kawamura, A. 1982a. Food habits and prey distributions of three rorqual species in the North Pacific Ocean. Scientific Reports of the Whales Research Institute, Tokyo **34**:59-91.

Kawamura, A. 1982b. A review of food of balaenopterid whales. Scientific Report to the Whales Research Institute **32**:155–197.

Kawamura, G., T. Naohara, Y. Tanaka, T. Nishi, and K. Anraku. 2009. Near-ultraviolet radiation guides the emerged hatchlings of loggerhead turtles Caretta caretta (Linnaeus) from a nesting beach to the sea at night. Marine and Freshwater Behaviour and Physiology **42**:19-30.

Keller, J. M., K. Kannan, S. Taniyasu, R. D. Day, M. D. Arendt, A. L. Segars, and J. R. Kucklick. 2005. Perfluorinated compounds in the plasma of loggerhead and Kemp's ridley sea turtles from the southeastern coast of the United States. Environmental Science and Technology **39**:9101-9108.

Keller, J. M., J. R. Kucklick, C. A. Harms, and P. D. McClellan-Green. 2004a. Organochlorine contaminants in sea turtles: Correlations between whole blood and fat. Environmental Toxicology and Chemistry **23**:726-738.

Keller, J. M., J. R. Kucklick, and P. D. McClellan-Green. 2004b. Organochlorine contaminants in loggerhead sea turtle blood: Extraction techniques and distribution among plasma, and red blood cells. Archives of Environmental Contamination and Toxicology **46**:254-264.

Keller, J. M., J. R. Kucklick, M. A. Stamper, C. A. Harms, and P. D. McClellan-Green. 2004c. Associations between organochlorine contaminant concentrations and clinical health parameters in loggerhead sea turtles from North Carolina, USA. Environmental Health Parameters **112**:1074-1079.

Keller, J. M., P. D. McClellan-Green, J. R. Kucklick, D. E. Keil, and M. M. Peden-Adams. 2006. Turtle immunity: Comparison of a correlative field study and in vitro exposure experiments. Environmental Health Perspectives **114**:70-76.

Kenney, R. D. 2002. North Atlantic, North Pacific, and southern right whales. Pages 806-813 *in* W. F. Perrin, B. Würsig, and J. G. M. Thewissen, editors. Encyclopedia of marine mammals. Academic Press, San Diego, California.

Kenney, R. D., M. A. M. Hyman, and H. E. Winn. 1985. Calculation of standing stocks and energetic requirements of the cetaceans of the northeast United States Outer Continental Shelf., NOAA Technical Memorandum NMFS-F/NEC-41. 99pp.

Kenyon, K. W. 1962. History of the Steller sea lion at the Pribilof Islands, Alaska. Journal of Mammology **43**:68-75.

Kjeld, M., Ö. Ólafsson, G. A. Víkingsson, and J. Sigurjónsson. 2006. Sex hormones and reproductive status of the North Atlantic fin whale (*Balaenoptera physalus*) during the feeding season. Aquatic Mammals **32**:75-84.

Knowlton, A. R., S. D. Kraus, and R. D. Kenney. 1994. Reproduction in North Atlantic right whales (Eubalaena glacialis). Canadian Journal of Zoology **72**:1297-1305.

Kopitsky, K., R. L. Pitman, and P. H. Dutton. 2002. Reproductive ecology of olive ridleys in the open ocean in the eastern tropical Pacific. Pp.90-91 *In:* Mosier, A., A. Foley, and B. Brost (Compilers), Proceedings of the 20th Annual Symposium on Sea Turtle Biology and Conservation. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-477.

Kopitsky, K., R. L. Pitman, and P. Plotkin. 2000. Investigations on at-sea mating and reproductive status of olive ridleys, Lepidochelys olivacea, captured in the eastern tropical Pacific. Pages 160-162 *in* Nineteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-443.

Kopitsky, K. L., R. L. Pitman, and P. H. Dutton. 2005. Aspects of olive ridley feeding ecology in the eastern tropical Pacific. Page 217 *in* Twenty-first Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-528.

Koski, K. 2004. Final Program Report: Soundwatch Public Outreach/Boater Education Project. The Whale Museum, Friday Harbor, Washington.

Koski, K. 2006. 2004-2005 Final Program Report: Soundwatch Public Outreach/Boater Education Project. The Whale Museum, Friday Harbor, Washington.

Koski, K. 2007. 2006. The Whale Museum, Friday Harbor, Washington.

Krahn, M., M. J. Ford, W. F. Perrin, P. R. Wade, R. P. Angliss, M. B. Hanson, B. L. Taylor, G. M. Ylitalo, M. E. Dahlheim, J. E. Stein, and R. S. Waples. 2004a. 2004 Status review of Southern Resident killer whales (*Orcinus orca*) under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-62. U.S. Department of Commerce.

Krahn, M. M. 1997. Chapter 5: Chlorinated hydrocarbon and DDT analyses of blubber from Steller sea lions from southeast Alaska *in* K. W. Pitcher, editor. Steller sea lion recovery investigation in Alaska 1995-1996. Alaska Department of Fish and Game.

Krahn, M. M., K. B. Beckmen, P. W. Pitcher, and K. A. Burek. 2004b. Population survey of organochlorine contaminants in blubber of four seal species: integrating biomonitoring and specimen banking. Chemosphere **34**:2109-2121.

Krahn, M. M., M. B. Hanson, G. S. Schorr, C. K. Emmons, D. G. Burrows, J. L. Bolton, R. W. Baird, and G. M. Ylitalo. 2009. Effects of age, sex and reproductive status on persistent organic pollutant concentrations in ‘‘Southern Resident” killer whales. Marine Pollution Bulletin.

Krahn, M. M., P. R. Wade, S. T. Kalinowski, M. E. Dahlheim, B. L. Taylor, M. B. Hanson, G. M. Ylitalo, R. P. Angliss, J. E. Stein, and R. S. Waples. 2002. Status review of Southern Resident killer whales (*Orcinus orca*) under the Endangered Species Act. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-54, 133p.

Krishna, S. 2005. Sporadic nesting of olive ridley turtles (*Lepidochelys olivacea*) and efforts to conserve them along the coast of Karnataka (South West India). Pages 218-219 *in* Twenty-first Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-528.

Kucey, L. 2005. Human Disturbance and the Hauling Out Behavior of Steller Sea Lions (*Eumetopias jubatus*). University of British Columbia.

Lackey, R. T. 2003. Pacific Northwest salmon: Forecasting their status in 2100. Reviews in Fisheries Science **11**:35-88.

Ladrón De Guevara, P. P., B. E. Lavaniegos, and G. Heckel. 2008. Fin whales (Balaenoptera physalus) foraging on daytime surface swarms of the euphausiid Nyctiphanes simplex in Ballenas Channel, Gulf of California, Mexico. Journal of Mammalogy **89**:559-566.

Lagueux, C. J., C. L. Campbell, and W. A. McCoy. 2003. Nesting, and conservation of the hawksbill turtle, Eretmochelys imbricata, in the Pearl Cays, Nicaragua. Chelonian Conservation and Biology **4**:588-602.

Lambertsen, R. H. 1986. Disease of the common fin whale (*Balaenoptera physalus*): Crassicaudiosis of the urinary system. Journal of Mammalogy **67**:353-366.

Lambertsen, R. H. 1992. Crassicaudosis: a parasitic disease threatening the health and population recovery of large baleen whales. Rev. Sci. Technol., Off. Int. Epizoot. **11**:1131-1141.

Lambertsen, R. H., B. A. Kohn, J. P. Sundberg, and C. D. Buergelt. 1987. Genital papillomatosis in sperm whale bulls. Journal of Wildlife Diseases **23**:361-367.
Law, R. J., R. L. Stringer, C. R. Allchin, and B. R. Jones. 1996. Metals and organochlorines in sperm whales (Physeter macrocephalus) stranded around the North Sea during the 1994/1995 winter. Marine Pollution Bulletin **32**:72-77.
Leatherwood, S., R. R. Reeves, W. F. Perrin, and W. E. Evans. 1982. Whales, dolphins, and porpoises of the eastern North Pacific and adjacent Arctic waters: a guide to their identification.U.S. Department of Commerce, NOAA Technical Report NMFS Circular 444. 245p.
Leblanc, A. M. and T. Wibbels. 2009. Effect of Daily Water Treatment on Hatchling Sex Ratios in a Turtle With Temperature-Dependent Sex Determination. Journal of Experimental Zoology Part a-Ecological Genetics and Physiology **311A**:68-72.
Lee, J. S., S. Tanabe, H. Umino, R. Tatsukawa, T. R. Loughlin, and D. C. Calkins. 1996. Persistent Organochlorines in Steller Sea Lion (*Eumetopias jubatus*) from the Bulk of Alaska and the Bering Sea, 1976-1981. Marine Pollution Bulletin **32**:535.
Lee Long, W. J., R. G. Coles, and L. J. McKenzie. 2000. Issues for seagrass conservation management in Queensland. Pacific Conservation Biology **5**:321-328.
Lee, T. 1993. Summary of cetacean survey data collected between the years of 1974 and 1985.
León, Y. M. and K. A. Bjorndal. 2002. Selective feeding in the hawksbill turtle, an important predator in coral reef ecosystems. Marine Ecology Progress Series **245**:249-258.
León, Y. M. and C. E. Diez. 1999. Population structure of hawksbill turtles on a foraging ground in the Dominican Republic. Chelonian Conservation and Biology **3**:230-236.
LGL Ltd. 2007. Environmental Assessment of a Marine Geophysical Survey by the *R/V Marcus G. Langseth* off Central America, January–March 2008. Prepared for the Lamont-Doherty Earth Observatory, Palisades, NY, and the National Science Foundation, Arlington, VA, by LGL Ltd., environmental research associates, Ontario, Canada. LGL Report TA4342-1.
Lichatowich, J. A. 1999. Salmon without rivers. A history of the Pacific salmon crisis. Island Press, Washington, D.C.
Lien, J. 1994. Entrapments of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979-1990). Reports of the International Whaling Commission Special Issue **15**:149-157.
Lima, S. L. 1998. Stress and decision making under the risk of predation. . Advances in the Study of Behavior **27**:215-290.
Limpus, C. 2002. Conservation, and research of sea turtles in the western Pacific region: an overview. Pages 41-50 *in* Western Pacific Sea Turtle Cooperative Research and Management Workshop. . Western Pacific Regional Fishery Management Council, Honolulu, Hawaii.
Limpus, C. and M. Chaloupka. 1997. Nonparametric regression modeling of green sea turtle growth rates (southern Great Barrier Reef). Marine Ecology Progress Series **149**:23-34.
Limpus, C. J. 1985. A study of the loggerhead turtle, Caretta caretta, in eastern Australia. PhD thesis. University of Queensland, Brisbane, Australia.
Limpus, C. J. 1995. Global overview of the status of marine turtles: A 1995 viewpoint. Pages 605-609 *in* K. Bjorndal, editor. Biology and conservation of sea turtles, revised edition. Smithsonian Institution Press, Washington, D.C.
Limpus, C. J. 2004. A biological review of Australian marine turtles. III. Hawksbill turtle, Eretmochelys imbricata (Linnaeus). Department of Environment and Heritage and Queensland Environmental Protection Agency.
Limpus, C. J. and D. J. Limpus. 2003. Loggerhead turtles in the equatorial, and southern Pacific Ocean: A species in decline. Pages 199-209 *in* A. B. Bolten and B. E. Witherington, editors. Loggerhead sea turtles. Smithsonian Books, Washington D.C.
Limpus, C. J. and J. D. Miller. 2000. Final report for Australian hawksbill turtle population dynamics project.
Limpus, C. J. and N. Nicholls. 1988. The Southern Oscillation regulates the annual numbers of green turtles (Chelonia mydas) breeding around northern Australia. Australian Journal of Wildlife Research **15**:157-161.
Little, A. D. 1964. Feasibility of a commercial sea lion operation in Alaska. Report for U.S. Bureau of Indian Affairs. 145 pp.
Lockyer, C. 1972. The age at sexual maturity of the southern fin whale (Balaenoptera physalus) using annual layer counts in the ear plug. J. Cons. Int. Explor. Mer **34**:276-294.

Lockyer, C. 1981. Estimates of growth and energy budget for the sperm whale, Physeter catodon. FAO Fisheries Series **5**:489-504.
Loughlin, T. R. 1997. Using the phylogeographic method to identify Steller sea lion stocks. Pages 159-171 *in* A. E. Dizon, S. J. Chivers, and W. F. Perrin, editors. Molecular genetics of marine mammals. Society for Marine Mammalogy
Loughlin, T. R. and R. Nelson Jr. 1986. Incidental mortality of northern sea lions in Shelikof Strait, Alaska. Marine Mammal Science **2**:14-33.
Loughlin, T. R., M. A. Perez, and R. L. Merrick. 1987. *Eumetopias jubatus*. Mammalian Species Account No. 283.
Loughlin, T. R., D. J. Rugh, and C. H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-80. Journal of Wildlife Management **48**:729-740.
Lowry, L. F. 1993. Foods and feeding ecology. Pages 201-238 *in* J. J. Burns, J. J. Montague, and C. J. Cowles, editors. The bowhead whale. . Society of Marine Mammals, Lawrence, Kansas.
Lusseau, D. 2004. The hidden cost of tourism: detecting long-term effects of tourism using behavioral information. Ecology and Society **9**:2.
Lutcavage, M. E., P. Plotkin, B. E. Witherington, and P. L. Lutz. 1997. Human impacts on sea turtle survival. Pages 387-409 *in* P. L. Lutz and J. A. Musick, editors. Biology of sea turtles. CRC Press, New York, NY.
Lyrholm, T. and U. Gyllensten. 1998. Global matrilineal population structure in sperm whales as indicated by mitochondrial DNA sequences. Proceedings of the Royal Society of London B **265**:1679-1684.
Lyrholm, T., O. Leimar, and U. Gyllensten. 1996. Low diversity and biased substitution patterns in the mitochondrial DNA control region of sperm whales: implications for estimates of time since common ancestry. Molecular Biology and Evolution **13**:1318-1326.
Lyrholm, T., O. Leimar, B. Johanneson, and U. Gyllensten. 1999. Sex-biased dispersal in sperm whales: Contrasting mitochondrial and nuclear genetic structure of global populations. Transactions of the Royal Society of London, Series B: Biological Sciences **266**:347-354.
Makowski, C., J. A. Seminoff, and M. Salmon. 2006. Home range and habitat use of juvenile Atlantic green turtles (Chelonia mydas L.) on shallow reef habitats in Palm Beach, Florida, USA. Marine Biology **148**:1167-1179.
Malme, C. I., P. R. Miles, C. W. Clark, P. Tyack, and J. E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior: phase II: January 1984 migration. 5586, U.S. Department of Interior, Minerals Management Service, Alaska OCS Office.
Malme, C. I., P. R. Miles, G. W. Miller, W. J. Richardson, D. G. Roseneau, D. H. Thomson, and C. R. Green Jr. 1989. Analysis and ranking of the acoustic disturbance potential of petroleum industry activities and other sources of noise in the environment of marine mammals in Alaska. 6945, Minerals Management Service, U.S. Department of the Interior.
Marcovaldi, M. A. and M. Chaloupka. 2007. Conservation status of the loggerhead sea turtle in Brazil: An encouraging outlook. Endangered Species Research **3**:133-143.
Márquez, M. R. 1990. Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Species Catalog, FAO Fisheries Synopsis 11(125):81p. .
Márquez, M. R., M. A. Carrasco, M. C. Jimenez, C. P.-. S., and R. Bravo-G. 2005. Kemp's, and olive ridley sea turtles populations status. Pages 273-239 *in* Twenty-first Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-528.
Márquez, M. R., C. Peñaflores, and J. Vasconcelos. 1996. Olive ridley turtles (Lepidochelys olivacea) show signs of recovery at La Escobilla, Oaxaca. Marine Turtle Newsletter **73**:5-7.
Marsili, L. and S. Focardi. 1996. Organochlorine levels in subcutaneous blubber biopsies of fin whales (Balaenoptera physalus) and striped dolphins (Stenella coeruleoalba) from the Mediterranean Sea. Environmental Pollution **91**:1-9.
Martin, A. R. and M. R. Clarke. 1986. The diet of sperm whales (Physeter macrocephalus) between Iceland and Greenland. Journal of the Marine Biological Association of the United Kingdom **66**:779-790.
Masaki, Y. 1976. Biological studies on the North Pacific sei whale. Bulletin of Far Seas Fishery Research **14**:1-104.
Masaki, Y. 1977. The separation of the stock units of sei whales in the North Pacific. Report of the International Whaling Commission:71-79.

Maser, C., B. R. Mate, J. F. Franklin, and C. T. Dyrness. 1981. Natural History of Oregon Coast Mammals.U.S. Department of Agriculture, Forest Service, General Technical Report PNW-133. 524p.

Mate, B., R. Mesecar, and B. Lagerquist. 2007. The evolution of satellite-monitored radio tags for large whales: One laboratory's experience. Deep Sea Research II **54**:224-247.

Mate, B. R., R. Gisiner, and J. Mobley. 1998. Local and migratory movements of Hawaiian humpback whales tracked by satellite telemetry. Canadian Journal of Zoology **76**:863-868.

Mate, B. R., B. A. Lagerquist, and J. Calambokidis. 1999. Movements of North Pacific blue whales during the feeding season off southern California and their southern fall migration. Marine Mammal Science **15**:1246-1257.

Mate, B. R., S. L. Nieukirk, and S. D. Kraus. 1997. Satellite-monitored movements of the northern right whale. Journal of WIldlife Management **61**:1393-1405.

Mathisen, O. A. 1959. Studies on Steller sea lions *Eumetopias jubatus* in Alaska. Transactions of the North American Wildlife and Natural Resources Conference **24**:346-356.

Matkin, C. O., G. Ellis, L. Barrett-Lennard, H. Yurk, E. Saulitis, D. Scheel, P. Olesiuk, and G. Ylitalo. 2003. Photographic and acoustic monitoring of killer whales in Prince William Sound and Kenai Fjords. North Gulf Oceanic Society, Homer, Alaska.

Matkin, C. O., D. R. Matkin, G. M. Ellis, E. Saulitis, and D. McSweeney. 1997. Movements of resident killer whales in southeastern Alaska and Prince William Sound, Alaska. Marine Mammal Science **13**:469-475.

Mazaris, A. D., A. S. Kallimanis, J. Tzanopoulos, S. P. Sgardelis, and J. D. Pantis. 2009. Sea surface temperature variations in core foraging grounds drive nesting trends and phenology of loggerhead turtles in the Mediterranean Sea. Journal of Experimental Marine Biology and Ecology.

McKenzie, C., B. J. Godley, R. W. Furness, and D. E. Wells. 1999. Concentrations and patterns of organochlorine contaminants in marine turtles from Mediterranean and Atlantic waters. Marine Environmental Research **47**:117-135.

McKenzie, J. and K. M. Wynne. 2008. Spatial and temporal variation in the diet of Steller sea lions in the Kodiak Archipelago, 1999 to 2005. Marine Ecology Progress Series **360**:265-283.

McMahon, C. R. and G. C. Hays. 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. Global Change Biology **12**:1330-1338.

Mellgren, R. L. and M. A. Mann. 1996. Comparative behavior of hatchling sea turtles. Pages 202-204 *in* Fifteenth Annual Symposium on Sea Turtle Biology and Conservation.

Mellgren, R. L., M. A. Mann, M. E. Bushong, S. R. Harkins, and V. K. Krumke. 1994. Habitat selection in three species of captive sea turtle hatchlings. Pages 259-260 *in* Fourteenth Annual Symposium on Sea Turtle Biology and Conservation.

Merrick, R. L. and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the year Steller sea lions in Alaskan waters. Canadian Journal of Zoology **75**:776-786.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in 1954-1986. U.S. Fishery Bulletin **85**:351-365.

Metcalfe, C., B. Koenig, T. Metcalfe, G. Paterson, and R. Sears. 2004. Intra- and inter-species differences in persistent organic contaminants in the blubber of blue whales and humpback whales from the Gulf of St. Lawrence, Canada. Marine Environmental Research **57**:245–260.

Meylan, A. 1988. Spongivory in hawksbill turtles: A diet of glass. Science **239**:393-395.

Meylan, A. B., B. W. Bowen, and J. C. Avise. 1990. A genetic test of the natal homing versus social facilitation models for green turtle migration. Science **248**:724-727.

Miao, X., G. H. Balazsb, S. K. K. Murakawa, and Q. X. Li. 2001. Congener-specific profile, and toxicity assessment of PCBs in green turtles (Chelonia mydas)from the Hawaiian Islands. The Science of the Total Environment **281**:247-253.

Mikhalev, Y. A. 1997. Humpback whales *Megaptera novaeangliae* in the Arabian Sea. Marine Ecology Progress Series **149**:13-21.

Miller, G. W., R. E. Elliot, W. R. Koski, V. D. Moulton, and W. J. Richardson. 1999. Whales.*in* R. W.J., editor. Marine mammal and acoustical monitoring of Western Geophysical's open-water seismic program in the Alaskan Beaufort Sea, 1998.

Miller, J. D., K. A. Dobbs, C. J. Limpus, N. Mattocks, and A. M. Landry. 1998. Long-distance migrations by the hawksbill turtle, Eretmochelys imbricata, from north-eastern Australian. Wildlife Research **25**:89-95.

Mills, S. K. and J. H. Beatty. 1979. The propensity interpretation of fitness. Philosophy of Science **46**:263-286.

Mitchell, E. 1974a. Canada progress report on whale research, May 1972–May 1973. Report of the International Whaling Commission **24**.

Mitchell, E. 1974b. Present status of northwest Atlantic fin and other whale stocks. In: W.E. Schevill (Ed.) The Whale Problem: A Status Report. Harvard University Press, Cambridge, MA. Pp.108-169.

Mitchell, E. and D. G. Chapman. 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*). Report of the International Whaling Commission:117-120.

Miyashita, T., H. Kato, and T. Kasuya. 1995. Worldwide map of cetacean distribution based on Japanese sighting data. Volume 1. National Research Institute of Far Seas Fisheries, Shizuoka, Japan. 140pp.

Mizroch, S. A., D. W. Rice, and J. M. Breiwick. 1984. The sei whale, Balaenoptera borealis. Marine Fisheries Review **46**:25-29.

Mizroch, S. A., D. W. Rice, D. Zwiefelhofer, J. Waite, and W. L. Perryman. 1999. Distribution and movements of fin whales (Balaenoptera physalus) in the Pacific Ocean. Thirteenth Biennial Conference on the Biology of Marine Mammals, Wailea, Hawaii.

MMMP. 2002. Marine Mammal Monitoring Annual Report 2001-2002. Marine Mammal Monitoring Project, Victoria, British Columbia. 25p.

Mobley, J. R., Jr., S. S. Spitz, K. A. Forney, R. Grotefendt, and P. H. Forestell. 2000. Distribution and abundance of odontocete species in Hawaiian waters: Preliminary results of 1993-98 aerial surveys., NOAA, NMFS, SWFSC Administrative Report LJ-00-14C. 27p.

Monagas, P., J. Oros, J. Anana, and O. M. Gonzalez-Diaz. 2008. Organochlorine pesticide levels in loggerhead turtles (Caretta caretta) stranded in the Canary Islands, Spain. Marine Pollution Bulletin **56**:1949-1952.

Moncado-G, F., A. M. Rodriguez, R. Marques-M, and E. Carrillo. 2000. Report of the olive ridley turtle (*Lepidochelys olivacea*) in Cuban waters. Marine Turtle Newsletter **90**:13-15.

Moore, S. E., J. M. Waite, L. L. Mazzuca, and R. C. Hobbs. 2000. Mysticete whale abundance and observations of prey associations on the central Bering Sea shelf. Journal of Cetacean Research and Management **2**:227-234.

Morreale, S. J., E. A. Standora, F. V. Paladino, and J. R. Spotila. 1994. Leatherback migrations along deepwater bathymetric contours. Pp.109-110 In: Schoeder, B.A. and B.E. Witherington (Eds), Proceedings of the 13th Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-341, Miami, Florida.

Mortimer, J. A. 1982. Factors influencing beach selection by nesting sea turtles. Pages 45-51 *in* K. Bjorndal, editor. The biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D.C.

Mortimer, J. A. and R. Bresson. 1999. Temporal distribution and periodicity in hawksbill turtles (Eretmochelys imbricata) nesting at Cousin Island, Republic of Seychelles, 1971-1997. Chelonian Conservation and Biology **3**:318-325.

Mortimer, J. A., J. Collie, T. Jupiter, R. Chapman, A. Liljevik, and B. Betsy. 2003. Growth rates of immature hawksbills (*Eretmochelys imbricata*) at Aldabra Atoll, Seychelles (Western Indian Ocean). Pages 247-248 *in* Twenty-second Annual Symposium on Sea Turtle Biology and Conservation.

Mortimer, J. A. and M. Donnelly. 2007. Marine Turtle Specialist Group 2007 IUCN Red List status assessment, hawksbill turtle (*Eretmochelys imbricata*). Internationa Union for the conservation of Nature.

Mrosovsky, N., S. R. Hopkins-Murphy, and J. I. Richardson. 1984. Sex ratio of sea turtles: seasonal changes. Science **225**:739-741.

Mrosovsky, N., G. D. Ryan, and M. C. James. 2009. Leatherback turtles: The menace of plastic. Marine Pollution Bulletin **58**:287-289.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers, and B. Taggart. 1994. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. Fishery Bulletin **92**.

Murakawa, S. K. K., G. H. Balazs, D. M. Ellis, S. Hau, and S. M. Eames. 2000. Trends in fibropapillomatosis among green turtles stranded in the Hawaiian Islands, 1982-98.*in* Nineteenth Annual Symposium on Sea Turtle Biology and Conservation.

Murphy, T. M. and S. R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. Final Report to NOAA/NMFS/SEFC, U.S. Department of Commerce, 73p.

Musick, J. A. and C. J. Limpus. 1997. Habitat utilization, and migration in juvenile sea turtles. Pages 137-163 *in* P. L. Lutz and J. A. Musick, editors. The biology of sea turtles. CRC Press, Boca Raton, Florida.

Napp, J. M. and G.L. Hunt, Jr. 2001. Anomalous conditions in the southeastern Bering Sea, 1997: linkages among climate, weather, ocean, and biology. Fisheries and Oceanography **10**:61-68.

Nasu, K. 1974. Movement of baleen whales in relation to hydrographic conditions in the northern part of the North Pacific Ocean and the Bering Sea. In: Oceanography of the Bering Sea with Emphasis on Renewable Resources:Hood, D.W. and E.J. Kelley (eds). International Symposium for Bering Sea Study, Hakodate, Japan, 31 January - 34 February 1972. p1345-1361.

Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. . Scientific Reports of the Whales Research Institute, Tokyo **12**:33-89.

Nemoto, T. 1959. Food of the baleen whales with reference to whales movements. Scientific Reports to the Whales Research Institute **14**:149-290.

Nemoto, T. 1970. Feeding pattern of baleen whales in the oceans. *In:* Steele, J.H. (ed.), Marine Food Chains. University of California Press, Berkeley, California. p.241-252

Nemoto, T. and A. Kawamura. 1977. Characteristics of food habits and distribution of baleen whales with special reference to the abundance of North Pacific sei and Bryde's whales. Report of the International Whaling Commission:80-87.

Nerini, M. K., H. W. Braham, W. M. Marquette, and D. J. Rugh. 1984. Life history of the bowhead whale (Balaena mysticetus) (Mammalia: Cetacea). Journal of Zoology **204**:443-468.

Nishiwaki, M. 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Pages 171-191 *in* K. S. Norris, editor. Whales, dolphins, and porpoises. University of California Press, Berkeley, California.

Nishiwaki, M. 1972. General biology. Pages 3-204 *in* S. H. Ridgway, editor. Mammals of the sea: Biology and medicine. Thomas, Springfield, Illinois.

Nishiwaki, M. and C. Handa. 1958. Killer whales caught in the coastal waters off Japan for recent 10 years. Scientific Reports of the Whales Research Institute **13**:85-96.

Nishiwaki, S., D. Tohyama, H. Ishikawa, S. Otani, T. Bando, H. Murase, G. Yasunaga, T. Isoda, K. Nemoto, M. Mori, M. Tsunekawa, K. Fukutome, M. Shiozaki, M. Nagamine, T. Konagai, T. Takamatsu, S. Kumagai, T. Kage, K. Ito, H. Nagai, and W. Komatsu. 2006. Cruise Report of the Second Phase of the Japanese Whale Research Program under Special Permit in the Antarctic (JARPAII) in 2005/2006 -Feasibility study. St Kitts and Nevis, WI.

NMFS. 1987. Marine Mammal Protection Act of 1972 - Annual Report 1986/87. National Marine Fisheries Service.

NMFS. 1992. Final recovery plan for Steller sea lions Eumetopias jubatus. NMFS Office of Protected Resources, Silver Spring, Maryland.

NMFS. 1995. Status review of the United States Steller sea lion (Eumetopias jubatus) population. NOAA, NMFS, AFSC, National Marine Mammal Laboratory, Seattle, Washington.

NMFS. 1998. Recovery plan for the blue whale (*Balaenoptera musculus*). Prepared by Reeves, R.L., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber for the National Marine Fisheries Service, Silver Spring, Maryland.

NMFS. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-455.

NMFS. 2005a. Draft environmental impact statement for amending the Atlantic Large Whale Take Reduction Plan: Broad-based gear modifications. Draft EIS prepared by Industrial Economics, Incorporated, and NOAA's National Marine Fisheries Service.

NMFS. 2005b. Proposed conservation plan for Southern Resident killer whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

NMFS. 2006a. Draft recovery plan for the fin whale (Balaenoptera physalus). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS. 2006b. Draft Recovery Plan for the Sperm Whale (*Physeter Macrocephalus*). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS. 2006c. Review of the status of the right whales in the North Atlantic and North Pacific Oceans. NOAA, National Marine Fisheries Service.

NMFS. 2008. Recovery plan for southern resident killer whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington.
NMFS and SEFSC. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. NMFS-SEFSC 455, U.S. Department of Commerce, National Marine Fisheries Service,Southeast Fisheries Science Center, Miami, Florida.
NMFS and USFWS. 1991. Recovery Plan for U.S. Population of Loggerhead Turtle (*Caretta caretta*). National Marine Fisheries Service and U.S. Fish and Wildlife Service, Washington, D.C.
NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland.
NMFS and USFWS. 1998a. Recovery Plan for the U.S. Pacific Populations of the Leatherback Turtles (*Dermochelys coriacea*). Silver Spring, Maryland.
NMFS and USFWS. 1998b. Recovery plan for U.S. Pacific populations of the green turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, Maryland.
NMFS and USFWS. 1998c. Recovery Plan for U.S. Pacific Populations of the Loggerhead Turtle (*Caretta caretta*). Silver Spring, Maryland.
NMFS and USFWS. 1998d. Recovery Plan for U.S. Pacific Populations of the Olive Ridley Turtle (*Lepidochelys olivacea*). National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
NMFS and USFWS. 2007a. Hawksbill Sea Turtle (*Eretmochelys imbricata*) 5-Year Review: Summary and Evaluation National Marine Fisheries Service and U.S. Fish and Wildlife Service.
NMFS and USFWS. 2007b. Loggerhead Sea Turtle (*Caretta caretta*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service.
NMFS and USFWS. 2007c. Olive Ridley Sea Turtle (*Lepidochelys olivacea*) 5-Year Review: Summary and Evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service.
Noongwook, G. H., P. Huntington, and J. George. 2007. Traditional knowledge of the bowhead whale (Balaena mysticetus) around St. Lawrence Island, Alaska. Arctic **60**:47-54.
Northrop, J. W., C. Cummings, and M. F. Morrison. 1971. Underwater 20-Hz signals recorded near Midway Island. Journal of the Acoustical Society of America **49**:1909-1910.
Northrop, J. W., C. Cummings, and P. O. Thompson. 1968. 20-Hz signals observed in the central Pacific. Journal of the Acoustical Society of America **43**:383-384.
Notarbartolo di Sciara, G. and M. Demma. 1997. Guida dei Mammiferi Marini del Mediterraneo, 2nd edition. Franco Muzzio Editore: Padova.
Nowak, R. M. 2003. Walker's marine mammals of the world. John Hopkins University Press, London.
NRC. 1990. Decline of the Sea Turtles: Causes and Prevention.National Academy of Sciences, National Academy Press, Washington, D.C.
O'Hara, T., M. C. Hanns, G. Bratton, R. Taylor, and V. M. Woshner. 2006. Essential and non-essential elements in eight tissue types from subsistence-hunted bowhead whale: Nutritional and toxicological assessment. International Journal of Circumpolar Health **65**:228-242.
O'Hara, T. M. and C. Rice. 1996. Polychlorinated biphenyls. Pp.71-86 In: Noninfectious Diseases of Wildlife, 2nd edition, A. Fairbrother, L.Locke, and G. Hoff (eds.). Iowa State University Press, Ames, Iowa.
Ohsumi, S. and Y. Fukuda. 1975. On the estimates of exploitable population size and replacement yield for the Antarctic sei whale by use of catch and effort data. Reports of the International Whaling Commission **25**:102-105.
Okuyama, J., O. Abe, H. Nishizawa, M. Kobayashi, K. Yoseda, and N. Arai. 2009. Ontogeny of the dispersal migration of green turtle (Chelonia mydas) hatchlings. Journal of Experimental Marine Biology and Ecology.
Olesiuk, P. F., M. A. Bigg, and G. M. Ellis. 1990. Life history and population dynamics of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commission **Special Issue 12**:209-243.
Olson, J. M. 1998. Temporal and spatial distribution patterns of sightings of southern community and transient orcas in the inland waters of Washington and British Columbia. Master's thesis. Western Washington University, Bellingham, Washington.
Omura, H., S. Ohsumi, T. Nemoto, K. Nasu, and T. Kasuya. 1969. Black right whales in the North Pacific. (Eubalaena glacialis). Scientific Reports of the Whales Research Institute Tokyo **21**:1-78, +18Pls.

ONR. 2001. Final Environmental Impact Statement for the North Pacific Acoustic Laboratory.Prepared by the Office of Naval Research, Arlington, Virginia.

Oros, J., O. M. Gonzalez-Diaz, and P. Monagas. 2009. High levels of polychlorinated biphenyls in tissues of Atlantic turtles stranded in the Canary Islands, Spain. Chemosphere **74**:473-478.

Osborne, R. W. 1999. A historical ecology of Salish Sea "resident" killer whales (*Orcinus orca*): with implications for management. Doctoral dissertation. University of Victoria, Victoria, British Columbia.

Osborne, R. W., K. L. Koski, R. E. Tallmon, and S. Harrington. 1999. Soundwatch 1999 final report. Soundwatch, Roche Harbor, Washington.

Overholtz, W. J. and J. R. Nicolas. 1979. Apparent feeding by the fin whale, *Balaenoptera physalus*, and humpback whale, *Megaptera novaeangliae*, on the American sand lance, Ammodytes americanus, in the northwest Atlantic. Fishery Bulletin **77**:285-287.

Owens, D. W. 1999. Reproductive Cycles and Endocrinology in Research and Management Techniques for the Conservation of Sea Turtles. K. L. Eckert, K. A. Bjourndal, F. A. Abreu-Grobois and M. Donnelly (editors). IUCN/SSC Marine Turtle Specialist Group Publication No 4, 1999. .

Owens, D. W. and G. J. Ruiz. 1980. New methods of obtaining blood and cerebrospinal fluid from marine turtles. Herpetologica **36**:17-20.

Palacios, D. M. and B. R. Mate. 1996. Attack by false killer whales (*Pseudorca crassidens*) on sperm whales (*Physeter macrocephalus*) in the Galápagos Islands. Marine Mammal Science **12**:582-587.

Paloma, L. D. G., B. E. Lavaniegos, and G. Heckel. 2008. Fin whales (Balaenoptera physalus) foraging on daytime surface swarms of the euphausiid Nyctiphanes simplex in Ballenas Channel, Gulf of California, Mexico. Journal of Mammalogy **89**:559-566.

Pandav, B. and B. C. Choudhury. 1999. An update on the mortality of the olive ridley sea turtles in Orissa, India. Marine Turtle Newsletter **83**:10-12.

Parker, D. M. and G. H. Balazs. 2008. Diet of the oceanic green turtle, *Chelonia mydas,* in the North Pacific. Preceedings of the twenty-fifth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-582.

Parker, D. M., W. J. Cooke, and G. H. Balazs. 2005. Diet of oceanic loggerhead sea turtles (*Caretta caretta*) in the central North Pacific. Fishery Bulletin **103**:142-152.

Parker, D. M., P. H. Dutton, K. Kopitsky, and R. L. Pitman. 2003. Movement and dive behavior determined by satellite telemetry for male and female olive ridley turtles in the Eastern Tropical Pacific. Pages 48-49 in: J.A. Seminoff, ed. Proceedings of the Twenty-second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503.

Parrish, A. and K. Goodman. 2006. Tagging and nesting research on hawksbill turtles (Eretmochelys imbricata) at Jumby Bay, Long Island, Antigua, West Indies: 2002 annual report. Prepared for the Jumby Bay Island Company, Limited.

Parrish, F. A., G. J. Marshall, B. Buhleier, and G. A. Antonelis. 2008. Foraging interaction between monk seals and large predatory fish in the northwestern Hawaiian Islands. Endangered Species Research **4**:299-308.

Payne, R. 1986. Long term behavioral studies of the southern right whale (Eubalaena australis). Report of the International Whaling Commission Special Issue **10**:161-167.-Right Whales Past and Present status. Proceedings of the Workshop on the status of Right Whales. Robert L. Brownell, Peter B. Best, John H. Prescott-Eds.).

Peckham, S. H., D. Maldonado-Diaz, V. Koch, A. Mancini, A. Gaos, M. T. Tinker, and W. J. Nichols. 2008. High mortality of loggerhead turtles due to bycatch, human consumption and strandings at Baja California Sur, Mexico, 2003 to 2007. Endangered Species Research **5**:171-183.

Pelletier, D., D. Roos, and S. Ciccione. 2003. Oceanic survival and movements of wild and captive-reared immature green turtles (Chelonia mydas) in the Indian Ocean. Aquatic Living Resources **16**:35-41.

Perez, M. A. and T. R. Loughlin. 1991. Incidental catch of marine mammals by foreign and joint venture trawl vessels in the U.S. EEZ of the North Pacific, 1973-1988. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-104. 54 pp.

Perez, M. J., F. Thomas, F. Uribe, M. Sepulveda, M. Flores, and R. Moraga. 2006. Fin whales (Balaenoptera physalus) feeding on Euphausia mucronata in nearshore waters off north-central Chile. Aquatic Mammals **32**:109-113.

Perkins, J. and D. Beamish. 1979. Net entanglements of baleen whales in the inshore fishery of Newfoundland. Journal of the Fisheries Research Board of Canada **36**:521-528.

Perrin, W. F. and S. B. Reilly. 1984. Reproductive parameters of dolphins and small whales of the family Delphinidae. Pages 97-134 in: Perrin, W.G., R.L. Brownell, Jr., and D.P. DeMaster, editors. Reproduction in whales, dolphins, and porpoises. International Whaling Commission (Special Issue 6), Cambridge, U.K.
Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999. The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973. Marine Fisheries Review **61**:1-74.
Perryman, W. L., R. LeDuc, and J. R. L. Brownell. 1999. Progress report on eastern North Pacific right whale research during July 1998. International Whaling Committee Scientific Committee paper SC/51/CAWS36.
Perugini, M., A. Giammarino, V. Olivieri, S. Guccione, O. R. Lai, and M. Amorena. 2006. Polychlorinated biphenyls and organochlorine pesticide levels in tissues of Caretta caretta from the Adriatic Sea. Diseases of Aquatic Organisms **71**:155-161.
Petersen, S. L., M. B. Honig, P. G. Ryan, R. Nel, and L. G. Underhill. 2009. Turtle bycatch in the pelagic longline fishery off southern Africa. African Journal of Marine Science **31**:87-96.
Phillips, C. D., J. W. Bickham, J. C. Patton, and T. S. Gelatt. 2009. Systematics of Steller sea lions (Eumetopias jubatus): Subspecies recognition based on concordance of genetics and morphometrics. Occasional Papers of the Museum of Texas Tech University **283**:1-15.
Pilcher, N. J. and L. Ali. 1999. Reproductive biology of the hawksbill turtle, Eretmochelys imbricata, in Sabah, Malaysia. Chelonian Conservation and Biology **3**:330-336.
Pita, J. and D. Broderick. 2005. Hawksbill turtles in the Solomon Islands. Pages 101-102 in: Kinan, I., editor. Proceedings of the Second Western Pacific Sea Turtle Cooperative Research and Management Workshop. Western Pacific Regional Fishery Management Council, Honolulu, Hawaii.
Pitcher, K. W. and D. G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. Journal of Mammalogy **62**:599-605.
Pitcher, K. W. and F. H. Fay. 1982. Feeding by Steller sea lions on harbor seals. Murrelet **63**:70-71.
Pitman, R. L. 1990. Pelagic distribution and biology of sea turtles in the eastern tropical Pacific. Pp.143-148 *In:* T.H. Richardson, J.I. Richardson, and M. Donnelly (compilers), Proceedings of the 10th Annual Symposium on Sea Turtle Biology and Conservation. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-278.
Pitman, R. L. 1992. Sea turtle associations with flotsam in the eastern tropical Pacific. Page 94 in M. Salmon and J. Wyneken (compilers), Proc. of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. of Comm., NOAA Tech. Memo. NMFS-SEFSC-302. 195 pp.
Pitman, R. L. 1993. Seabird associations with marine turtles in the eastern Pacific Ocean. Colonial Waterbirds **16**:194-201.
Pitman, R. L., L. T. Ballance, S. I. Mesnick, and S. J. Chivers. 2001. Killer whale predation on sperm whales: observations and implications. Marine Mammal Science **17**:494-507.
Pitman, R. L. and P. H. Dutton. 2004. Killer whale predation on a leatherback turtle in the Northeast Pacific. Northwest Science **58**:497-498.
Plotkin, P. 2003. Adult migrations and habitat use. Pages 225-241 in: Lutz, P.L., J.A. Musick, and J. Wyneken, editors. Biology of sea turtles, volume II. CRC Press, Boca Raton, Florida.
Plotkin, P. and J. Bernardo. 2003. Investigations into the basis of the reproductive behavioral polymorphism in Lepidochelys olivacea. Page 29 in: Seminoff, J.A., editor. Proceedings of the Twenty-second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503.
Plotkin, P. T. 1994. Migratory and reproductive behavior of the olive ridley turtle, Lepidochelys olivacea (Eschscholtz, 1829), in the eastern Pacific Ocean. Doctoral dissertation, Texas A&M University, College Station, Texas.
Plotkin, P. T., (Ed). 1995. National Marine Fisheries Service and the U.S. Fish and Wildlife Service Status Reviews for Sea Turtles Listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland.
Plotkin, P. T., R. A. Byles, and D. W. Owens. 1994a. Migratory and reproductive behavior of *Lepidochelys olivacea* in the eastern Pacific Ocean. Jekyll Island, Georgia.
Plotkin, P. T., R. A. Byles, and D. W. Owens. 1994b. Post-breeding movements of male olive ridley sea turtles *Lepidochelys olivacea* from a nearshore breeding area. Department of Commerce.

Plotkin, P. T., R. A. Byles, D. C. Rostal, and D. W. Owens. 1991. Arribadas: Social events or simply aggregations? Preliminary results from satellite telemetry. P.95 *In:* Proceedings of the Eleventh Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFC-302.

Plotkin, P. T., R. A. Byles, D. C. Rostal, and D. W. Owens. 1995. Independent versus socially facilitated oceanic migrations of the olive ridley, Lepidochelys olivacea. Marine Biology **122**:137-143.

Plotkin, P. T., D. W. Owens, R. A. Byles, and R. Patterson. 1996. Departure of male olive ridley turtles (Lepidochelys olivacea) from a nearshore breeding ground. Herpetologica **52**:1-7.

Plotkin, P. T., D. C. Rostal, R. A. Byles, and D. W. Owens. 1997. Reproductive and developmental synchrony in female Lepidochelys olivacea. Journal of Herpetology **31**:17-22.

Polovina, J. J., G. H. Balazs, E. A. Howell, D. M. Parker, M. P. Seki, and P. H. Dutton. 2004. Forage and migration habitat of loggerhead (Caretta caretta) and olive ridley (Lepidochelys olivacea) sea turtles in the central North Pacific Ocean. Fisheries Oceanography **13**:36-51.

Polovina, J. J., E. Howell, D. M. Parker, and G. H. Balazs. 2003. Dive-depth distribution of loggerhead (*Carretta carretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the central North Pacific: Might deep longline sets catch fewer turtles? Fishery Bulletin **101**:189-193.

Postma, L. D. L. P. D. M. P. H.-J. and S. E. Cosens. 2006. Molecular genetic support of a single population of bowhead whales (Balaena mysticetus) in eastern Canadian Arctic and western Greenland waters. Canadian Science Advisory Secretariat Research Document 2006/051.

Prieto, A., A. Prietol, F. Moncadal, G. Nodarse, R. Pugal, M. E. d. Leon, R. Diaz-Fernandez, G. Espinoru, D. Castillo, M. Hernandez, E. Peregrin, M. d. Arazoza, D. Salabarria, E. Morales, G. Webbs, C. Manolis, and R. Gomez. 2001. Biological and ecological aspects of the hawksbill turtle population in Cuban waters. Report from the Republic of Cuba. First CITES wider Caribbean hawksbill turtle dialogue meeting. Mexico City, May l5 -17, 2001.

Pritchard, P. C. H. 1969. Studies of the systematics and reproductive cycles of the genus Lepidochelys. Doctoral dissertation, University of Florida, Florida.

Pritchard, P. C. H. 1971. The leatherback or leathery turtle, Dermochelys coriacea. IUCN Monograph **1**:1-39.

Pritchard, P. C. H. 1982. Nesting of the leatherback turtle, Dermochelys coriacea in Pacific Mexico, with a new estimate of the world population status. Copeia 1982:741-747.

Pritchard, P. C. H. 1997. Evolution, phylogeny, and current status. Pages 1-28 in: Lutz, P.L., and J.A. Musick, editors. The biology of sea turtles. CRC Press, Boca Raton, Florida.

Pritchard, P. C. H., P. Bacon, F. H. Berry, A. Carr, J. Feltemyer, R. M. Gallagher, S. Hopkins, R. Lankford, M. R. Marquez, L. H. Ogren, W. Pringle, Jr., H. Reichart, and R. Witham. 1983. Manual of sea turtle research and conservation techniques, 2nd ed. K. A. Bjorndal and G. H. Balazs (eds.). Center for Environmental Education, Washington, DC.

Pritchard, P. C. H. and P. T. Plotkin. 1995. Olive ridley sea turtle, Lepidochelys olivacea. Pages 123-139 in: Plotkin, P.T., editor. Status Reviews of Sea Turtles Listed under the Endangered Species Act of 1973. National Marine Fisheries Service and U.S. Fish and Wildlife Service. National Marine Fisheries Service, Silver Springs, Maryland.

Pritchard, P. C. H. and P. Trebbau. 1984. The turtles of Venezuela. SSAR Contribution to Herpetology No. 2.

Rasmussen, K., D. M. Palacios, J. Calambokidis, M. T. Saborío, L. D. Rosa, E. R. Secchi, G. H. Steiger, J. M. Allen, and G. S. Stone. 2007. Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration. Biology Letters **3**:302-305.

Reeves, R. R. 1980. Spitsbergen bowhead stock: a short review. Marine Fisheries Review 42(9/10:65-69.

Reeves, R. R., P. J. Clapham, R. L. B. Jr., and G. K. Silber. 1998. Recovery plan for the blue whale (Balaenoptera musculus). Office of Protected Resources, Silver Spring, MD.

Reeves, R. R., S. Leatherwood, G. S. Stone, and L. G. Eldredge. 1999. Marine mammals in the area served by the South Pacific Regional Environment Programme (SPREP). SPREP, Apia, Samoa.

Reeves, R. R., B. D. Smith, E. A. Crespo, and G. c. Notarbartolo di Sciara. 2003. Dolphins, Whales and Porpoises: 2002–2010 Conservation Action Plan for the World's Cetaceans. IUCN/SSC Cetacean Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. ix + 139p.

Reeves, R. R., T. D. Smith, E. A. Josephson, P. J. Clapham, and G. Woolmer. 2004. Historical observations of humpback and blue whales in the North Atlantic Ocean: Clues to migratory routes and possibly additional feeding grounds. Marine Mammal Science **20**:774-786.

Reeves, R. R. and H. Whitehead. 1997. Status of the sperm whale, *Physeter macrocephalus*, in Canada. Canadian Field-Naturalist **111**:293-307.

Reid, K. A., D. Margaritoulis, and J. R. Speakman. 2009. Incubation temperature and energy expenditure during development in loggerhead sea turtle embryos. Journal of Experimental Marine Biology and Ecology **378**:62-68.

Reilly, S. B. and V. G. Thayer. 1990. Blue whale (*Balaenoptera musculus*) distribution in the Eastern Tropical Pacific. Marine Mammal Science **6**:265-277.

Reiner, F., J. M. Gonçalves, and R. S. Santos. 1993. Two new records of Ziphiidae (Cetacea) for the Azores with an updated checklist of cetacean species. Arquipélago (Life and Marine Sciences) 11A:113-118.

Reynolds, J. E., D. P. DeMaster, and G. K. Silber. 2002. Endangered species and populations. Pages 373-382 in: Perrin, W.F., B. Würsig, and J.G.M. Thewissen, editors. Encyclopedia of marine mammals. Academic Press. San Diego, California.

Rhodin, A. G. J. 1985. Comparative chondro-osseous development and growth in marine turtles. Copeia **1985**:752-771.

Rice, D. W. 1960. Distribution of the bottle-nosed dolphin in the leeward Hawaiian Islands. Journal of Mammalogy **41**:407-408.

Rice, D. W. 1974. Whales and whale research in the eastern North Pacific.Pp.170-195 *In:* The whale problem: a status report. W.E. Schevill (ed). Harvard Univ. Press, Cambridge, Mass. 419p.

Rice, D. W. 1977. Synopsis of biological data on the sei whale and Bryde's whale in the eastern North Pacific. Report of the International Whaling Commission:92-97.

Rice, D. W. 1978a. The humpback whale in the North Pacific: distribution, exploitation, and numbers. In K. S. Norris and R. R. Reeves (Editors), Report on a Workshop on Problems Related to Humpback Whales (*Megaptera novaeangliae*) in Hawaii. Contr. Rep. to U.S. Mar. Mammal Comm., NTIS PB-280-794.pp. 29–44.

Rice, D. W. 1978b. Sperm whales.p.82-87 *In*: D. Haley (ed), Marine Mammals of the Eastern North Pacific and Arctic Waters. Pacific Search Press, Seattle, Washington. 256p.

Rice, D. W. 1989. Sperm whale, Physeter macrocephalus Linnaeus, 1758. Pages 177-233 *in* S. H. Ridgway and R. Harrison, editors. Handbook of marine mammals: Volume 4: River dolphins and the larger toothed whales. Academy Press, London.

Rice, D. W. 1998. Marine Mammals of the World. Systematics and Distribution.Special Publication Number 4. The Society for Marine Mammalogy, Lawrence, Kansas.

Richardson, J. I., R. Bell, and T. H. Richardson. 1999. Population ecology and demographic implications drawn from an 11-year study of nesting hawksbill turtles, Eretmochelys imbricata, at Jumby Bay, Long Island, Antigua, West Indies. Chelonian Conservation and Biology **3**:244-250.

Richardson, T. H., J. I. Richardson, C. Ruckdeshel, and M. W. Dix. 1978. Remigration patterns of loggerhead sea turtles (*Caretta caretta*) nesting on Little Cumberland and Cumberland Islands, Georgia. Florida Marine Research Publications **33**:39-44.

Richardson, W. J. 1995. Documented disturbance reactions. Pp. 241-324 in: W.J. Richardson, C.R. Greene, C.I. Malme, and D.H. Thomson, editors. Marine mammals and noise. Academic Press, San Diego, California.

Richardson, W. J., M. A. Fraker, B. Wursig, and R. S. Wells. 1985. Behavior of bowhead whales *Balaena mysticetus* summering in the Beaufort Sea: Reactions to industrial activities. Biological Conservation **32**:195-230.

Richardson, W. J. and C. I. Malme. 1993. Man-made noise and behavioral responses. Pages 631-700 *in* J. J. Burns, J. J. Montague, and C. J. Cowles, editors. The bowhead whale. . Society for Marine Mammalogy.

Richardson, W. J., T. L. McDonald, C. R. Greene, and S. B. Blackwell. 2004. Acoustic localization of bowhead whales near Northstar, 2001-2003: Evidence of deflection at high-noise times? Chapter 8 in: Richardson, W.J., and M.T. Williams, editors. Monitoring of industrial sounds, seals, and bowhead whales near BP's Northstar oil development, Alaskan Beaufort Sea, 1999-2003. Report from LGL, Ltd, Greenridge Science, Inc., and WEST Inc. for BP Exploration Inc., Anchorage, Alaska.

Richter, C., S. Dawson, and E. Slooten. 2006. Impacts of commercial whale watching on male sperm whales at Kaikoura, New Zealand. Marine Mammal Science **22**:46-63.
Romero, A., A. I. Agudo, S. M. Green, and G. Notarbartolo Di Sciara. 2001. Cetaceans of Venezuela: Their Distribution and Conservation Status. NMFS-151, Department of Commerce, Seattle, Washington.
Romero, L. M. 2004. Physiological stress in ecology: lessons from biomedical research. Trends in Ecology and Evolution **19**:249-255.
Rosa, C. J., E. Blake, L. Mazzaro, P. Hoekstra, G. M. Ylitalo, and T. M. O. Hara. 2007. Vitamin A, and E tissue distribution with comparisons to organochlorine concentrations in the serum, blubber, and liver of the bowhead whale (Balaena mysticetus). Comparative Biochemistry and Physiology B: Biochemistry and Molecular Biology **148**:454-462.
Rosenbaum, H. C., R. L. Brownell Jr., M. W. Brown, C. M. Schaeff, V. Portway, B. N. White, S. Malik, L. A. Pastene, N. J. Patenaude, C. S. Baker, M. Goto, P. B. Best, P. J. Clapham, P. K. Hamilton, M. Moore, R. Payne, V. Rowntree, C. T. Tynan, J. L. Bannister, and R. DeSalle. 2000. World-wide genetic differentiation of *Eubalana*: questioning the number of right whale species. Molecular Ecology **9**:1793-1802.
Ross, J. P. 1979. Sea turtles in the Sultanate of Oman. Manuscript report of IUCN/WWF Project 1320.
Ross, J. P. 1998. Estimations of the nesting population size of loggerhead sea turtles, Caretta caretta, Masirah Island, Sultanate of Oman. Pages 84-87 in: S.P. Epperly, and J. Braun, editors. Proceedings of the Seventeenth Annual Sea Turtle Symposium. NOAA Technical Memorandum NMFS-SEFSC-415.
Ross, J. P. and M. A. Barwani. 1982. Review of sea turtles in the Arabian area. Pages 373-383 in: Bjorndal, K.A., editor. Biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D.C.
Ross, P. S., G. M. Ellis, M. G. Ikonomou, L. G. Barrett-Lennard, and R. F. Addison. 2000. High PCB concentrations in free-ranging Pacific killer whales, Orcinus orca: effects of age, sex, and dietary preference. Marine Pollution Bulletin **40**:504-515.
Russell, D. F. and G. H. Balazs. 2009. Dietary Shifts by Green Turtles (Chelonia mydas) in the Kane'ohe Bay Region of the Hawaiian Islands: A 28-Year Study. Pacific Science **63**:181-192.
Rybitski, M. J., R. C. Hale, and J. A. Musick. 1995. Distribution of organochlorine pollutants in Atlantic sea turtles. Copeia 1995:379-390.
Saba, V. S., J. R. Spotila, F. P. Chavez, and J. A. Musick. 2007. Bottom-up and climatic forcing on the global population of leatherback turtles. Pages 162-163 in: Frick, M., A. Panagopoulou, A.F. Rees, and K. Williams, editors. Twenty-seventh Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Myrtle Beach, South Carolina.
Saeki, K., H. Sakakibara, H. Sakai, T. Kunito, and S. Tanabe. 2000. Arsenic accumulation in three species of sea turtles. Biometals **13**:241-250.
Sahoo, G., R. K. Sahoo, and P. Mohanty-Hejmadi. 1996. Distribution of heavy metals in the eggs and hatchlings of olive ridley sea turtle, Lepidochelys olivacea, from Gahirmatha, Orissa. Indian Journal of Marine Sciences **25**:371-372.
Sale, A. and P. Luschi. 2009. Navigational challenges in the oceanic migrations of leatherback sea turtles. Proceedings of the Royal Society B-Biological Sciences **276**:3737-3745.
Sale, A., P. Luschi, R. Mencacci, P. Lambardi, G. R. Hughes, G. C. Hays, S. Benvenuti, and F. Papi. 2006. Long-term monitoring of leatherback turtle diving behaviour during oceanic movements. Journal of Experimental Marine Biology and Ecology **328**:197-210.
Sandegren, F. E. 1970. Breeding and maternal behavior of the Steller sea lion (Eumatopias jubatus) in Alaska. University of Alaska.
Sapolsky, R. M., L. M. Romero, and A. U. Munck. 2000. How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. Endocrine Reviews **21**:55-89.
Sarti, L. M., S. A. Eckert, N. T. Garcia, and A. R. Barragan. 1996. Decline of the world's largest nesting assemblage of leatherback turtles. Marine Turtle Newsletter **74**:2-5.
Saulitis, E., C. Matkin, L. Barrett-Lennard, K. Heise, and G. Ellis. 2000. Foraging strategies of sympatric killer whale (Orcinus orca) populations in Prince William Sound, Alaska. Marine Mammal Science **16**:94-109.
Scarff, J. E. 1986. Historic and present distribution of the right whale (*Eubalaena glacialis*) in the eastern North Pacific south of 50^{o}N and east of 180^{o}W. Report of the International Whaling Commission:43-63.

Scheffer, V. B. and J. W. Slipp. 1948. The whales and dolphins of Washington State with a key to the cetaceans of the west coast of North America. American Midland Naturalist **39**:257-337.
Scheidat, M., C. Castro, J. Gonzalez, and R. Williams. 2004. Behavioural responses of humpback whales (*Megaptera novaeangliae*) to whalewatching boats near Isla de la Plata, Machalilla National Park, Ecuador. Journal of Cetacean Research and Management **6**:63-68.
Schell, D. M. and S. M. Saupe. 1993. Feeding and growth as indicated by stable isotopes. Pages 491-509 in: Burns, J.J., J.J. Montague, and C.J. Cowles, editors. The bowhead whale. Special Publication Number 2. Society of Marine Mammals, Lawrence, Kansas.
Schell, D. M., S. M. Saupe, and N. Haubenstock. 1989. Bowhead whale (Balaena mysticetus) growth and feeding as estimated by 13C techniques. Marine Biology **103**:433-443.
Schick, R. S. and D. L. Urban. 2000. Spatial components of bowhead whale (Balaena mysticetus) distribution in the Alaskan Beaufort Sea. Canadian Journal of Fisheries and Aquatic Sciences **57**:2193-2200.
Schofield, G., C. M. Bishop, K. A. Katselidis, P. Dimopoulos, J. D. Pantis, and G. C. Hays. 2009. Microhabitat selection by sea turtles in a dynamic thermal marine environment. Journal of Animal Ecology **78**:14-21.
Sears, R. and F. Larsen. 2002. Long range movements of a blue whale (*Balaenoptera musculus*) between the Gulf of St. Lawrence and west Greenland. Marine Mammal Science **18**:281-285.
Sears, R., J. M. Williamson, F. W. Wenzel, M. Bérubé, D. Gendron, and P. Jones. 1990. Photographic identification of the blue whale (Balaenoptera musculus) in the Gulf of St. Lawrence, Canada. Reports of the International Whaling Commission **Special Issue 12**:335-342.
Seminoff, J. A. 2004. 2004 global status assessment: Green turtle (Chelonia mydas). IUCN Marine Turtle Specialist Group Review.
Seminoff, J. A. and T. T. Jones. 2006. Diel movements and activity ranges of green turtles (*Chelonia mydas*) at a temperate foraging area in the Gulf of California, Mexico. Herpetological Conservation and Biology **1**:81-86.
Seminoff, J. A., T. T. Jones, and G. J. Marshall. 2006. Underwater behaviour of green turtles monitored with video-time-depth recorders: what's missing from dive profiles? Marine Ecology Progress Series **322**:269-280.
Seminoff, J. A., T. T. Jones, A. Resendiz, W. J. Nichols, and M. Y. Chaloupka. 2003. Monitoring green turtles (Chelonia mydas) at a coastal foraging area in Baja California, Mexico: Multiple indices to describe population status. Journal of the Marine Biological Association of the United Kingdom **83**:1355-1362.
Seminoff, J. A., A. Resendiz, and W. J. Nichols. 2002. Diet of East Pacific green turtles (Chelonia mydas) in the central Gulf of California, Mexico. Journal of Herpetology **36**:447-453.
Sergeant, D. E. 1977. Stocks of fin whales *Balaenoptera physalus* L. in the North Atlantic Ocean. Report of the International Whaling Commission **27**:460-473.
Shallenberger, E. W. 1981. The status of Hawaiian cetaceans. Final report to U.S. Marine Mammal Commission. MMC-77/23.
Shanker, K. and B. Mohanty. 1999. Operation Kachhapa: In search of a solution for the olive ridley of Orissa. Marine Turtle Newsletter **86**:1-3.
Shirihai, H. 2002. A complete guide to Antarctic wildlife. Alula Press, Degerby, Finland.
Sigler, M. F., D. J. Tollit, J. J. Vollenweider, J. F. Thedinga, D. J. Csepp, J. N. Womble, M, y. A. Wong, M. J. Rehberg, and r. W. Trites. 2009. Steller sea lion foraging response to seasonal changes in prey availability. Marine Ecology Progress Series **388**:243-261.
Sigurjónsson, J. 1995. On the life history and autoecology of North Atlantic rorquals. Whales, Seals, Fish, and Man:Blix, A.S., L. Walloe, and O. Ulltang (Eds.), Proceedings of the International Symposium on the Biology of Marine Mammals in the North East Atlantic. Tromso, Norway, 29 November - 21 December 1994. Elsevier. pp.1425-1441.
Sigurjónsson, J. and T. Gunnlaugsson. 1990. Recent trends in abundance of blue (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*) off West and Southwest Iceland, with a note on occurrence of other cetacean species. Report of the International Whaling Commission **40**:537-551.
Sinclair, E. and T. Zeppelin. 2002. Seasonal and spatial differences in diet in the western stock of Steller sea lions (Eumetopias jubatus). Journal of Mammalogy **83**:973-990.

Smith, A. W. and A. B. Latham. 1978. Prevalence of vesicular exanthema of swine antibodies among feral animals associated with the southern California coastal zones. American Journal of Veterinary Research **39**:291–296.

Smith, T. D., J. Allen, P. J. Clapham, P. S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, and P. J. Palsbøll. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). Marine Mammal Science **15**:1-32.

Solow, A. R., K. A. Bjorndal, and A. B. Bolten. 2002. Annual variation in nesting numbers of marine turtles: The effect of sea surface temperature on re-migration intervals. Ecology Letters **5**:742-746.

Spotila, J. R. 2004. Sea turtles: A complete guide to their biology, behavior, and conservation. John Hopkins University Press, Baltimore. 227p.

Spotila, J. R., A. E. Dunham, A. J. Leslie, A. C. Steyermark, P. T. Plotkin, and F. V. Paladino. 1996. Worldwide population decline of *Dermochelys coriacea*: Are leatherback turtles going extinct? Chelonian Conservation and Biology **2**:209-222.

Spotila, J. R., R. D. Reina, A. C. Steyermark, P. T. Plotkin, and F. V. Paladino. 2000. Pacific leatherback turtles face extinction. Nature **405**:529-530.

SPREP. 2007. Pacific Islands regional marine species programme 2008–2012. Pacific ISlands Regional Marine Species Programme, Apia, Samoa.

Spring, C. S. 1982. Status of marine turtle populations in Papua New Guinea. Pages 281-289 *in* K. A. Bjorndal, editor. Biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D. C.

STAJ. 2002. Population trends and mortality of Japanese loggerhead turtles, Caretta caretta in Japan. Presented at the Western Pacific Sea Turtle Cooperative Research and Management Workshop, Honolulu, Hawaii, February 5-8, 2002.

Stearns, S. C. 1992. The evolution of life histories.Oxford University Press, 249p.

Steiger, G. H., J. Calambokidis, J. M. Straley, L. M. Herman, S. Cerchio, D. R. Salden, J. U.-. R., J. K. Jacobsen, O. v. Ziegesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, S. Uchida, J. K. B. Ford, P. L. d. G.-. P., M. Yamaguchi, and J. Barlow. . 2008. Geographic variation in killer whale attacks on humpback whales in the North Pacific: Implications for predation pressure. Endangered Species Research **4**:247-256.

Sternberg, J. 1981. The worldwide distribution of sea turtle nesting beaches. Sea Turtle Rescue Fund, Center for Environmental Education, Washignton, D. C.

Stevick, P., J. Allen, P. J. Clapham, N. Friday, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsbøll, J. Sigujónsson, T. D. Smith, N. Øien, and P. S. Hammond. 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Marine Ecology Progress Series **258**:263-273.

Stewart, B. S. 2002. Diving behavior. Pages333-339 in: Perrin, W.F., B. Würsig, and J.G.M. Thewissen, editors. Encyclopedia of marine mammals. Academic Press, San Diego, California.

Stewart, B. S., S. A. Karl, P. K. Yochem, S. Leatherwood, and J. L. Laake. 1987. Aerial surveys for cetaceans in the former Akutan, Alaska, whaling grounds. Arctic **40**:33-42.

Stinson, M. L. 1984. Biology of sea turtles in San Diego Bay, California, and in northeastern Pacific Ocean. Master's thesis. San Diego State University, San Diego, California.

Stokes, L. W. and S. P. Epperly. 2006. Lepidochelys olivacea (olive ridley sea turtle). Western North Atlantic Ocean. Herpetological Review 37(1):105.

Storelli, M., M. G. Barone, and G. O. Marcotrigiano. 2007. Polychlorinated biphenyls and other chlorinated organic contaminants in the tissues of Mediterranean loggerhead turtle Caretta caretta. Science of the Total Environment 273 (2-3:456-463.

Storelli, M., M. G. Barone, A. Storelli, and G. O. Marcotrigiano. 2008. Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (Chelonia mydas) from the Mediterranean Sea. Chemosphere **70**:908-913.

Sweeney, J. 1990. Marine mammal behavioral diagnostics.*in* L. Dierauf, editor. CRC handbook of marine mammal medicine: health, disease, and rehabilitation, 1st edition. CRC Press, Boca Raton, FL.

Taquet, C., M. Taquet, T. Dempster, M. Soria, S. Ciccione, D. Roos, and L. Dagorn. 2006. Foraging of the green sea turtle Chelonia mydas on seagrass beds at Mayotte Island (Indian Ocean), determined by acoustic transmitters. Marine Ecology Progress Series **306**:295-302.

Tarpley, R., G. Jarrell, J. George, J. Cubbage, and G. Scott. 1995. Male pseudohermaphroditism in the bowhead whale. Journal of Mammalogy **76**:1267-1275.

Tarpy, C. 1979. Killer Whale Attack! National Geographic **155**:542-545.
TEWG. 1998. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NMFS-SEFSC-409, Department of Commerce, Turtle Expert Working Group.
Thompson, P. O. and W. A. Friedl. 1982. A long term study of low frequency sounds from several species of whales off Oahu, Hawaii. Cetology **45**:1-19.
Thorbjarnarson, J. B., S. G. Platt, and S. T. Khaing. 2000. Sea turtles in Myanmar: Past, and present. Marine Turtle Newsletter **88**:10-11.
Thorsteinson, F. V. and C. J. Lensink. 1962. Biological observations of Steller sea lions taken during an experimental harvest. Journal of Wildlife Management **26**:353-359.
Tillman, M. F. 1977. Estimates of population size for the North Pacific sei whale. Report of the International Whaling Commission:98-106.
Tiwari, M., K. A. Bjorndal, A. B. Bolten, and B. M. Bolker. 2005. Intraspecific application of the mid-domain effect model: Spatial, and temporal nest distributions of green turtles, Chelonia mydas, at Tortuguero, Costa Rica. Ecology Letters **8**:918-924.
Tiwari, M., K. A. Bjorndal, A. B. Bolten, and B. M. Bolker. 2006. Evaluation of density-dependent processes, and green turtle Chelonia mydas hatchling production at Tortuguero, Costa Rica. Marine Ecology Progress Series **326**:283-293.
Tomás, J., P. Gozalbes, J. A. Raga, and B. J. Godley. 2008. Bycatch of loggerhead sea turtles: insights from 14 years of stranding data. Endangered Species Research **5**:161-169.
Tomilin, A. G. 1967. Mammals of the USSR, and adjacent countries. Volume 9, Cetacea. Israel Program Sci. Transl. No. 124, National Technical Information Service TT 65-50086. Springfield, Virginia (Translation of Russian text published in 1957).
Tomillo, P. S., J. S. Suss, B. P. Wallace, K. D. Magrini, G. Blanco, F. V. Paladino, and J. R. Spotila. 2009. Influence of emergence success on the annual reproductive output of leatherback turtles. Marine Biology **156**:2021-2031.
Trites, A. W., B. P. Porter, V. B. Deecke, A. P. Coombs, M. L. Marcotte, and D. A. S. Rosen. 2006. Insights into the timing of weaning and the attendance patterns of lactating Steller sea lions (Eumetopias jubatus) in Alaska during winter, spring, and summer. Aquatic Mammals **32**:85-97.
Troëng, S. and M. Chaloupka. 2007. Variation in adult annual survival probability and remigration intervals of sea turtles. Marine Biology 151:1721–1730.
Tuato'o-Bartley, N., T. E. Morrell, and P. Craig. 1993. Status of sea turtles in American Samoa in 1991. Pacific Science **47**:215-221.
Tyack, P. L. 1981. Interactions between singing Hawaiian humpback whales and conspecifics nearby. Behavioral Ecology and Sociobiology **8**:105-116.
Tynan, C. T., D. G. Ainley, J. A. Barth, T. J. Cowles, S. D. Pierce, and L. B. Spear. 2005. Cetacean distributions relative to ocean processes in the northern California Current System. Deep-Sea Research II **52**:145-167.
U.S. Department of Commerce. 1983. Draft Management Plan and Environmental Impact Statement for the Proposed Hawaii Humpback Whale National Marine Sanctuary.Prepared by the NOAA Office of Ocean and Coastal Resource Management and the State of Hawaii. 172p.
U.S. Navy. 2006. 2006 Rim of the Pacific Exercise After Action Report: analysis of the effectiveness of the mitigation and monitoring measures as required under the Marine Mammal Protection Act (MMPA) incidental harassment authorization and National Defense Exemption from the requirements of the MMPA for mid-frequency active sonar mitigation measures. Third Fleet. Chief of Naval Operations, Washington, D.C.
U.S. Navy. 2008a. Southern California Range Complex Final Environmental Impact Statement /Overseas Environmental Impact Statement.
U.S. Navy. 2008b. U.S. Navy Hawaii Undersea Warfare Exercise after action report 13-15 November 2007. U.S. Department of the Navy, Pacific Fleet, Honolulu, Hawaii.
U.S. Navy. 2008c. U.S. Navy Hawaii Undersea Warfare Exercise. USS Ronald Reagan CSG after action report 27-31 May 2008. U.S. Department of the Navy, Pacific Fleet, Honolulu, Hawaii.
U.S. Navy. 2008d. US Navy Hawaii Rim of the Pacific Excercise (RIMPAC 2008) After Action Report 29 June - 31 July 2008.
Van Dam, R. P. and C. E. Diez. 1997. Predation by hawksbill turtles on sponges at Mona Island, Puerto Rico. Proceedings of the Eighth International Coral Reef Symposium **2**:1421-1426.

van de Merwe, J. P. V., M. Hodge, H. A. Olszowy, J. M. Whittier, K. Ibrahim, and S. Y. Lee. 2009. Chemical Contamination of Green Turtle (Chelonia mydas) Eggs in Peninsular Malaysia: Implications for Conservation and Public Health. Environmental Health Perspectives **117**:1397-1401.

Varanasi, U., J. E. Stein, W. L. Reichert, K. L. Tilbury, M. M. Krahn, and S. Chan. 1992. Chlorinated and aromatic hydrocarbons in bottom sediments, fish and marine mammals in U.S. coastal waters: laboratory and filed studies of metabolism and accumulation *in* C. H. Walker and D. R. Livingstone, editors. Persistent Pollutants in Marine Ecosystems.

Velez-Zuazo, X., W. D. Ramos, R. Van Dam, C. E. Diez, A. Arreu-Grobois, and O. McMillan. 2008. Dispersal, recruitment and migratory behavior in a hawksbill sea turtle aggregation. Molecular Ecology **17**:839-853.

Wade, P. M., P. Heide-Jorgensen, K. Shelden, J. Barlow, J. Carretta, J. Durban, R. LeDuc, L. Munger, S. Rankin, A. Sauter, and C. Stinchcomb. 2006. Acoustic detection and satellite tracking leads to discovery of rare concentration of endangered North Pacific right whales. Biology Letters **2**:417-419.

Wade, P. R. and T. Gerrodette. 1993. Estimates of cetacean abundance and distribution in the Eastern Tropical Pacific. Report of the International Whaling Commission **43**.

Waite, J. M., K. Wynne, and D. K. Mellinger. 2003. Documented sighting of a North Pacific right whale in the Gulf of Alaska and post-sighting acoustic monitoring. Northwestern Naturalist **84**:38-43.

Walker, B. G., P. D. Boersma, and J. C. Wingfield. 2005. Physiological and behavioral differences in magellanic Penguin chicks in undisturbed and tourist-visited locations of a colony. Conservation Biology **19**:1571-1577.

Walker, B. G. and P. L. Boveng. 1995. Effects of time-depth recorders on maternal foraging and attendance behavior of Antarctic fur seals. Canadian Journal of Zoology **73**:1538-1544.

Wallace, B. P., L. Avens, J. Braun-McNeill, and C. M. McClellan. 2009. The diet composition of immature loggerheads: Insights on trophic niche, growth rates, and fisheries interactions. Journal of Experimental Marine Biology and Ecology **373**:50-57.

Ward, E. J., E. E. Holmes, and K. C. Balcomb. 2009a. Quantifying the effects of prey abundance on killer whale reproduction. Journal of Applied Ecology **46**:632-640.

Ward, E. J., K. Parsons, E. E. Holmes, K. C. B. III, and J. K. B. Ford. 2009b. The role of menopause and reproductive senescence in a long-lived social mammal. Frontiers in Zoology **6**.

Wardle, C. S., T. J. Carter, G. G. Urquhart, A. D. F. Johnstone, A. M. Ziolkowski, G. Hampson, and D. Mackie. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research **21**:1005-1027.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam, and M. Sano. 1993. Sperm whales associated with Gulf Stream features off the north-eastern USA shelf. Fisheries Oceanography **2**:101-105.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley. 2006. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2005. NOAA Technical Memorandum NMFS-NE-194. Woods Hole, Massachusetts. 358p.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley. 2007. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2006. U.S. Department of Commerce. NOAA Technical Memorandum NMFS NE:201.

Waring, G. T., E. Josephson, C. P. Fairfield, and K. Maze-Foley. 2008. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2007. U.S. Department of Commerce. NOAA Technical Memorandum NMFS NE:205.

Waring, G. T., R. M. Pace, J. M. Quintal, C. P. Fairfield, and K. Maze-Foley. 2004. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2003. NOAA Technical Memorandum NMFS-NE-182:Woods Hole, Massachusetts, 300p.

Watkins, W. A., K. E. Moore, J. Sigujónsson, D. Wartzok, and G. N. di Sciara. 1984. Fin Whale (*Balaenoptera physalus*) tracked by radio in the Irminger Sea. Rit Fiskideildar **8**:1-14.

Watkins, W. A., K. E. Moore, D. Wartzok, and J. H. Johnson. 1981. Radio tracking of finback (Balaenoptera physalus), and humpback (Megaptera novaeangliae) whales in Prince William Sound, Alaska, USA. Deep Sea Research Part A. Oceanographic Research Papers **28**:577-588.

Watson, K. P. and R. A. Granger. 1998. Hydrodynamic effect of a satellite transmitter on a juvenile green turtle (Chelonia mydas). Journal of Experimental Biology **201**:2497-2505.

Waycott, M. B., J. Longstaff, and J. Mellors. 2005. Seagrass population dynamics and water quality in the Great Barrier Reef region: A review and future research directions. Marine Pollution Bulletin **51**:343-350.

Weinrich, M. T., J. Bove, and N. Miller. 1993. Return and survival of humpback whale (*Megaptera novaeangliae*) calves born to a single female in three consecutive years. Marine Mammal Science **9**:325-328.

Weinrich, M. T., R. H. Lambertsen, C. S. Baker, M. R. Schilling, and C. R. Belt. 1991. Behavioral responses of humpback whales (*Megaptera novaeangliae*) in the southern Gulf of Maine to biopsy sampling. Report of the International Whaling Commission:91-98.

Weinrich, M. T., R. H. Lambertsen, C. R. Belt, M. Schilling, H. J. Iken, and S. E. Syrjala. 1992. Behavioral reactions of humpback whales *Megaptera novaeangliae* to biopsy procedures. Fishery Bulletin **90**:588-598.

Weller, D. W., B. Würsig, H. Whitehead, J. C. Norris, S. K. Lynn, R. W. Davis, N. Clauss, and P. P. Brown. 1996. Observations of an interaction between sperm whales and short-finned pilot whales in the Gulf of Mexico. Marine Mammal Science **12**:588-594.

Wenzel, F. W., D. K. Mattila, and P. J. Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Marine Mammal Science **4**:172-175.

White, G. C. and R. A. Garrot. 1990. Effects of Tagging on the Animal. Chapter 3 In: Analysis of Wildlife Radio-Tracking Data. Academic Press, San Diego, CA. 383p.

Whitehead, H. 1995. Status of Pacific sperm whale stocks before modern whaling. Report of the International Whaling Commission **45**:407-412.

Whitehead, H. 2002. Estimates of the current global population size and historical trajectory for sperm whales. Marine Ecology Progress Series **242**:295-304.

Whitehead, H. 2003. Sperm whales: social evolution in the ocean. University of Chicago Press, Chicago, Illinois. 431p.

Whitehead, H., A. Coakes, N. Jaquet, and S. Lusseau. 2008. Movements of sperm whales in the tropical Pacific. Marine Ecology Progress Series **361**:291-300.

Whitehead, H., S. Waters, and T. Lyrholm. 1991. Social organization of female sperm whales and their offspring: Constant companions and casual acquaintances. Behavioral Ecology and Sociobiology **29**:385-390.

Wibbels, T. 2003. Critical approaches to sex determination in sea turtle biology and conservation. Pages 103-134 *in* P. Lutz, J. Musik, and J. Wynekan, editors. Biology of sea turtles. CRC Press.

Wilkinson, C. 2000. Status of coral reefs of the world: 2000. Global Coral Reef Monitoring Network, Australian Institute of Marine Science.

Williams, R., D. E. Bain, J. K. B. Ford, and A. W. Trites. 2002a. Behavioural responses of male killer whales to a ‘leapfrogging’ vessel. Journal of Cetacean Research, and Management **4**:305-310.

Williams, R., A. W. Trites, and D. E. Bain. 2002b. Behavioural responses of killer whales (Orcinus orca) to whale-watching boats: opportunistic observations and experimental approaches. Journal of Zoology **256**:255-270.

Wilson, R. P. and C. R. McMahon. 2006. Measuring devices on wild animals: what constitutes acceptable practice? Frontiers in Ecology and the Environment **4**:147-154.

Wing, B. L. and R. P. Hodge. 2002. Occurrence terminology for marine turtles. Marine Turtle Newsletter **95**:15-16.

Winn, H. E. and N. E. Reichley. 1985. Humpback whale - *Megaptera novaeangliae*. Handbook of Marine Mammals: Vol. 3 The Sirenians and Baleen Whales:241-274.

Winship, A. J. and A. W. Trites. 2006. Risk of extripation of Steller sea lions in the Gulf of Alaska and Aleutian Islands: a population viability analysis based on alternative hypotheses for why sea lions declined in Western Alaska. Marine Mammal Science **23**:124-155.

Winter, A., R. J. Foy, and K. Wynne. 2009. Seasonal differences in prey availability around a Steller sea lion haulout and rookery in the Gulf of Alaska. Aquatic Mammals **35**:145-162.

Witherington, B. E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica **48**:31-39.

Witherington, B. E. and K. A. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles Caretta caretta. Biological Conservation **55**:139-149.

Witherington, B. E., R. Herren, and M. Bresette. 2006. *Caretta caretta* – Loggerhead Sea Turtle. Chelonian Research Monographs **3**:74-89.

Witzell, W. N. 1983. Synopsis of biological data on the hawksbill sea turtle, *Eretmochelys imbricata* (Linnaeus, 1766). FAO Fisheries Synopsis No. 137, FAO, Rome, 78p.

Wolfe, R. J., J. A. Fall, and R. T. Stanek. 2005. The subsistence harvest of harbor seals and sea lions by Alaska natives in 2004. Technical Paper No. 303. Alaska Department of Fish and Game, Division of Subsistence.

Woodby, D. A. and D. B. Botkin. 1993. Stock sizes prior to commercial whaling. Pages 387-407 in: Burns, J.J., J.J. Montague, and C.J. Cowles, editors. The bowhead whale. Society of Marine Mammals, Special Publication 2. Lawrence, Kansas.

Wright, A. J. 2005. Lunar cycles and sperm whale (Physeter macrocephalus) strandings on the north Atlantic coastlines of the British isles and eastern Canada. Marine Mammal Science **21**:145-149.

Würsig, B., T. A. Jefferson, and D. J. Schmidly. 2000. The marine mammals of the Gulf of Mexico.Texas A&M University Press, College Station. 232p.

Wursig, B., S. K. Lynn, T. A. Jefferson, and K. D. Mullin. 1998. Behaviour of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquatic Mammals **24**:41-50.

Yochem, P. K. and S. Leatherwood. 1985. Blue whale *Balaenoptera musculus* (Linnaeus, 1758). In: Ridgway SH, Harrison R, editors. Handbook of Marine Mammals, vol. 3: The Sirenians and Baleen Whales.:London: Academic Press. p 193-240.

York, A. 1994. The population dynamics of the northern sea lions, 1975-85. Marine Mammal Science **10**:38-51.

York, A., R. Merrick, and T. Loughlin. 1996. An analysis of the Steller sea lion metapopulation in Alaska. Pages 259-292 *in* D. McCullough, editor. Metapopulations and Wildlife Conservation. Island Press, Covelo, California.

Zug, G. R., M. Chaloupka, and G. H. Balazs. 2006. Age and growth in olive ridley sea turtles (Lepidochelys olivacea) from the north-central Pacific: A skeletochronological analysis. Marine Ecology **26**:1-8.

Zug, G. R. and J. F. Parham. 1996. Age and growth in leatherback turtles, Dermochelys coriacea (Testudines: Dermochelyidae): A skeletochronological analysis. Chelonian Conservation and Biology **2**:244-249.