National Marine Fisheries Service

Endangered Species Act Section 7 Consultation

Biological Opinion

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

Proposed Action: Proposal to issue permit No. 15634 to National Marine Fisheries Service Southwest Fisheries Science Center, which would conduct scientific research on leatherback sea turtles off the coasts of California, Oregon, and Washington, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

Prepared by: Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service

Approved by: [signature]

Date: April 13, 2012

Section 7(a)(2) of the Endangered Species Act (ESA; 16 U.S.C. 1536(a)(2)) requires each Federal agency to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a Federal agency's action "may affect" a listed species or designated critical habitat, that agency is required to consult with the National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service, depending on the species that may be affected.

In this instance, the Permits and Conservation Division of NMFS ("Permits Division," the action agency) consulted with the Endangered Species Act Interagency Cooperation Division of NMFS (the consulting agency) on the former's issuance of a scientific research permit (the action) to the Southwest Fisheries Science Center (SWFSC, the applicant or researchers). This Biological Opinion is the result of our interagency consultation and describes how the Permits and Conservation Division has insured that their issuance of scientific research permit No. 15634 is not likely to jeopardize the continued existence of the endangered leatherback sea turtle (*Dermochelys coriacea*) or adversely modify or destroy its critical habitat.

We, the Endangered Species Act Interagency Cooperation Division, prepared this Biological Opinion in accordance with Section 7 of the ESA and its regulations (50 CFR Part 402). We based this opinion on information provided in the research permit application, the draft permit, and the environmental assessment. We also reviewed published and unpublished scientific data, recovery plans, and other sources of information.

The format of this biological opinion is as follows. After a brief history of the consultation, we describe the proposed action and the area in which it will occur (i.e., *Action Area*). In the *Status of the Species* section, we document which listed species occur in the action area. We identify which, if any, listed species are not likely to be adversely affected and can be eliminated from further consideration in the Biological Opinion. For species that are likely to be affected by the action, we provide the background information required to assess the action's impact on their continued survival. In the *Environmental Baseline* section, we review past and present activities that have affected these species, specifically in the action area. These summaries serve as the context for the *Effects of the Proposed Action* section, in which we consider the species' exposure and responses to stressors caused by the action. In the *Risk Analyses* section, we determine whether activities that adversely affect listed individuals are likely to reduce their fitness and, in turn, diminish the viability of the population(s) they represent. In addition, we consider the *Cumulative Effects* of future state or private activities that are reasonably certain to occur in the action area. We integrate all information in a final synthesis and use this to arrive at our conclusion: whether the Federal agency has insured that their action is not likely to jeopardize listed species or destroy/adversely modify critical habitat. We end with the following sections: *Incidental Take Statement, Conservation Recommendations* and *Reinitiation Statement*.

CONSULTATION HISTORY

In 2007, the Permits Division issued a five-year scientific research permit (No. 1596) to the SWFSC for the study of leatherback sea turtles off the coasts of California, Oregon, and Washington. Subsequently, the Permits Division issued three amendments to the original permit. In 2008, they substituted suction-cup tag attachments to replace the harness attachment for satellite tags. In 2009, they authorized a suite of sampling and tagging procedures for captured turtles. In 2010, they authorized the use of medial ridge attachment for satellite tags.

The current permit will expire on 1 April, 2012. In anticipation, the SWFSC submitted a new research permit application on August 12, 2011. In a memorandum dated November 22, 2011, the Permits Division requested ESA Section 7 consultation on its proposal to issue scientific research permit No. 15634. We initiated consultation on November 23, 2011.

DESCRIPTION OF THE PROPOSED ACTION

The Permits Division proposes to issue a five-year, scientific research permit pursuant to Section 10(a)(1)(A) of the ESA. Permit No. 15634 would authorize researchers at the SWFSC (responsible party, Lisa Ballance) to annually take 55 leatherback sea turtles (*Dermochelys coriacea*) off the coasts California, Oregon and Washington. The purpose of the research is to monitor the status of Pacific leatherback turtles in an important foraging area by collecting data on abundance, distribution, size ranges, sex ratio, health status, diving behavior, local movements, habitat use, and migration routes.

The new permit, if issued, would authorize the activities as described in Table 1. Additional details are provided below the table to adequately assess the effects of the action on listed species.

Table 1. Permitted activities and maximum annual takes under Permit No. 15634.

No. Turtles	Life Stage	Activites
10	Adult, Subadult, Juvenile	Aerial survey; close vessel approach; suction-cup attachment; track; capture; handle; weigh; tag (flipper and passive integrated transponder, PIT); sample collection (blood, tissue, stomach, fecal, cloacal, and subcutaneous fat); oxytetracycline injection; ultrasound; measure, photograph/video; platform terminal transmitter (PTT) attachment; pop-up archival transmitting (PAT) attachment; insert stomach telemeter pill; release.
25	Adult	Aerial survey; close vessel approach; suction-cup attachment; track; capture; handle; weigh; tag (flipper and PIT); sample collection (blood, tissue, stomach, fecal, cloacal, and subcutaneous fat); oxytetracycline injection; ultrasound; measure, photograph/video; release.
20	Adult	Aerial survey; close vessel approach; suction-cup attachment; sample collection (tissue); photograph/video; track.

Aerial survey

To locate leatherback sea turtles, the researchers would conduct aerial surveys at 650-1000 ft in a twin engine, fixed wing aircraft. They would guide an in-water vessel to the vicinity of the leatherback.

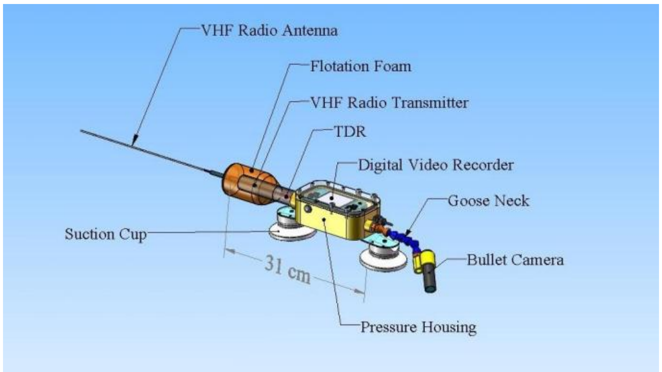
Close vessel approach

The vessel would slowly approach the turtle to evaluate its behavior and condition. In California, the researchers would use a 30’x10’ PackCat aluminum hull landing craft, modified specifically for the capture of leatherbacks. In Oregon or Washington, they would use a rigid-hulled inflatable boat launched from a larger vessel (i.e., a NOAA ship).

Suction-cup attachment

The researchers would attach a telemetry instrument (e.g., camera, sonic tag or VHF transmitter with time-depth recorder) to the free-swimming leatherback via a suction-cup attachment (Fig. 1). The purpose of this instrument would be to measure pre- and post-capture behavior patterns (e.g., short-term movements, diving behavior, and foraging ecology) to determine the impact of handling on turtles. The suction cup would remain on the turtle for a maximum of five days. The researchers would spread denture adhesive on the suction cup and attach the tag to the end of a 6 m pole. They would approach the turtle to within 2.5 m and place the tag on the moist dorsal surface of the carapace between the longitudinal ridges. The vessel would immediately retreat.

Figure 1. Suction cup attachment. (Figure courtesy of SWFSC).

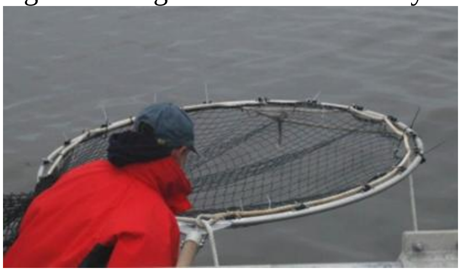


Track
The researchers would track a sonic-tagged leatherback from the vessel, keeping a minimum distance of 300 m. They would track a VHF-tagged turtle either from the vessel (minimum distance 100 m and up to 4 km) or using aircraft (>4 km). They would track turtles for a minimum of one hour and a maximum of five days. Suction cups that detach within five days would be retrieved by the vessel; those that do not detach would be removed from the turtle upon re-approach.

Re-approach
The researchers would re-approach the leatherback to remove the suction cup attachments (if they have not fallen off previously) and perform other activities as follows:

Capture
The researchers would capture the leatherback in a large diameter breakaway hoop net with knotless mesh (Fig. 2). The researchers would use a pulley system to guide the turtle up the landing ramp and onto the vessel.

Figure 2. Large diameter breakaway hoop net. (Photo courtesy of SWFSC).



Weigh
Using a pulley system (Fig. 3), the researchers would lift the leatherback to simultaneously remove the net and measure its weight.

Figure 3. Lifting technique for weight measurement and net removal. (Photo courtesy of SWFSC).

Handle
The researchers would secure the leatherback by holding its limbs close to its body to prevent injuries. They would place wet toweling on the turtle for cover and shade; they would not restrict its breathing. The researchers would use a hose to continuously pump cool, fresh sea water onto the turtle, which would be held for 30 minutes to 1.5 hours.

Tag
For future identification purposes, the researchers would tag the leatherback with flipper and Passive Integrated Transponder (PIT) tags.

Flipper
The researchers would attach Inconel tags (Style 681, National Band & Tag Co.) to the turtle's rear flippers. Inconel is a metal alloy that was designed to resist marine degradation. Prior to attachment, the researchers would sterilize the tags and applicators. They would clean the soft skin along the trailing edge of the rear flippers (near the carapace) with Betadine antiseptic and alcohol.

PIT
Passive Integrated Transponder (PIT) tags are glass-enclosed, electromagnetic tags that are injected subcutaneously and read by a radio frequency scanner. The researchers would clean the injection area (i.e., the right, left or both shoulder areas) with Betadine and alcohol. They would inject the PIT tag(s) into the turtle's shoulder muscle(s).

Sample collection
The researchers would collect specimens from the leatherback to assess genetic stock structure (DNA analyses), foraging ecology (stable isotope analysis), and exposure to marine pathogens and contaminants (hematology/toxicology).

Blood
Using a sterile needle attached to a vacuum syringe, the researchers would draw 10 cc of blood from the hind flipper of the turtle. If the turtle is not calm or easily restrained, they would draw blood from the turtle's dorsal cervical sinuses. They would take care to avoid striking the vertebral column or causing tissue trauma.

Tissue
Researchers would collect a skin sample from free-swimming and captured turtles. For a free-swimming turtle, they would superficially scrape the carapace with a 1 cm diameter stainless steel corer attached to a long. For a captured turtle, they would use a sterile biopsy punch or razor to remove a small amount of tissue from the rear flipper.

Stomach
The researchers would opportunistically collect regurgitated food samples.

Fecal
The researchers would opportunistically collect fecal samples.

Cloacal
The researchers would swab the cloaca (~5 mm deep) to assess the efficacy of this minimally-invasive DNA sampling technique in leatherbacks.

Subcutaneous fat
The researchers would collect subcutaneous fat biopsies from the turtle's hind flippers. They would first prepare the area with Betadine and alcohol, and then apply a lidocaine hydrochloride

solution to minimize pain. They would cut open the skin (1-2 cm) and remove 0.4-4.0 g of fat. They would close the incision site using absorbable sutures and veterinary tissue glue.

Oxytetracycline injection
Oxytetracycline is an antibiotic. Upon injection or ingestion, it becomes deposited into mineralizing tissue, such as bone, and can be used to evaluate age and growth in recovered carcasses. The researchers would inject oxytetracycline either intravenously in the dorsal cervical sinus (using the same needle as described above for blood collection) or intramuscularly in the dorsal shoulder musculature. The dose would be dependent on the mass of the turtle (10-15 mg oxytetracycline/kg turtle).

Ultrasound
The researchers would use ultrasonography to non-invasively measure the depth of the subcutaneous fat layer in an effort to quantify the nutritional condition of the leatherback. They would apply ultrasound gel to the turtle's skin prior to using a portable veterinary ultrasound machine (Sonosite Vet 180 Plus, C60 5-2 MHz transducer).

Measure
Using a measuring tape, the researchers would measure the leatherback.

Photograph/Video
The researchers would photograph or videotape the leatherback for subsequent identification.

Platform Transmitter Terminal (PTT) attachment
Satellite transmitters enable scientists to remotely track the large-scale movements of animals over several years. The leatherback sea turtle's unique "soft" shell requires modification of satellite tag attachment procedures. Wildlife Computers has designed a satellite transmitter tag (the platform transmitter terminal or PTT) specifically for direct attachment to the medial ridge of a leatherback's carapace (Fig. 4). It is concave to conform to the shape of the medial ridge and is painted with anti-fouling marine paint to reduce potential drag. The researchers would attach a PTT to the captured leatherback (> 90 cm curved carapace length) using the following protocol. They would first prepare the site of attachment by applying Betadine antiseptic, isopropyl alcohol, and a topical anesthetic. Using a Betadine-dipped orthopedic drill bit, they would drill two small (4.5 mm diameter) holes in the medial ridge. The holes would penetrate a few millimeters into the carapace ride and would not enter the body cavity. The researchers would insert surgical tubing through the holes and thread flexible, braided stainless steel wire through the tubing. They would place the PTT on a silicone putty base and use the wire to tether it to the turtle's medial ridge with stainless steel crimps. The crimps would corrode after one year, detaching the PTT apparatus from the turtle.

Figure 4. PTT attached to the medial ridge of a leatherback turtle (Jones et al 2011).

Pop-up Archival Transmitter (PAT) attachment

The researchers would also attach a pop-up archival transmitter (PAT) to the leatherback, to validate the PTT data and to collect short-term geo-location and high resolution dive profile information. They would attach the PAT to the pygal region (the overhanging posterior projection) of the carapace. They would use a 7/32" drill bit to drill a hole through the pygal and apply NewSkin to protect against infection. They would insert surgical tubing through the hole and thread monofilament through the tubing. They would tether the PAT to the pygal using the monofilament and stainless steel crimps. The crimps would corrode after one year, releasing the PAT apparatus from the turtle. The attachment is also equipped with a breakaway feature (triggered by dives deeper than 1500 m) and a short tether to minimize the potential for entanglement.

Insert stomach telemeter pill

Stomach telemeter "pill" detects rapid changes in stomach temperature when an endotherm (e.g., leatherback) ingests an ectotherm, such as jellyfish (Casey et al 2010). The researchers would select turtles >150 cm curved carapace length for this procedure. They would insert the pill into the turtle's esophagus as follows: use flat nylon webbing to open turtle's mouth and keep jaws agape; insert lubricated, flexible PVC tube in turtle's esophagus to a depth of 40 cm; insert pill in tube; push pill out of tube using rigid PVC trocar (with a stop to prevent insertion beyond 2 cm). Once in the stomach, the pill coating would dissolve, exposing a chemical which would cause the pill to expand to 40 mm (for retention). The instrument would register temperatures and transmit the data to the PTT (see above). The pill coating would continue to dissolve, until the instrument would be small enough to pass through the digestive tract (12-13 days).

Suction-cup attachment

The researchers would attach a short-term telemetry device, as described above, to compare behavior pre- and post-capture.

Release

The researchers would guide the leatherback down the landing ramp to the water's surface.

Track

The researchers would track the leatherback for one hour to five days, as described above.

PERMIT CONDITIONS

The Permits Division requires permitted researchers to minimize the potential for any adverse impacts to the target species (i.e., leatherback sea turtles) as well as any additional ESA-listed species in the action area. Only experienced personnel may handle, biopsy, and tag the leatherbacks. Biopsy and tag attachment areas must be cleaned with Betadine before and after each procedure. Sampling equipment and tags must be cleaned and disinfected before each use; any invasive tools must be either new or sterilized between uses. In addition, the Permits Division would place following conditions and requirements on research permit No. 15634:

1. Aerial surveys must be flown at altitudes of at least 650 feet; they must not be conducted over marine mammal haul out areas, and the researchers must try to avoid flying over marine mammals.
2. The researchers should not approach or capture severely wounded turtles or those displaying abnormal behavior. They may capture injured sea turtles, but only if the above described activities will not further compromise the health of the animal.
3. The researchers must minimize in-water chase activities to the extent possible.
4. The researchers should limit the number of attempts to attach the suction cup transmitter or to capture an animal with the hoop-net. If researchers are unsuccessful after three attempts, they must wait a minimum of four hours before making at most two more attempts in any 24 hour period.
5. The researchers must remove turtles from the net safely and quickly.
6. The researchers must handle turtles according to procedures specified in the permit and its attachments. Specifically,
   a) At least two researchers should handle each turtle, one on either side with both providing support from underneath the turtle.
   b) Turtles are to be protected from temperature extremes, provided adequate air flow, and kept moist (if appropriate) during the procedures.
   c) Turtles must be placed on pads for cushioning; this surface must be cleaned and disinfected between turtles. The area surrounding the turtle must not contain any materials that could be accidentally ingested.
7. The researchers must examine turtles for existing flipper and PIT tags before attaching or inserting new ones.
8. The researchers should ensure that no injury results from biopsy sampling. If an animal cannot be adequately immobilized or if conditions on the boat preclude the safety and health of the turtle, samples must not be taken.
   a) Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side. A single blood sample must not exceed 3 ml/kg.
   b) Biopsy punches must be collected from the rear flipper if possible.
   c) To obtain samples from free-swimming turtles, the researcher should collect shallow carapacial scrapes from the most safely and easily accessible area (except for the head).
9. The researchers must maintain a separate set of tagging and sampling equipment for handling animals displaying fibropapillomas tumors or lesions.
10. The total combined weight of all transmitter attachments must not exceed 5 percent of the body mass of the animal. Each attachment must be made so that there is no risk of entanglement. The transmitter attachment must include a corrodible, breakaway link for release. Researchers must make attachments as hydrodynamic as possible.

When drilling through the medial ridge or pygal region, a new or sterilized drill bit must be used for each turtle. This permit only authorizes the PTT, PAT and stomach telemeter pills for the first year of the permit or the first year it is used. Attachments using these techniques in subsequent years will be authorized only after review of reported results of its use and issuance of written authorization from the Permits Division. If researchers discover that a transmitter is compromising the turtle's health (e.g., animal exhibits infection due to attachment, unusual behavior, etc.), they must attempt to recapture the animal to remove the transmitter. Any wounds must be debrided and cleaned.

11. Researchers must contact a veterinarian if a turtle becomes highly stressed, injured, or comatose. When possible they should transfer injured animals to rehabilitation facilities and allow them an appropriate period of recovery before release. For comatose turtles, the researchers must follow the resuscitation procedures described in 50 CFR 223.206(d)(1)(i) prior to release.
12. Researchers must carefully observe newly released turtles. If a turtle is not behaving normally within one hour of release, it must be recaptured and taken to a rehabilitation facility.

APPROACH TO THE ASSESSMENT

The National Marine Fisheries Service approaches its Section 7 analyses 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 effects (i.e., the *Action Area*). The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time. We then perform our *Effects Analyses*. The first of these are our *Exposure Analyses,* in which 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. We evaluate which aspects of the proposed actions could be considered stressors on listed species (i.e., *Potential Stressors*). We then examine available scientific and commercial data to determine whether and how listed individuals are likely to respond to each stressor (i.e., *Response Analyses*).

The final steps of our analyses include assessing the risks those responses pose to listed species and the impacts to their designated critical habitat (i.e., *Risk Analyses*). Our jeopardy determinations must be based on an action's impact on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct populations of vertebrate species. The continued existence of species depends on the fate of the populations that comprise them. Similarly, the continued existence of populations is 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 the species, and the individuals that comprise those populations. They begin by identifying the probable risks that actions pose to listed individuals. 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.

We measure risks to listed individuals in terms of "fitness," i.e., their 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 identified during our response analyses) are likely to have consequences for its fitness.

When individual listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (Stearns, 1992; Mills and Beatty 1979; Anderson 2000). 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. Alternatively, 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. 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 are 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 must next consider whether those fitness reductions are likely to reduce the viability of the population(s) the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population's base condition (established in the *Environmental Baseline* and *Status of the Species* sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

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

To conduct these analyses, we rely on all of the evidence available to us. This evidence might consist of: monitoring reports submitted by past and present permit holders; reports from NMFS

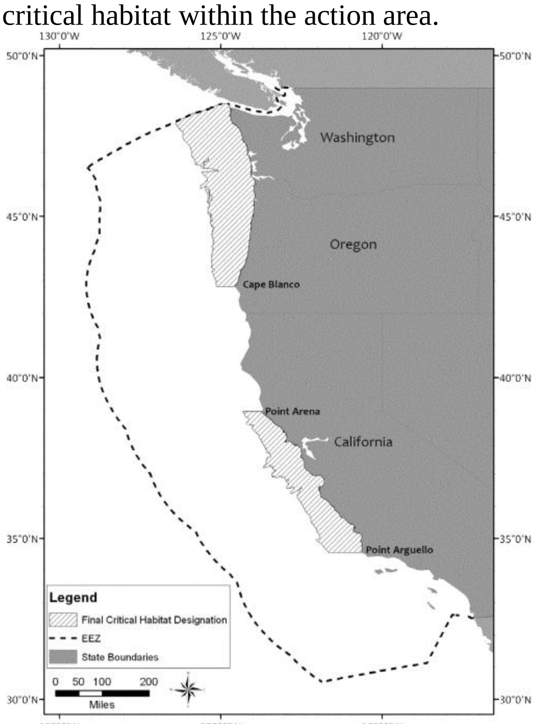
Science Centers; reports prepared by natural resource agencies in states and other countries; reports from domestic and foreign non-governmental organizations involved in marine conservation issues; the information provided by the Permits Division when it initiates formal consultation; and published scientific literature. To find this information, we conduct searches of peer reviewed scientific literature, master's theses, doctoral dissertations, government reports, and commercial studies. These searches include the use of literature search engines such as *Science Direct*, *BioOne*, *JSTOR*, and *Google Scholar* as well as the use of NOAA and university libraries. We focus on identifying recent information on the biology, ecology, distribution, status, and trends of the threatened and endangered species considered in this opinion.

We evaluate all evidence based on the quality of the study design, sample sizes, and study results. When data are equivocal, or in the face of 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. In those cases, in keeping with the direction from the U.S. Congress to provide the "benefit of the doubt" to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], we generally make determinations which provide the most conservative outcome for listed species.

ACTION AREA

The action area is defined in 50 CFR 402.2 as "all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action." The action area under these proposed activities would be as follows for the next five years: waters within 200 nautical miles (U.S. EEZ) off the coasts of California, Oregon and Washington (Fig. 5).

Figure 5. The action area, indicated by the broken line. The striped areas indicate leatherback turtle critical habitat within the action area.



STATUS OF THE SPECIES

The following endangered and threatened species may occur in the action area:

Common Name	Scientific Name	Listing Status
Sea Turtles		
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle,	*Caretta caretta*	
North Pacific DPS		Endangered
Olive ridley sea turtle	*Lepidochelys olivacea*	
Breeding populations on the Pacific coast of Mexico DPS		Endangered
All other populations DPS		Threatened
Green sea turtle	*Chelonia mydas*	
Mexico's Pacific coast breeding colony		Endangered
All other areas		Threatened
Marine Mammals		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Pacific right whale	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Killer whale	*Orcinius orca*	
Southern resident population		Endangered
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Steller sea lion	*Eumetopias jubatus*	
Eastern DPS		Threatened
Fish		
Chinook salmon ESUs	*Oncorhynchus tshawytscha*	Threatened, Endangered
Chum salmon ESUs	*Oncorhynchus keta*	Threatened
Coho salmon ESUs	*Oncorhynchus kisutch*	Threatened, Endangered
Sockeye salmon	*Oncorhynchus nerka*	Threatened, Endangered
Steelhead trout DPSs	*Oncorhynchus mykiss*	Threatened, Endangered
Green sturgeon	*Acipenser medirostris*	
Southern DPS		Threatened
Pacific eulachon/smelt	*Thaleichthys pacificus*	
Southern DPS		Threatened
Marine Invertebrates or Plants		
Black abalone	*Haliotis cracherodii*	Endangered
White abalone	*Haliotis sorenseni*	Endangered

Species and Critical Habitat Not Likely to Be Affected by the Action

The purpose of this action is to perform research on leatherback sea turtles, discussed in a later section. There is potential for non-target species to be affected by three activities: aerial surveys, close-vessel approach, and acoustic tracking. No activities are likely to destroy or adversely modify critical habitat.

The researchers would conduct aerial surveys at 650-1000 ft, or higher if required by marine sanctuary regulations. The minimum altitude of 650 ft provides a greater noise buffer than the 500 ft minimum required of all small aircraft by Federal Aviation Regulation 91.79. As required by the permit, the researchers would not hover or circle over marine life and would avoid all marine mammals. They would specifically avoid known pinniped haul-out areas and rookeries, including those of Guadalupe fur seals and Steller sea lions, Eastern DPS. Their flights may pass unknowingly over submerged cetaceans, including: blue whales, fin whales, humpback whales, North Pacific right whales, sei whales, sperm whales, and the southern resident population of killer whales. Unlike whale watching flights or aerial surveys that target cetaceans, the proposed surveys would actively try to avoid whales. They would not hover over, circle or track these species. Any disturbance would thus be transient and minimal. The SWFSC has conducted aerial surveys of this type for over 21 years, flying 50-150 hours per year. In that time, they have not documented any effects on marine mammals or turtles. We conclude that the distant sight and noise of the plane would have an insignificant impact on the behavior of ESA listed cetaceans, pinnipeds, and non-target turtles. Therefore, aerial surveys are not likely to adversely affect cetaceans, pinnipeds, and non-target turtles.

The researchers would not intentionally approach non-target species in their vessel. They would avoid all mammals, fish, and invertebrates. They would not approach loggerhead, olive ridley, or green sea turtles because leatherbacks are easily identifiable from other sea turtles. Leatherbacks lack a hard, bony shell, and their unique shape is recognizable from a distance. The approach of non-target species is thus discountable, i.e., extremely unlikely to occur. Therefore, close-vessel approach is not likely to adversely affect the above listed marine mammals, fish, invertebrates, and non-leatherback sea turtles.

Acoustic tracking involves the use of high frequency sound transmission. If this frequency does not overlap with the hearing range of listed species, the effects on exposed individuals are expected to be insignificant. The acoustic tags transmit at a frequency of 69 kHz. This is well above the hearing range of tested sea turtles: green, 100-800 Hz; Kemp's ridley, 100-500 Hz; and loggerhead, 250-1000 (Bartol & Ketten 2000; Bartol et al 1999; Ketten & Bartol 2006). The hearing range olive ridley sea turtles is likely similar to that of other sea turtle species (i.e., <1000 Hz). The high frequency acoustic pinging is also above the hearing range of listed cetaceans that may occur in the area: blue whale (200 Hz), fin whale (160-750 Hz), humpback whale (50-10,000 Hz), right whale (0.01-22 kHz), sei whale (<3.5 kHz), sperm whale (16-30 kHz), and killer whale (0.25-35 kHz) (Ketten 1997; McDonald et al 2005; Parks et al 2007). Steller sea lions hear within the range of 0.5-32 kHz (Kastelein et al 2005). Though there has been no auditory assessment of the Guadalupe fur seal, it is likely that their hearing falls within a similar range as that of the Northern fur seal, 2-40 kHz (Moore & Schusterman 1987). Fishes hear at low frequencies, <0.5-1 kHz (Wahlberg & Westerberg 2005); and mollusks merely detect low frequency sound (Mooney et al 2010). Therefore, acoustic tracking is not likely to adversely affect the above listed sea turtles, marine mammals, fish, and abalone.

Within the action area, there is critical habitat for the Steller sea lion, Eastern DPS, and black abalone (in addition to the leatherback sea turtle critical habitat, which is discussed in a later section). The following areas are considered to be critical habitat of the Steller sea lion, Eastern DPS, within the action area: Long Brown and Seal Rocks, Pyramid Rock, Sugarloaf Island and Cape Mendocino, Southeast Farallon Island, and Ana Nuevo Island. For each of these important rookery and haul-out sites, critical habitat consists of terrestrial lands, 3000 ft seaward (important foraging grounds) and 3000 ft above (aerial restrictions). The researchers would avoid these areas during their aerial surveys and while in their vessel. They would maintain minimum distances at all time. Therefore, their proposed actions are not likely to destroy or adversely modify designated critical habitat of the Steller sea lion, Eastern DPS.

Black abalone critical habitat consists of the rocky intertidal and subtidal areas along the California coast between the Del Mar Landing Ecological Reserve to the Palos Verdes Peninsula, as well as off the following islands: Farallon, Ano Nuevo, San Miguel, Santa Rosa, Santa Cruz, Anacapa, Santa Barbara, and Santa Catalina. This includes the intertidal and subtidal habitats from the mean high water line to a depth of 6 m (relative to the mean low water line). The researchers' activities would not occur in rocky intertidal and subtidal areas; therefore, their actions are not likely to destroy or adversely modify designated or proposed critical habitat.

In conclusion, the following non-target species and their critical habitats are not likely to be affected by the actions of the researchers, and therefore, are not considered further in this opinion:

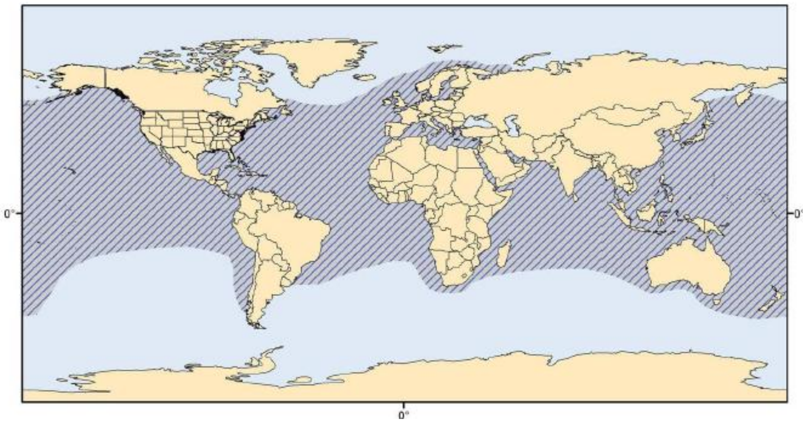
- Loggerhead sea turtle, North Pacific DPS
- Olive ridley sea turtle, breeding populations on the Pacific coast of Mexico and other populations DPSs
- Green sea turtle, Mexico's Pacific coast breeding colony and all other areas
- Blue whale
- Fin whale
- Humpback whale
- North Pacific right whale
- Sei whale
- Sperm whale
- Killer whale, Southern resident population
- Guadalupe fur seal
- Steller sea lion, Eastern DPS
- Chinook salmon ESUs
- Chum salmon ESUs
- Coho salmon ESUs
- Sockeye salmon
- Steelhead trout DPSs
- Green sturgeon, Southern DPS
- Pacific eulachon/smelt, Southern DPS
- Black abalone
- White abalone

Species Likely to be Affected by the Action: leatherback sea turtle (*Dermochelys coriacea*)

Species Description and Distribution

The leatherback is the largest of all sea turtles (up to 916 kg; Eckert & Luginbuhl 1988) and the only species lacking a hard, bony carapace. Its slightly flexible carapace is made primarily of tough, oil saturated connective tissue. The species has an extensive distribution, ranging from tropical to subpolar latitudes (Fig. 6). This unique reptile is able to withstand broad temperature extremes because of its large body size (Paladino et al 1990), thick peripheral insulation (Goff & Stenson 1988), counter-current heat exchange (Greer et al 1973), and thermoregulatory behavior (Bostrom et al 2010). Juveniles are restricted to tropical waters (≥26 °C); after they exceed 100 cm in carapace length, they are able to move into the temperate waters that comprise their primary foraging habitat (Eckert 2002).

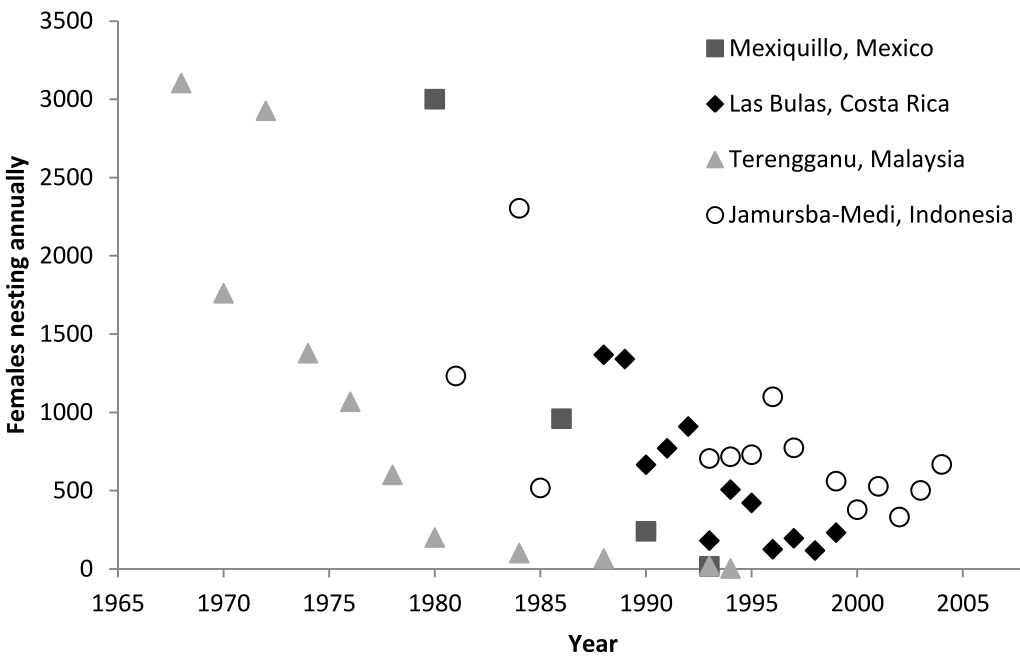
Figure 6. Range of the leatherback turtle.



Listing Status

The leatherback sea turtle has been listed as endangered under the ESA since 1973 and, prior to that, under the Endangered Species Conservation Act (35 FR 8491). The species is considered to be critically endangered worldwide (Sarti Martinez 2000). The global population of adult females has declined over 70 percent in less than one generation, from an estimated 115000 adult females in 1980 to 34500 adult females in 1995 (Pritchard 1982; Spotila et al 1996). Dramatic reductions have occurred in several populations in the Pacific (Fig. 7), which was once considered the stronghold of the species (Sarti Martinez 2000).

Figure 7. Population trends in the Indo-Pacific (Hitipeuw et al 2007; Reina et al 2002; Spotila et al 1996).



Population Designations, Abundance and Trends

Leatherbacks turtles are long-lived, far-ranging, and tolerant of a range of sea surface temperatures. Though both males and females exhibit some degree of natal homing (James et al 2005c), nest-site and breeding-site fidelity does not appear to be as rigid in this species as in other sea turtles (Dutton et al 1999). Therefore, population designations are less discrete. Nevertheless, we can group nesting aggregations into five broad geographic regions: eastern Pacific, western Pacific, Indian, eastern Atlantic, and western Atlantic. Genetic studies indicate the reproductive isolation of these designations, which are distinguished by the presence of unique mitochondrial DNA haplotypes or significant differences in haplotype frequencies (Dutton et al 1999; Dutton et al 2007).

Eastern Pacific. In the eastern Pacific, the estimated number of adult females declined by from 4638 to 1690 (64 percent) between the years of 1995 and 2000 (Spotila et al 1996; Spotila et al 2000). The largest nesting aggregations of this region occur on the beaches of Mexico and Costa Rica. There has been a steady decline in the number of females observed at the four major nesting sites in Mexico: Mexiquillo, Tierra Colorada, Cahuitan, and Barra de la Cruz (Sarti Martinez et al 2007). At Las Baulas National Park, the largest leatherback rookery in Costa Rica, the nesting population declined 83 percent (from 1367 to 231 adult females) from 1988 to 1999 (Fig.7; Reina et al. 2002).

Western Pacific. The western Pacific region supports an estimated 2100-5700 breeding females (Dutton et al 2007). The largest leatherback rookeries occur at the Jamursba-Medi and Wermon beaches of Papua, Indonesia (Hitipeuw et al 2007). There are also significant nesting aggregations on beaches throughout Papua New Guinea, Vanuatu, and the Solomon Islands (Benson et al 2007c; Dutton et al 2007; Hitipeuw et al 2007). It is difficult to describe leatherback abundance trends in the western Pacific because new nesting aggregations are continually being found, and historical data is limited to one location. At Jamursba-Medi, an estimated 300-900 females nest annually (Hitipeuw et al 2007). Though these estimates are similar to those reported in the 1990s (Dutton et al 2007; Spotila et al 1996), they are lower than those from the early 1980s (Fig. 7; Hitipeuw et al. 2007). We do not include the Terengganu, Malaysia rookery here because it is genetically differentiated from western Pacific populations (Dutton et al 2007), suggesting long-term reproductive isolation possibly as a result of previous barriers to gene flow (e.g., the Sunda Shelf).

Indian. The once large rookery at Terengganu, Malaysia is now functionally extinct. Beaches that once supported over 3000 females nesting annually, now host 2 or 3 females per year, representing a 99 percent decline since 1950 (Chan & Liew 1989; Chan et al 1988). At present, the largest nesting aggregations in the Indian Ocean occur on Andaman and Nicobar Islands (India), where 400-500 females nest annually (Andrews & Shanker 2002). Significant nesting aggregations also occur in Sri Lanka, South Africa, and Mozambique (Hamann et al 2006). We tentatively group all Indian Ocean rookeries, but no genetic or tagging data are available to assess the stock structure of these populations.

Atlantic (eastern and western). In 2007, the Turtle Expert Working Group provided a population estimate of 34,000-94,000 adult leatherbacks in the North Atlantic (TEWG 2007). Based on genetic and tagging data, there are at least two stocks (eastern and western Atlantic) and possibly as many as seven (TEWG 2007). In the western Atlantic and Caribbean Sea, nesting occurs on beaches in Puerto Rico, St. Croix, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Sao Tome and Principe, French Guiana, Suriname, and Florida (Bräutigam & Eckert 2006; Márquez 1990; Spotila et al 1996). Nesting occurs in the eastern Atlantic, from

Mauritania to Angola (Fretey et al 2007). Gabon hosts the world's largest population of leatherbacks, estimated at 15,730- 41,373 females (Witt et al 2009). Population dynamics are relatively stable in the Atlantic, but estimates fluctuate considerably due to individual variance in remigration intervals, clutch number, and inconsistent nest site fidelity (TEWG 2007).

Threats
Leatherbacks face a multitude of threats. Natural threats include: predation on adults by sharks and killer whales (Pitman & Dutton 2004); predation on hatchlings by seabirds, land predators, and sharks; and tidal inundation of nests (Caut et al 2009). Anthropogenic threats are more numerous and diverse. Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Crognale et al 2008; Fossette et al 2009; Gless et al 2008; Petersen et al 2009). Harvest of females along nesting beaches is of concern worldwide. Egg collection is widespread and has contributed to catastrophic declines, such as in Malaysia. There is increasing development and tourism along nesting beaches (Hernandez et al 2007; Maison 2006; Santidrián Tomillo et al 2007). Structural impacts to beaches include: building and piling construction, beach armoring and renourishment, and sand extraction (Bouchard et al 1998; Lutcavage et al 1997). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al 2009; Chacón Chaverri 1999; Formia et al 2003; Laurance et al 2008). Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea (Bourgeois et al 2009; Cowan et al 2002; Deem et al 2007; Witherington 1992; Witherington & Bjorndal 1991). Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al 2009). Although global climate change may expand foraging habitats into higher latitude waters, increasing temperatures may increase feminization of nests (Hawkes et al 2007; James et al 2006; McMahon & Hays 2006; Mrosovsky et al 1984). It may also result in rising sea levels, which may inundate nests on some beaches.

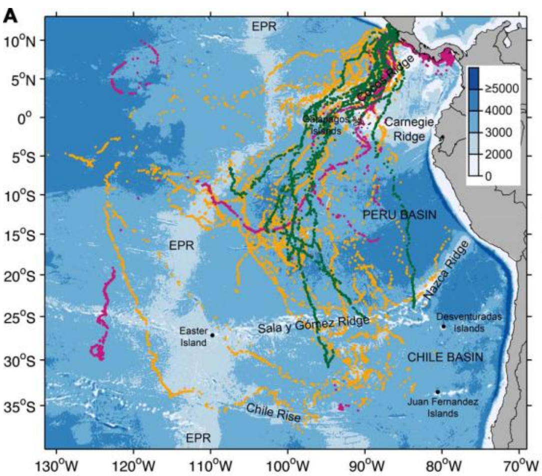
Reproduction
Both males and females exhibit some degree of philopatry, returning to their natal beaches for breeding and nesting (James et al 2005b). Age to maturity remains elusive, with estimates ranging from 5 to 29 years (Avens et al 2009; Spotila et al 1996). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing >80 g (Reina et al 2002; Wallace et al 2007). Females remigrate every 1-7 years, with most turtles returning every two years to nest in French Guiana (Rivalan et al 2005b) and every three years in Las Baulas, Costa Rica (Reina et al 2002). The remigration interval for western Pacific leatherbacks is unknown but estimated as "several years" (Benson et al 2011). According to Wallace (2007), high seasonal and lifetime fecundity likely reflect compensation for high and unpredictable mortality during early life history stages.

Migration
Leatherback sea turtles migrate long distances between their tropical nesting beaches and the highly productive temperate waters where they forage (i.e., remigration; Fig. 8). Leatherbacks weigh ~33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al 2005a; Wallace et al 2006). Sea turtles must meet an energy threshold before returning to nesting beaches (Casey et al 2010; Rivalan et al 2005b; Sherrill-Mix & James 2008). Therefore, their

remigration intervals (the time between breeding seasons) are dependent upon foraging success and duration (Hays 2000; Price et al 2004). Eastern Pacific leatherbacks use a consistent migration corridor to forage in the South Pacific Gyre, a low-productivity region (Shillinger et al 2008). Western Pacific turtles that nest during the boreal summer migrate to forage in temperate waters of the North Pacific or tropical waters of the South China Sea; those that nest during the boreal winter forage in temperate and tropical waters of the southern hemisphere (Benson et al 2011). Post-nesting, western Atlantic leatherbacks migrate to foraging areas in the North Atlantic or the equatorial eastern Atlantic (Eckert et al 2006; Eckert 2006; Ferraroli et al 2004; Hays et al 2004). Eastern Atlantic leatherbacks migrate to foraging areas in the equatorial Atlantic, temperate waters off South America, or temperate waters off southern Africa (Witt et al 2011).

Figure 8. Leatherback turtle migration from nesting beaches in a) the eastern Pacific (Shillinger et al 2008); b) the western Pacific (Benson et al 2011); c) western Atlantic (Hays et al 2004); and d) eastern Atlantic (Witt et al 2011)

a)



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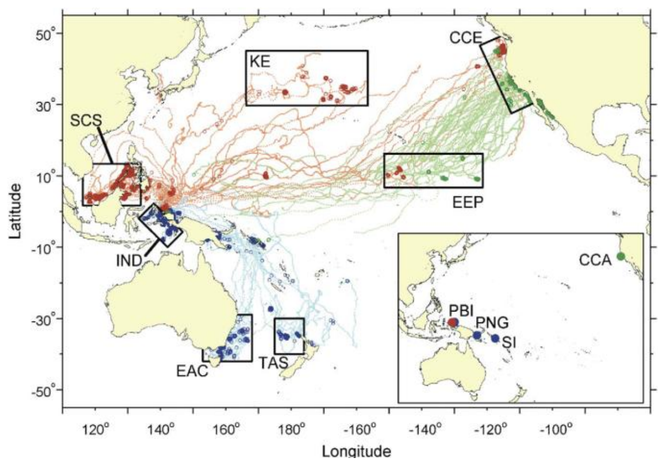

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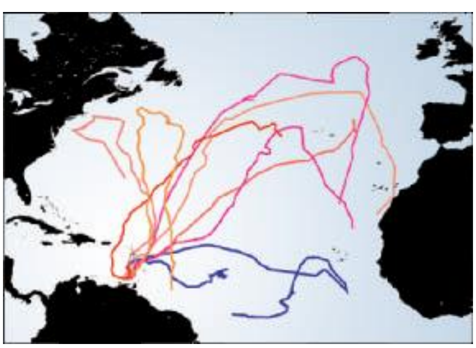

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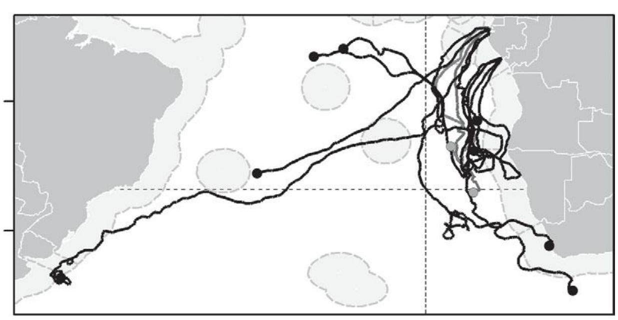

Foraging

Leatherbacks feed primarily on jellyfish, such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974), and tunicates (salps, pyrosomas). These gelatinous zooplankton are relatively nutrient-poor (Doyle et al 2007), such that leatherbacks must consume large quantities to support their body weight. Leatherbacks are deep divers with a maximum-recorded depth of over 4000 m (Eckert et al 1989; López-Mendilaharsu et al 2009). Dives are typically 50-84 m (Standora et al

1984) and last 1-14 min (Eckert et al 1989; Eckert et al 1996; Harvey et al 2006; López-Mendilaharsu et al 2009). The depth of their dives often corresponds with the vertical distribution of their prey (Harvey et al 2006; Hodge & Wing 2000).

Habitat

Leatherbacks are widely distributed throughout oceans. They migrate to areas of high prey density, often concentrated by oceanographic features such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al 2011; Collard 1990; Davenport & Balazs 1991; Frazier 2001; HDLNR 2002). Leatherbacks off the western United States are more likely to occur in continental slope waters than shelf waters (Bowlby et al 1994; Carretta & Forney 1993; Green et al 1992; Green et al 1993). Leatherbacks also require sandy beach habitat for nesting. In the southwest Pacific, females appear to favor nesting sites with higher wind and wave exposure, possibly as a means to aid hatchling dispersal (Garcon et al 2010).

Critical Habitat

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands 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 support significant critical habitat deterioration.

On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle (50 CFR Part 226). This designation includes approximately 43798 km^2 stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64760 km^2 stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2000 m depth contour (Fig. 5). The designated areas comprise approximately 108558 km^2 of marine habitat and include waters from the ocean surface down to a maximum depth of 80 m.

ENVIRONMENTAL BASELINE

The *Environmental Baseline* includes the past and present impacts of all state, Federal, or private actions and other human activities in the action area. It also includes the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, as well as those of state or private actions that are contemporaneous with this consultation (50 CFR §402.02). Here we discuss activities affecting the status and trends of leatherback sea turtles in the action area (i.e., the U.S. West Coast EEZ); we also discuss activities occurring in areas to which leatherbacks could migrate during the course of their life cycle (i.e., migratory routes throughout the Pacific Ocean and nesting beaches in the western Pacific). While some activities (e.g. commercial harvesting of individuals as well as eggs) no longer occur in the United States, they affect leatherbacks when they nest on beaches in other countries. Natural phenomena have also contributed, and continue to influence, the current status of leatherback sea turtles. The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood that this species will survive and recover in the wild. These include predation, habitat degradation and climate change, bycatch, directed harvest, and scientific research.

Natural Stressors
In the action area (i.e., West Coat EEZ), sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman & Dutton 2004). At nesting beaches (in the western Pacific), hatchlings are preyed upon by land predators, sea birds and sharks. Tidal inundation is also a concern. Beaches are subject to seasonal and storm-related erosion, which washes away unhatched nests (e.g., 80 percent during one season at Jamursba-Medi; Hitipeuw et al. 2007. Additionally, high sand temperatures may exceed the thermal tolerance of embryos (Tapilatu & Tiwari 2007).

Anthropogenic Stressors

Hunting/Poaching/Harvesting
To our knowledge, adult and juvenile leatherbacks are not hunted within the West Coast EEZ. On the high seas, however, adults and juveniles are caught incidentally and killed for human consumption (Benson et al 2007a; Benson et al 2011). Subsistence hunting of adults occurs on foraging grounds and/or nesting beaches in Indonesia, PNG and the Kei Islands (Benson et al 2011; Dutton & Squires 2008). Eggs are harvested for subsistence and commercial sale in the western Pacific (Benson et al 2007c; Dutton & Squires 2008).

Fisheries Interactions
In U.S. Pacific waters, leatherback bycatch occurs in the following fisheries: California pelagic longline; California set net; and Hawaii pelagic longline. They have a total annual mean bycatch of 30 leatherbacks, 10 of which result in mortality (Finkbeiner et al 2011). The majority of interactions (N = 23) involve the Hawaii longline fishery, which uses shallow sets to target swordfish. Because leatherbacks spend the majority of time near the surface (Eckert et al 1989), these shallow fisheries pose a greater risk to leatherbacks than deep set lines (Dutton & Squires 2008). To minimize interactions, the Hawaii fishery now employs spatial and temporal closures, 100 percent observer coverage, and gear restrictions (Moore et al 2009). Closure of the California-based shallow-set longline fishery (69 FR 11540-11545) and regulation of the California/Oregon drift gillnet fishery (66 FR 44549-44552) have eliminated two sources of bycatch in the West Coast EEZ (Finkbeiner et al 2011; Moore et al 2009).

Leatherbacks are also caught incidentally in high seas longline fisheries (Benson et al 2007b; Dutton et al 2007; Dutton & Squires 2008). This international, industrial-scale fishery involves more than 2000 vessels, the majority of which are from Japan, Korea, and Taiwan. Current fishing effort is 400 million hooks per year in the western and central Pacific and 200 million hooks per year in the eastern Pacific (Dutton & Squires 2008).

Though the Pacific high seas drift gillnet fishery was shut down by the United Nations in the late 1980s, it continues under vessels reflagged under non-signatory nations (Dutton & Squires 2008). Other fisheries that contribute to leatherback mortality include shrimp trawling, purse seining, and groundfish trawling (Dutton & Squires 2008). Coastal driftnet fisheries also have a large impact on leatherbacks, especially when they are conducted close to nesting beaches in the western Pacific (Benson et al 2007b; Dutton et al 2007; Dutton & Squires 2008). In Indonesia, most fishing occurs during the eastern monsoon season, which coincides with peak nesting at

Jamursba-Medi; incidental take and entanglements have been reported by local communities (Hitipeuw et al 2007).

Development and Construction
Western Pacific nesting beaches are threatened by erosion as a result of logging activity (Hitipeuw et al 2007). Development and tourism threaten beach habitat but are less of a threat in the western Pacific as compared to the eastern Pacific (Hamann et al 2006; Hernandez et al 2007; Maison 2006; Santidrián Tomillo et al 2007).

Marine Debris
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).

Non-native species introductions
On their natal beaches in the western Pacific, hatchlings are preyed upon by pigs, dogs, and lizards; at one beach in Jamursba-Medi, ~30 percent of nests were depredated in one season (Hitipeuw et al 2007; Tapilatu & Tiwari 2007).

Global climate change
Global climate change has and will continue to result in sea level rise, more frequent severe weather events, increased sea surface temperatures, and increased air temperatures. An increase in sea level and/or more frequent storms would likely increase the number of leatherback nests that are washed away prior to hatching. Increasing sea surface temperatures may expand foraging habitats into higher latitude waters, but increasing air temperatures may increase feminization of nests (Hawkes et al 2007; James et al 2006; McMahon & Hays 2006; Mrosovsky et al 1984).

Research
Section 10(a)(1)(A) of the ESA enables the Permits and Conservation Division to issue a permit, allowing take of certain ESA-listed species for the purposes of scientific research. There are four permits that allow research on leatherbacks in the West Coast EEZ: Nos. 1596-03 (the applicant's current permit, which the proposed action would replace), 14381, 14097, and 14510. Each been reviewed for compliance with Section 7(a)(2) of the ESA, i.e., to insure that issuance of the permit does not result in jeopardy to the species. Permits Nos. 14097 and 14510 are held by the applicant. No. 14097 authorizes similar research activities as proposed above on leatherbacks (N=10) in U.S. territorial and international waters. Permit No. 14510 authorizes research to be performed on stranded leatherbacks (N=2) along the California coast. Permit No. 14381, held by the NMFS Pacific Islands Regional Office, authorizes similar research activities (e.g., flipper tagging, measuring, and specimen collection) to be conducted on leatherbacks (N=39) captured as bycatch in Pacific commercial fisheries, primarily around the Hawaiian Islands and American Samoa.

Conservation, Management and Recovery Actions Shaping the Environmental Baseline
Several mitigation measures are underway to protect leatherbacks at sea and on nesting beaches. In the U.S. West Coast EEZ, regulations have reduced bycatch by 70 percent and mortality by 80 percent (Finkbeiner et al 2011). The California-based shallow-set longline fishery has been permanently closed (69 FR 11540-11545). No leatherback takes have been recorded in the California/Oregon drift gillnet fishery since time-area closures were put into place in 2001 (Moore et al 2009). To minimize interactions, the Hawaii fishery employs spatial and temporal closures, 100 percent observer coverage, and gear restrictions (Moore et al 2009). California pelagic longline fishery regulations (69 FR 11540) include spatial and gear-specific closures (Finkbeiner et al 2011)

There are two international agreements which promote leatherback conservation in the Pacific: the Indian Ocean South East Asian Marine Turtle Memorandum of Understanding (IOSEA-MOU) and the Inter-American Convention for the Conservation and Protection of Sea Turtles (IAC). The Conservation and Management plan of the IOSEA-MOU includes provisions to mitigate threats by reducing incidental capture and mortality through turtle excluder devices (TEDs) and seasonal/spatial closures of fisheries (Dutton & Squires 2008). The IAC prohibits the intentional capture or killing of sea turtles in the Americas, with exceptions for subsistence take.

Western Pacific nations have also taken measures to limit the harvest of adults and eggs on nesting beaches. In 1994, a local district decree created a wildlife sanctuary to protect Jamursba-Medi beaches (Hitipeuw et al 2007). Large-scale egg harvest has been eliminated at Jamursba-Medi, and subsistence harvest of eggs had been reduced in Papua New Guinea (Dutton et al 2007). There is local effort in both Indonesia and Papua New Guines to protect nesting beaches against predation and erosion (Benson et al 2007c; Hitipeuw et al 2007).

EFFECTS OF THE PROPOSED ACTION

Pursuant to Section 7(a)(2) of the ESA, Federal agencies are directed to insure 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. For this consultation, we are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed permit would authorize non-lethal "takes" by harassment of listed species during activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. For this Opinion, we define harassment as an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents. This is similar to the U.S. Fish and Wildlife Service's regulatory definition of "harass" pursuant to the ESA (50 CFR 17.3).

Exposure Analyses
In accordance with Section 10(a)(1)(A) of the Endangered Species Act, the Permits Division determines the maximum number of exempted annual takes allowed (Table 1), should the permit

be issued. It is important to emphasize that the take table defines the maximum level of take that would be permitted; it does not necessarily reflect the number of turtles that *are likely* to be exposed to such activities. To determine the number of leatherbacks that are likely to be exposed to such activities, we consider past research effort and proposed modifications to the previous research permit.

Since 2006, the annual number of leatherback sea turtle interactions ranged from 0 to 21, with an average of 6 per year (Table 2). With the exception of 2007, 0-1 turtles were captured per year. The number of suction cup attachments ranged from 0-8, with an average of 1.4 per year. Though size and sex data was not reported for all turtles, the available data indicate that most turtles are female and all are adults.

Table 2. Actual takes from previously permitted activities, calculations (in italics), and proposed maximum take for 2012-2017 (in bold).

Year	Total no. interactions	percent female	percent adult	Capture, tag, sample, harness PTT	Capture, tag, sample	Suction cup, no capture
2006	0	0	0	0	0	0
2007	21	76	100	7	5	8
2008	7	Unk.	Unk.	0	1	6
2009	1	Unk.	Unk.	0	1	0
2010	1	100	100	0	0	1
Total	*30*	*77*	*100*	*7*	*7*	*15*
Mean	*6*	*NA*	*NA*	*3*	*1.4*	*1.4*
SD	*8.8*	*NA*	*NA*	*3.7*	*3.1*	*2.1*
Mean + 4SD	*42*			*18 (cannot exceed 10)*	*14*	*10*
Maximum take	**55**			**10 (PTT&PAT)**	**25**	**20**

In the past, the researchers have concentrated most of their work in the waters off California because that is where the turtles appear to be most abundant (relative to Oregon and Washington). Aerial surveys along the central and northern California coast sighted 2-28 turtles per year from 1990 to 2003 (Benson et al 2007b) . The annual estimated abundance of leatherback turtles in California is 12-379 (Mean = 178). Aerial surveys conducted off the coasts of Oregon and Washington sighted 4 turtles over four days in 2010 (Benson & Seminoff 2011). Aerial sighting of leatherbacks is a prerequisite for the proposed research. Therefore, we do not expect the number of turtles exposed to the action to exceed sightings (i.e., maximum of 28 in one year); however, increased effort in all three states would result in greater exposure. Though funding will be limited in 2012, it may increase in the future, potentially leading to additional survey time.

How many turtles are likely to be exposed to the proposed activities? The actual take cannot exceed the annual permitted take (Table 1); however, the number of turtle interactions has not approached the maximum permitted take in previous years. Using the mean actual take per year would underestimate exposure in certain years; a better approach may be to consider four standard deviations of the mean, which would include 99.99 percent of the expected values, *given the researchers' previous effort* (Table 2). As discussed above, however, it is possible that effort would increase in the next five years. We are directed by the U.S. Congress to provide the "benefit of the doubt" to the endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)]. Because we do not want to underestimate exposure (which would work to the detriment of the species), and because the annual permitted take numbers are within the realm of possibility, we will use the annual permitted take as the number of individuals that would be exposed to the proposed activities.

Therefore, 55 leatherback turtles will be exposed to the various research activities. Given the previous data, we would expect all of these individuals to be adults (N = 55). In the above sample, ~77 percent were female. An additional dataset described 68 percent (27 of 40) of the turtles captured off the coast of central California to be female (Benson et al 2007b). Combining these datasets, we would expect 71 percent of exposed individuals to be female (N ~ 39).

Annually, 10 adult turtles (~7 females) would be exposed to all activities described above, including: capture, tagging, sampling, PTT and PAT attachments, and inserting a stomach telemeter pill. In addition, 25 adult turtles (~18 females) would be exposed to all activities except for the stomach telemeter pill, and PTT/PAT attachments. Another 20 adult leatherbacks (~14 females) would be sampled and tracked (via suction cup attachment) without capture.

Duration of Exposure

The researchers designed the PTT and PAT attachments to corrode and detach in approximately one year. Therefore, we will consider the duration of exposure to the stressors of the PTT/PAT attachments to be one year. Likewise, the suction cup attachments would detach or be removed within five days (i.e., the duration of exposure). The stomach telemeter pill would dissolve and pass through the turtle's digestive tract in 12-13 days. The wounds caused by biopsy sampling (tissue plug and subcutaneous fat) would be expected to heal in a few days. The duration of exposure for handling would be 30 minutes to 1.5 hours. The duration of exposure to stress induced by capture and handling would last from a few hours to a few days. For all other activities, the duration of exposure would be equivalent to the time required to perform the activities (i.e., 0-5 minutes).

Stocks Exposed

The turtles that forage in the waters off of California, Oregon and Washington appear belong to the western Pacific metapopulation as indicated by a diagnostic mitochondrial haplotype and tracking data (Benson et al 2011; Dutton et al 2007). Satellite tracking indicates a significant proportion (10 of 30) of turtles that nested during the summer at Papua Barat, Indonesia foraged in the California Current Ecosystem; and at least one turtle foraging in the California Current Ecosystem returned to nesting beaches in the Solomon Islands (Benson et al 2011). Benson et al. (2011) conclude that these nesters can be further distinguished as a demographically distinct foraging unit. Therefore, leatherbacks of the western Pacific summer nesting aggregation that forage in the California Current would likely be exposed to the proposed activities.

Potential Stressors and Response Analyses

For each activity listed below, we first identify potential physical, chemical, or biotic stressors (presented in a bulleted list). We then describe likely responses to such stressors. Animal responses to human disturbance are similar to their responses to potential predators (Beale & Monaghan 2004; Frid & Dill 2002; Gill & Sutherland 2001; Lima 1998; Romero 2004). These responses include interruptions of essential behavior and physiological processes such as feeding, mating, resting, digestion, etc. Each of these can result in stress, injury, and increased susceptibility to disease and predation (Frid & Dill 2002; Romero 2004).

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. When possible, we base the likelihood of a response on previously collected data describing leatherback responses to similar stressors; however, when that data is not available, we use information from other species to proximate a leatherback's response.

Aerial Survey

- Simulates predatory behavior
- Exposure to anthropogenic noise

The appearance and noise of aircraft could illicit anti-predatory or avoidance behavior in leatherbacks. The SWFSC has conducted aerial surveys of this type for over 21 years, flying 50-150 hours per year. In that time, they have not documented any behavioral effects on this species. The hearing sensitivity of leatherbacks is likely similar to that of other sea turtles (<1 kHz (Bartol & Ketten 2000; Bartol et al 1999; Ketten & Bartol 2006). The low frequency noises produced by the survey aircraft dissipate with distance, and the minimum altitude of 650 ft provides a greater noise buffer than the 500 ft minimum required of all small aircraft by Federal Aviation Regulation 91.79. Therefore, it is unlikely that future aerial surveys, conducted similarly to those in the past, would trigger a behavioral response in leatherbacks.

Close vessel approach

- Simulates predatory behavior
- Potential for collision
- Potential for injury by propellers

At sea, adult and juvenile leatherbacks are occasionally preyed upon by killer whales, sharks, crocodiles, and humans. To reduce the risk of predation, sea turtles may alter their habitat usage or change their dive patterns; in essence, individuals would sacrifice foraging opportunities in order to be safe (Heithaus et al. 2008). Close vessel approach may be perceived by leatherbacks as predatory behavior. Previous data, however, does not indicate that leatherbacks change their foraging behavior or avoid the energy-rich foraging area in response. In 2005, the researchers approached three leatherbacks to apply suction cup tags; all turtles remained in the vicinity and continued to forage, diving at depth to obtain prey (Harvey et al 2006). In 2007 and 2008, the researchers similarly approached a total of 14 leatherbacks; these turtles remained in the vicinity and continued to forage after the close vessel approach (SWFSC 2008). Given these past encounters, leatherbacks are unlikely to exhibit a behavioral response to close vessel approach in the future.

Operation of watercraft in the vicinity of marine animals is always accompanied by some risk of collision or injury via the propellers. To minimize this risk, only experienced researchers and boat handlers would approach the turtle. They would approach slowly and minimize in-water chase. They would only approach healthy turtles (e.g. normal swimming behavior, no obvious injuries). The researchers would limit their approach to five attempts in a 24-hour period, and after three failed attempts, they would wait 4 hours before making the final two approaches. Given these precautions, collision or injury by the propellers would be unlikely. Therefore, close vessel approach would not adversely affect leatherbacks.

Suction cup attachment

- Potential chemical irritant (dental adhesive)
- Increases the potential for entanglement
- Increases drag

Dental adhesive is used to secure the suction cup in place. Dental adhesive includes polyvinyl alcohol-methyl acrylate copolymer, poly(methylvinylether/maleic acid), or a similar polymer. As indicated on the material safety data sheet (MSDS) for several common brands (Polygrip, Fixodent, and Sea-Bond), dental adhesive is non-toxic upon ingestion of small amounts, non-irritating to skin, and does not produce adverse effects on fertility or development. Though tested for oral use by humans, there is no indication that dental adhesive would produce adverse effects on the external skin of a leatherback carapace.

Any external attachment to marine animal increases its risk of entanglement in marine debris. If the suction cup attachment became entangled in fishing gear, the turtle would likely respond by attempting to disentangle itself or fleeing. Under tension, the suction cup would likely detach from the carapace. Therefore, we do not anticipate a significant increase in entanglement risk as a result of the suction cup attachment.

The largest suction cup attachment would include a digital video recorder, a VHF radio transmitter and a TDR; it would weigh 1256 grams and would be ~31 cm in length (plus antenna, see Fig. 1). Jones et al. (2011) tested the drag caused by various tags when placed on casts of sea turtle carapaces. Though they did not test the attachments described above, they found that the large National Geographic Crittercam system (30 cm in length) increased drag on olive ridley turtles by 68-111 percent. Similar drag would adversely affect a leatherback by reducing its ability to swim and forage. Both the Crittercam and the proposed suction-cup attachment are only intended for short-term deployments (i.e., 1 hour to 5 days). Assuming the turtle increases power output due to increased drag costs, the energetic cost of carrying a Crittercam would be <1 percent of its annual energy budget (Jones et al. 2011). Jones et al. (2011) conclude that the long-term effects of such an attachment are negligible. Therefore, while the drag of the suction cup attachment is likely to adversely affect a leatherback sea turtle, its duration is short and unlikely to significantly reduce fitness.

Track

- Exposure to acoustic pinging (noise)

Because tracking would occur at a distance (>100 m in water and >4 km in the air), simulated predatory behavior would not be a concern. The acoustic pinging, however, could affect leatherbacks. The acoustic tags transmit at a frequency of 69 kHz, which is well above the hearing range of tested sea turtles: green, 100-800 Hz; Kemp's ridley, 100-500 Hz; and loggerhead, 250-1000 Hz (Bartol & Ketten 2000; Bartol et al 1999; Ketten & Bartol 2006). The hearing range of leatherbacks is likely similar to that of other sea turtle species (i.e., <1000 Hz). Therefore, leatherbacks are not likely to respond to acoustic tracking.

Capture and Handling

- Simulates predatory behavior
- Potential for injury or abrasion
- Exposure to sun, heat, etc. for 30 minutes to 1.5 hours
- Potential to transfer diseases

It is difficult to determine the relative stress induced by capture versus handling versus some of the procedures performed prior to release. Furthermore, previous procedures (i.e., harness PTT attachment) were more invasive than those proposed here, and the available response data may not be representative. Because it is impossible to tease apart the long-term responses to each of these steps, we will consider them together. We focus on the general response to capture and extensive handling but indicate when reported behaviors may reflect the more invasive procedures of the past.

During capture/handling, there is potential for injury to the turtle as it struggles to free itself, abrasion from the hoop net, and exposure to sun, heat or inclement weather. Materials used to capture, support or restrain turtles could transfer infectious diseases among individuals. To minimize these risks, the Conservation Division has placed numerous conditions and requirements on research permit No. 15634 (see above), including: limiting the number of capture attempts, removing turtles from the net safely and quickly, using at least two researchers to handle each turtle, protecting turtles from temperature extremes, providing adequate air flow, keeping turtles moist during the procedures, and cleaning equipment between turtles. In addition, the researchers have indicated in their permit application that they would use a hose to continuously pump cool, fresh sea water onto the turtle. Based on their previous experience, the researchers reported that once captured, all turtles (12 of 12) became fairly quiescent and were relatively easy to handle (SWFSC 2008). Therefore, these precautions appear to minimize the likelihood of injury, abrasion or exposure.

Capture and handling often induce stress-related physiological responses to sea turtles. Using a similar procedure as described above (i.e., aerial surveys, close vessel approach and hoop nets), the researchers previously captured 19 leatherbacks off the coast of central California. They found that the mean heart rate of these foraging turtles was nearly four times higher than values reported for swimming, diving, and nesting leatherbacks in Costa Rica (Harris et al 2011; Southwood et al 1999). The authors conclude that the increase in heart rate was a result of the stress and physical exertion associated with capture and restraint (Harris et al 2011). Stress hormone levels have not been assessed in leatherbacks captured at sea; however loggerhead and green sea turtles exhibit elevated levels of corticosterone (Aguirre et al 1995; Gregory et al 1996). A small loggerhead exhibited a 7.2-fold increase in plasma corticosteroid after 30 minutes of restraint; generally, the highest concentrations occurred three hours after capture and decreased by six hours post-capture (Gregory et al 1996). Leatherbacks would likely respond to capture/handling with temporarily elevated levels of stress hormones (e.g., corticosterone) and an increased heart rate; however, the transient nature of the response is unlikely to affect the individual’s overall fitness.

Leatherbacks may also respond to capture/handling by leaving the area and/or ceasing to forage. In a previous study by the applicant, leatherbacks were captured (and harnessed) while foraging off the coast of central California in August; 89 percent immediately moved southwest toward equatorial eastern Pacific waters, which are warmer but less productive (Benson et al 2011).

Generally, leatherbacks arrive in the California Current Ecosystem in June and leave by October-November, but individual variance is common (Benson et al. 2011). Another study in the North Atlantic indicates that 40 percent of harnessed leatherbacks immediately departed the foraging area upon release; for those that did not migrate, foraging ceased for a median of 12.7 days (range 0.175-48.9; Sherrill-Mix & James 2008). It is unknown whether the departures were premature, prior to obtaining adequate energy stores. Leatherbacks weigh ~33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and reproduction (James et al 2005a; Wallace et al 2006). Sea turtles must meet an energy threshold before returning to nesting beaches (Casey et al 2010; Rivalan et al 2005b; Sherrill-Mix & James 2008); if they do not, their remigration intervals (the time between breeding seasons) increases, without a corresponding increase in clutch size the next season (Hays 2000; Price et al 2004). Thus truncated foraging time has the potential to diminish lifetime reproductive success (Rivalan et al 2005b; Wallace et al 2006).

Early departure and interrupted foraging may constitute a response to capture/handling; however, evidence suggests that the behaviors observed in these studies may reflect responses to the large, relatively heavy harness placed on the turtle. The researchers have tracked one leatherback using the PTT direct attachment methods; it remained in the foraging area after release. According to the researchers, direct attachment of the PTT does not appear to interfere with foraging or remigration intervals as the harness method did (R. LeRoux, pers. comm.). Another researcher using the medial ridge attachment reports that all leatherbacks (N = 20) remained in the North Atlantic for one month or more post-capture. Sixteen of these individuals were tracked long enough to observe a directed, southward migration in the fall, with clear changes in diving patterns, swim speed and orientation that reflected a transition from foraging to transiting behavior (K. Dodge, pers. comm.). Therefore, early departure and interrupted foraging appear to be linked with the harness attachment, rather than capture/handling (or the medial ridge attachment of the PTT). We conclude that while capture/handling adversely affects leatherback sea turtles, it does not reduce their fitness.

Weighing/Measuring

- Potential for fall

Suspending a 200+ kg turtle is not without risk, but it is unlikely that all straps would break simultaneously, causing the turtle to fall.

Tagging (flipper and PIT)

- Potential for infection
- Potential for PIT tag to migrate
- Potential for flipper tag to rip through skin

The application of both tag types (Inconel flipper tags and PIT tags) requires penetration of the skin. The turtle's responses would likely include pain and discomfort, which would be of variable intensity among individuals but short-lived (Balazs 1999). There is also the potential for infection at the site of attachment/insertion. Subcutaneously injected PIT tags may trigger infection in leatherbacks. Dutton and McDonald (1994) describe infection at 2 and swelling at 5 of 105 PIT tag injection sites, though the majority of injection sites healed within 9-11 days. Other studies have linked PIT tags to malignant tumors in rodents at rates of 1-10 percent (Albrecht 2010; Elcock et al 2001); however, over 10 million pets have been microchipped with few complications (e.g., Vascellari et al. 2006). We could not find a single report linking tumors to PIT tags in leatherbacks, sea turtles, or any reptile species. PIT tags have also been known to migrate throughout the body, triggering inflammation and infection (Wyneken et al 2010). To minimize such risk, the researchers would inject the PIT tag into the shoulder muscle, where it is likely to become encapsulated and unable to migrate. They would clean the injection site with Betadine and alcohol prior to injection, and they would use sterile applicators. They would also inject the turtle with oxytetracycline, an antibiotic, which would minimize the risk of infection associated with both tag types at the time of application. The Inconel tags, however, may become snagged and tear through the skin at any time, including long after the antibiotic has cleared the turtle's system (van Dam & Diez 1999). Because infections of the primary locomotor structures may decrease survival probability (Wyneken et al 2010), the researchers would only attach the Inconel tags to the rear flippers. Though we have found numerous reports describing flipper tag loss, none have described infection in association with this loss (Balazs 1999; Dutton & McDonald 1994; Rivalan et al 2005a); this was confirmed by the researchers (R. LeRoux, pers. comm.). Balazs (1999) reports that there is no evidence to suggest that the tagging experience or presence of tags will cause lasting harm or alter a turtle's long term behavior. We conclude that while flipper and PIT tagging would adversely affect leatherbacks, neither is likely to reduce an individual's fitness.

Biological Sample Collection (blood, tissue, stomach, fecal, cloacal, subcutaneous fat)

- Potential for infection

Stomach, fecal and cloacal sampling is minimally invasive or opportunistic and not expected to adversely affect leatherback sea turtles. Blood, tissue and subcutaneous fat collection require penetration of the skin, which would likely cause pain and discomfort for the turtle, though the response would be temporary. There is also potential for infection. When possible, the researchers would take blood from the interdigitary vessels in the flippers, which are a low-risk alternative to the dorsal cervical sinus (Wallace & George 2007). Before removing subcutaneous fat from the base of the hind flipper, the researchers would apply lidocaine to minimize the turtle's pain. They would close the incision site with absorbable sutures and veterinary tissue glue to minimize the risk of infection. In all instances, they would use sterile or disinfected tools and clean the affected areas with Betadine and alcohol. Most importantly, they would also inject the turtle with oxytetracycline, an antibiotic. The risk of infection at the site of the biopsies is greatest immediately following the procedure. Therefore, the risk of a debilitating infection would be minimized by treatment with the antibiotic. While biological specimen removal would adversely affect leatherbacks, it is not likely to reduce their fitness.

Oxytetracycline injection

- Potential for overdose

Oxytetracycline is broad-spectrum, bacteriostatic (i.e., inhibits the reproduction of bacteria) antibiotic. At high doses, it penetrates all tissues (including mineralizing tissue such as bone) and persists in the body for a long-acting effect (Helmick et al 2004); researchers exploit this characteristic to "mark" a turtle for age and growth studies. The pharmacokinetics of a single injection of oxytetracycline has been studied in loggerhead sea turtles and American alligators (Harms et al 2004; Helmick et al 2004). There were no adverse affects associated with intravenous or intramuscular injections of 25 mg/kg (loggerheads) and 10 mg/kg (American alligators). Similarly, we expect no adverse affects from 10-15 mg/kg injected intravenously or intramuscularly into a leatherback; in fact, there may be some benefit to the turtle. Oxytetracycline has activity against several gram negative bacteria that are associated with morbidity and mortality in sea turtles (Harms et al 2004). The one-dose treatment was found to be effective against pathogens for 1-5 days in reptiles (Harms et al 2004; Helmick et al 2004). Though we do not expect the antibiotic to confer lasting protection against pathogens, it provides initial prophylaxis (Harms et al 2004). We conclude that the oxytetracycline injection is wholly beneficial to leatherbacks.

Ultrasound

- Potential chemical irritant (ultrasound gel)
- Exposure to high frequency sound waves
- Potential for internal heat generation

Ultrasoundography is a noninvasive internal imaging technique. It requires no anesthesia and significantly reduces the risk of trauma and infection in comparison to laparoscopic examinations (Rostal et al 1990). The gel applied to the skin is made of propylene glycol, glycerine, and phenoxyethanol (none of which are hazardous). According to the MSDS for Graham-Field Ultrasound Gel, the only acute health hazard is "slight skin irritation in very sensitive individuals" (i.e., humans). We do not expect turtles to respond to this gel. Turtles would be exposed to ultra-high frequency sound waves (e.g., 2-5MHz), which are beyond their range of hearing. The probe would only be held against the skin for several seconds, to avoid internal heat generation. Therefore, ultrasound is not likely to adversely affect sea turtles.

Photograph/video

- No stressors other than those associated with capture and handling

There is no evidence to indicate that leatherbacks are adversely affected by photography or videography.

Platform Transmitter Terminal (PTT) Attachment

- Potential for infection at site of attachment
- Potential for surgical tubing to lacerate or becoming imbedded in the carapace
- Potential chemical irritant (silicone putty)
- Potential for entanglement
- Increases drag

The PTT would be directly attached to the medial ridge of the leatherback's carapace. This modification is intended to reduce drag and injury as compared to the previous "harness" method (Byrne et al 2009; Fossette et al 2007; Jones et al 2011). Direct attachment requires drilling two holes (4.5 mm diameter) through the medial ridge. Threaded metal wire encased in surgical tubing would be threaded through the holes. Silicone putty would be used to secure the PTT to the carapace.

The drilling would likely cause temporary pain and could result in infection. To minimize pain, the researchers would apply a topical anesthetic. To minimize the risk of infection, they would soak the drill bit in Betadine antiseptic and clean the attachment site with Betadine and isopropyl alcohol. They would also inject the turtle with oxytetracycline, which would provide at least initial protection against bacterial infections (see above). Byrne et al. (2009) report no infections after one month of direct attachment in two leatherbacks. Thus, it is unlikely that the direct attachment would result in infection.

There have been problems associated with the tubing used to attach harnesses to leatherbacks. The applicant reported that the Tygon® tubing used to attach the harness became embedded in the carapace after one year and caused lacerations upon removal; the turtle seemed otherwise healthy and was observed actively foraging (SWFSC 2009). Troëng et al. (2006) describe a similar situation in which the silicone tubing of the harness became embedded in the carapace; these injuries did not prevent the turtle from reproducing, and after removal of the harness, the wounds healed within a month (Troëng et al 2006). For direct attachment, the researchers would use surgical tubing, which is designed for human medical applications. It is generally made of latex, which makes it flexible, elastic, and strong (unlike silicone or Tygon® materials which are more rigid). The tubing would be thin (< 4.5 mm diameter) and would only come into contact with a small surface area of the carapace (Fig. 4). There would be less force exerted on the tubing used in the medial ridge attachment as compared to the much larger, heavier harness attachment. Therefore, we do not expect the surgical tubing to lacerate or become imbedded in the carapace.

Silicone putty is classified as a non-hazardous material. According to the MSDSs for two commercially available brands (EasyMold and Smooth-On), no acute toxic skin effects are expected upon contact with human skin. The MSDSs also report no expected damaging effects to aquatic organisms, based on physical and chemical properties of polydimethyl hydrogenmethyl siloxane. Therefore, we do not expect silicone putty to cause chemical irritation to the carapace.

Leatherbacks are caught (and often killed) as bycatch in pelagic longline, gillnet, and trawl fisheries (Lewison & Crowder 2007). While longline interactions usually result in hookings near the mouth or flippers (Ryder 2004), turtles also become entangled in nets and lobster pot lines (Sadove & Morreale 1990). Protrusions from the streamlined carapace of the turtle could get caught in fishing gear. The researchers would use a small, concave-shaped PTT designed fit snugly to the medial ridge. Their application of anti-fouling mater would minimize any hard edges, which could get caught in fishing gear. Therefore, we do not expect the PTT to significantly increase the risk of entanglement.

Increased drag is a concern for any species undergoing long-distance migrations. Studies comparing drag indicate that direct medial ridge attachment of the PTT attachment results in faster swimming speeds than the harness apparatus (Byrne et al 2009; Fossette et al 2007); however, the direct attachment still causes drag. In wind tunnel experiments, direct attachment of the PTT to a leatherback cast increased drag by 0.6-1.8 percent for adults and 4.2-12 percent for juveniles (Jones et al 2011). At wind speeds equivalent to sea water velocities of 0.13 to 1.25 m/s, the PTT increased drag by 63.3 percent at low speeds and 1.1 percent at high speeds in adults (Jones et al 2011). For the proposed research, the tags are designed to remain on the turtle for at most one year. In this time, some leatherbacks are expected to migrate across the ocean to nest in the western Pacific (Benson et al. 2011); therefore, even small increases in drag would be a concern and are likely to adversely affect leatherbacks. Leatherbacks would respond to increased drag via greater energy expenditure or slower swimming speeds (Jones et al 2011). Leatherbacks are constrained to a tight metabolic budget (Wallace & Jones 2008). As stated above, leatherbacks must meet a reproductive energy threshold before returning to nesting beaches to reproduce; if they do not, their remigration intervals (the time between breeding seasons) increases, without a corresponding increase in clutch size the next season (Hays 2000; Price et al 2004; Wallace et al 2006). The end result would be diminished lifetime reproductive success and reduced fitness. It is important to note that the direct attachment method is likely to have far less impact on foraging and remigration intervals than the harness method, and studies have reported normal nesting behavior by some harnessed turtles (Benson et al 2007c; Eckert et al 2006). To address the impact of drag while insuring the safety of the turtles, the Permits Division would require annual reauthorization for the medial ridge attachment. Until that data becomes available, we must give the benefit of the doubt to the species and acknowledge the significant risks associated with drag. <u>We conclude that drag caused by the PTT has the potential to reduce the fitness of leatherback sea turtles.</u>

Pop-up Archival Terminal (PAT) Attachment

- Potential for infection at site of attachment
- Potential chemical irritant (silicone putty)
- Potential for tether to rip through carapace
- Potential for entanglement
- Increases drag

Attachment of the PAT would be similar to that of the PTT. As such, their stressors, and the turtle's responses, would be the same. One exception is that attachment of the PAT to the pygal region (the overhanging posterior projection) of the carapace may pose a greater risk of entanglement. To mitigate this risk the PAT would equipped with a breakaway feature (triggered by dives deeper than 1500 m) and a short tether. These modifications would minimize the risk of entanglement. Another concern is the additive drag caused by multiple protruding attachments (i.e., the PTT and the PAT). Wind tunnel experiments indicate that two tags (e.g., one on the medial ridge and one on the pygal) would have an additive effect (Jones et al. 2011). Because drag is reduced by avoiding the peak of the carapace, the drag from the PAT and PTT would not be twice that of the PTT (Jones et al 2011). To address the impact of drag while insuring the safety of the turtles, the Permits Division would require annual reauthorization for the PAT attachment. <u>Without additional data, we conclude that drag caused by the PAT has the potential to reduce the fitness of leatherback sea turtles.</u>

Stomach telemeter pill

- Potential for injury during insertion
- Potential displacement of ingested food

Insertion of the stomach telemeter pill requires that a PVC tube be inserted into the turtle's esophagus to a depth of 40 cm. The researchers would use a rigid PVC trocar to push the pill through the tube, not to extend more than 2 cm beyond the tube. Care would be taken not to scratch the mouth or esophagus during insertion. Another concern is that expansion of the pill in the stomach would block digestion: plastic lodged in the gut of a leatherback has been shown to obstruct the passage of food (Mrosovsky et al 2009). Previous use of this methodology did not impair the foraging activities of inter-nesting leatherbacks: Casey et al. (2010) report that seven of the eight tagged turtles ingested 6 to 48 prey items at a rate of 0.11±.12 per hour. The eighth turtle excreted its telemeter pill within 27 hours. It did not make any ingestions during that time, but its diving and migration patterns were normal (A. Southwood Williard, pers. comm.). The researchers conclude that the pill is safe to use in leatherbacks. In addition, all traces of the pill would be gone within two weeks. Therefore, it is unlikely that stomach telemeter pills would adversely affect leatherbacks. As an added precaution, because the technique is relatively new, the Permits Division would require annual reauthorization for the stomach telemeter pill.

Release

- Potential for injury as returned to water

The researchers have previously captured and released leatherbacks as described above. They have guided turtles down the ramp to the water level without injury. In 2007, 10 of 12 leatherbacks swam away vigorously upon release. One actively rolled at the surface, then charged the vessel. After another episode of rolling, the turtle rested at the surface then swam away. It was observed one year later at the Solomon Islands. Another turtle appeared sluggish and did not swim away immediately. After receiving 60 mg of Dexamethasone sodium phosphate, the turtle swam vigorously away and resumed normal behavior. The turtle was still being tracked via satellite six months later (SWFSC 2008). The aberrant behavior was likely a response to all activities, not just the release. We conclude that any behaviors post-release would be transient and not likely to reduce the fitness of leatherbacks.

RISK ANALYSES

Fitness is defined as the individual's growth, survival, annual reproductive success and lifetime reproductive success. We have identified two activities that may reduce the fitness of individual leatherback sea turtles: PTT and PAT attachment. All individuals that receive the direct attachment of the PTT (N = 10) would also receive a PAT pygal attachment (i.e., no turtle would receive a PTT without a PAT or vice versa). Therefore, there is no need to dissect the risk posed by the PTT versus PAT attachments. Together the attachments would require additional energetic cost proportional to the total amount of drag and the duration of each attachment (i.e., one year or less). Here we assess the likelihood of fitness loss in individuals due to the attachments and examine whether changes in individual fitness diminish population viability. If both are true, we consider whether the action would jeopardize the continued existence of the species.

Individuals

Our *Potential Stressors and Response Analyses* indicate that leatherbacks would respond to PTT/PAT attachments with greater energy output or slower swimming speeds. Turtles may compensate by increasing the length of their foraging and remigration interval. Though the increase of a few days or weeks is unlikely to have an impact, the loss of weeks or months could delay their remigration by up to one breeding season. Though the California Current provides high productivity in the summer months, it is characterized by cold waters and limited prey availability in the winter months; therefore, leatherbacks are required to "overwinter" in the warmer waters of the equatorial eastern Pacific between successive foraging seasons (Benson et al 2011). This means that additional foraging days cannot simply be added to the end of a foraging season. In order to compensate for the additional energy required for migration and reproduction, a leatherback may need to delay its remigration to the western Pacific after an additional season of foraging in the California Current Ecosystem. Given that the PTT/PAT attachments are designed to release after one year, it is unlikely that the remigration interval would increase by more than one season.

It is important to note that remigration intervals are variable among and within individuals. For example, in French Guiana, females remigrate every 1-6 years; most turtles return to nest every two years, though some return every three years, and others return every two *or* three years in an unpredictable pattern (Rivalan et al 2005b). In Parque Nacional Marino Las Baulas, Costa Rica, females remigrate every 2-7 years with most turtles returning to nesting beaches in 3 years (Reina et al 2002). The remigration interval for western Pacific leatherbacks is unknown but estimated at "several years" (Benson et al 2011). In July of 2003, the applicant attached harnesses to nine nesting females in Jamursba-Medi (Benson et al 2007a). Five of the nine travelled to the northeastward toward the temperate waters of the eastern North Pacific. One retained its harness for 647 days: she arrived off the coast of Oregon/Washington in August of 2004 and spent 62 days foraging there before heading southwest in late October. In March of 2005, after wintering in the tropical Eastern Pacific, she headed back toward temperate waters (Benson et al 2007a). From these data, the harnessed female's remigration interval would have been approximately three years.

Several studies have indirectly addressed the impact of the PTT attachment (using the harness apparatus) on the remigration interval. Two studies tracked harnessed leatherbacks from their foraging grounds in the North Atlantic. James et al. (2005a) tracked 11 of the 25 harnessed turtles (45 percent) to waters adjacent to nesting beaches within months after capture. Sherrill-Mix and James (2008) captured, handled and attached harnesses to 20 mature females, 10 of which were observed on nesting beaches 0.6-3.8 years later. Six of the ten (60 percent) were observed on nesting beaches the season after capture (Sherrill-Mix & James 2008). Given a two-year remigration interval (Rivalan et al 2005b), we would expect to observe 50 percent of leatherbacks returning to nest each year on average. The studies above provide evidence that PTT/PAT attachment (using the harness) either did not interrupt the remigration interval, or did so minimally (e.g., one turtle).

Between 2000 and 2007, Benson et al. (2011) satellite tracked 126 harnessed leatherbacks, 37 of which were captured off the coasts of California and Oregon in August or September (the others were tagged at nesting sites). As stated above, 33 of 37 (89 percent) immediately departed this foraging area for the Equatorial Eastern Pacific (EEP). After wintering in the EEP, 17 of the 25 leatherbacks that continued to transmit signal returned to the coast of California to forage, and 7 headed westward, presumably to nesting beaches (Benson et al 2011). One of these turtles nested in the Solomon Islands the following May, and one nested in Jamursba-Medi the following July. From this study, we conclude that the drag caused by the harness did not prevent at least two and probably seven females (28 percent) from remigrating. Given a three-year remigration interval, we would expect 33 percent of the sample (i.e., eight turtles) to return to nest annually. We conclude that most harnessed turtles did not remigrate the season after capture because they were in the middle of a multi-year foraging event. All turtles that did not remigrate may have been in the middle of a multi-year foraging event; however, we give the benefit of the doubt to the species and acknowledge that a small percentage (~5 percent or one turtle) may have increased their remigration interval by one breeding season as a result of the harness PTT attachment.

As compared to harnessed turtles, the medial ridge attachment of the PTT results in lower drag, faster swimming speeds, and longer dives (Byrne et al 2009; Fossette et al 2007; Jones et al 2011). According to Fossette et al. (2007), harnessed turtles are 16 percent slower and their dives are 12 percent shorter than turtles with a direct attachment. Therefore, we would expect turtles with a direct attachment to migrate more quickly and efficiently, further reducing the risk of an increased remigration interval (<5 percent).

Leatherbacks produce 4-9 clutches per year. The average clutch size is 79.6 eggs at Jamursba-Medi and 76.2 eggs at Wermon (Tapilatu & Tiwari 2007). Therefore, the loss of a single breeding season results in a cost of 304-716 eggs per individual. Due to the great variance in hatchling success and the unknown lifetime reproductive success of leatherbacks, we are unable to accurately estimate the loss of reproductive potential in terms of offspring that survive to reproduce; however, the loss of a breeding season is likely to diminish lifetime reproductive success.

In conclusion, the proposed research (specifically the PTT/PAT attachments) is likely to lengthen the remigration interval of a leatherback sea turtle due to slower swimming speeds or greater energy requirements. To compensate, an individual may skip a single breeding season, reducing its lifetime reproductive success by 304-716 eggs. Based on previous data, the chance of this occurring is <5 percent.

Populations
The researchers would deploy PTT and PAT attachments to up to 10 leatherbacks annually. Because the nature of the risk is reproductive (i.e., the loss of a breeding season or eggs), we focus on exposed females. Our *Exposure Analyses* indicate that seven of the leatherbacks with PTT/PAT attachments are likely to be females. Our *Response* and *Risk Analyses* indicate that <5 percent of this sample would respond to the stressors by skipping a breeding season. Thus, we would expect at most one female to skip a breeding season per year of research.

Our *Exposure Analyses* indicate that the western Pacific nesting aggregation would be impacted by the proposed research. More specifically, turtles nesting during the summer at the Jamursba-Medi and Wermon beaches of Papua (Barat), Indonesia and Santa Isabel Island, Solomon Islands (Benson et al 2011). Turtles from Papua, Indonesia, Solomon Islands and Papua New Guinea represent a metapopulation composed of a single genetic stock (Dutton et al 2007). Though the extent of demographic connectivity is unknown, for the purposes of this Opinion, we will consider all turtles in this region as a single population.

Based on nest counts and 4-6 nests per female, the western Pacific population supports an estimated 844-3294 females nesting annually (Dutton et al 2007). The regional population size is estimated to be 2110-5735 females. These represent minimum estimates, as new rookeries are being continually discovered (Benson et al 2007a; Benson et al 2007c; Dutton et al 2007; Hitipeuw et al 2007). Newly discovered nesting beaches indicate that the Solomon Islands and Papua New Guinea likely support hundreds of nesting females (Benson et al 2007c; Dutton et al 2007). The largest nesting aggregations occur at beaches in Papua, Indonesia. Nest counts at Jamursba-Medi from 1981 to 2004 indicate slight long-term decline, but the population has not been depleted to the extent found at other major rookeries in the Pacific (Hitipeuw et al 2007). These counts also indicate a large degree of inter-annual variation in the number of females nesting annually. From 1993-2004, the minimum number of females nesting annually at Jamursba-Medi ranged from 331 to 1099 (Table 3; Hitipeuw et al 2007).

Table 3. The estimated number of females nesting annually at Jamursba-Medi (Hitipeuw et al 2007)

	1993	1994	1995	1996	1997	1999	2000	2001	2002	2003	2004
5.8 nests/female	705	716	729	1099	773	560	378	527	331	501	667
4.4 nests/female	930	944	961	1448	1018	739	499	695	437	660	879

The loss of one female nesting annually would result in the loss of 304-716 eggs, representing less than one percent (0.03-0.1 percent) of the total reproductive effort of the western Pacific population. This loss does not alter the current trend of the population. Furthermore, the loss is small in comparison to the inter-annual variation observed at a single beach (Table 3). Modeling suggests that environmental conditions may influence the remigration interval in leatherbacks and thus the number of females nesting annually (Hays 2000). In this context, the reduction in productivity resulting from the proposed research would be lost in noise of environmental stochasticity. Given the large size of the western Pacific population, the transient nature of the loss (i.e., one season), and the background inter-annual variation, the proposed research is not likely to reduce the viability of the population. Therefore, the proposed research is not likely to jeopardize (i.e., appreciably reduce the likelihood of survival and recovery of) the species.

Critical Habitat

On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle (50 CFR Part 226). This designation includes approximately 43798 km^2 stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64760 km^2 stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2000 m depth contour (Fig. 5). The designated areas comprise approximately 108558 km^2 of marine habitat and include waters from the ocean surface down to a maximum depth of 80 m. The primary constituent element essential for conservation of leatherback turtles is the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (*Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

The action would occur within this portion of the leatherback's designated critical habitat, but most activities would occur aboard the vessel. Some activities would occur in the water and produce stressors with the potential to impact the primary constituent elements (i.e., the quality and quantity of prey). These stressors include: noise exposure (aerial survey and acoustic pinging), potential for collision, and potential for injury by propellers. Scyphomedusae have rudimentary "hearing" organs that low frequency vibration; they are not likely to be adversely affected by distant aircraft noise or high frequency acoustic pinging. Their soft bodies are not likely to be injured by collision with the vessel. Though medusae may get caught in and injured by the propellers, the frequency of such an occurrence would be discountable, and it would not significantly reduce their abundance. Therefore, the action would not reduce the primary constituent elements or the conservation value of the critical habitat. We conclude that the proposed action would not adversely modify or destroy designated critical habitat of the leatherback sea turtle.

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 foreign non-governmental organizations, state departments of fish and game, state legislature websites, and Nexis. 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 EFFECTS

The narrative that follows integrates and synthesizes the information contained in the *Status of the Species*, the *Environmental Baseline*, the *Effects of the Action* and the *Risk Analyses* sections of this Opinion to assess the risk the proposed activities pose to leatherback sea turtles. There are no known cumulative effects (i.e., from future state, local, tribal, or private actions) that fold into our risk assessment for this species.

Leatherbacks that forage in the U.S. West Coast EEZ migrate to nesting beaches in the western Pacific. The western Pacific nesting aggregation is the largest and most robust in the Pacific, hosting 844-3294 females nesting annually for the past decade. The major threats to this population include: fisheries interactions (especially shallow longline and gill net fisheries), egg collection, and the harvest of nesting females; however, conservation measures have reduced these threats in recent years.

The proposed action would permit researchers to capture and handle leatherbacks in the U.S. West Coast EEZ in order to gather data, collect biological specimens, and attach satellite transmitters (i.e., PAT and PTT attachments). Most of the proposed activities would not adversely affect leatherbacks; however, the PAT and PTT attachments would result in slower swimming speeds or additional energy requirements for a maximum of ten leatherbacks per year. These responses would interfere with an individual's foraging and remigration interval. We expect that at most, one female leatherback would skip a breeding season as a result of the proposed action. This would potentially reduce the individual's lifetime reproductive success and diminish its fitness. Given the large size of the western Pacific nesting aggregation and current trends, the loss of one breeding female per year is not sufficient to reduce population viability or the continued existence of the species.

CONCLUSION

After reviewing the current status of the leatherback sea turtle, the environmental baseline for the action area, the effects of the take authorized in this permit, and probable cumulative effects, it is our biological opinion that issuance of the permit, as proposed, would not reduce the population viability of leatherback sea turtles that forage in the West Coast EEZ and nest in the western Pacific. Therefore, the issuance of the permit is not likely to jeopardize the continued existence of the leatherback sea turtle. Furthermore, the permitted activities are not likely to destroy or adversely modify its designated critical habitat.

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 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. Harass is defined by the U.S. Fish and Wildlife Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Only the species targeted by the proposed research activities (i.e., leatherback sea turtles) would be harassed as part of the intended purpose of the proposed action. Therefore, NMFS does not expect the proposed action would incidentally take threatened or endangered species.

CONSERVATION RECOMMENDATIONS

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

We recommend that the action agency (NMFS Permits and Conservation Division) use data from the applicant to evaluate the response to the PTT and PAT attachments after one year; we also recommend that the Permits Division share these data with the ESA Interagency Cooperation Division to better inform future consultations of this nature.

We recommend that the NMFS Permits and Conservation Division require the applicant to:

1. Report all responses of leatherbacks to capture/handling. It is especially important to note whether individuals cease foraging or leave the foraging area after capture/handing.
2. Report all responses of leatherbacks to the PTT/PAT attachments. Do these attachments affect foraging or lengthen remigration intervals?
3. When appropriate, minimize the number of leatherbacks that are captured and handled (e.g., the sample size is already adequate for statistical analyses, additional analyses would be redundant, etc.)
4. When appropriate, eliminate or reduce the number of protruding attachments

5. To minimize the drag from telemetry devices (Jones et al 2011), use
   a) Low profile, teardrop shaped tags with a reduced frontal area
   b) Minimal antenna length and diameter
   c) Do not place tags at the peak height of the carapace
   d) Minimal adhesives, base plates and "build-up" materials
6. To assess the stress related with capture and handling, measure corticosterone levels in the blood

REINITIATION NOTICE

This concludes formal consultation and conference on the proposal to issue scientific research permit (No. 15634). As described 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 proposed take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS Office of Protected Resources – Permits and Conservation Division must immediately request reinitiation of Section 7 consultation.

LITERATURE CITED

Aguirre AA, Balazs GH, Spraker TR, Gross TS. 1995. Adrenal and hematological responses to stress in juvenile green turtles (*Chelonia mydas*) with and without Fibropapillomas. Physiological Zoology 68(5):831-854.

Albrecht K. 2010. Microchip-induced tumors in laboratory rodents and dogs: a review of the literature 1990-2006. 2010 IEEE International Symposium on Technology and Society. p. 337-349.

Andrews H, Shanker K. 2002. A signficant population of leatherback turtles in the Indian Ocean. Kachhapa: a newsletter for the Indian Ocean on sea turtle conservation and management(6):19.

Avens L, Taylor JC, Goshe LR, Jones TT, Hastings M. 2009. Use of skeletochronological analysis to estimate the age of leatherback sea turtles Dermochelys coriacea in the western North Atlantic. Endangered Species Research 8:165-177.

Balazs G. 1999. Factors to consider in the tagging of sea turtles. IUCN/SSC Marine Turtle Specialist Group Publication.

Bartol SM, Ketten DR. 2000. Turtle and tuna hearing. In: Swimmer Y, Brill R, editors. NOAA Technical Memorandum. U.S. Department of Commerce. p. 98-103.

Bartol SM, Musick JA, Lenhardt ML. 1999. Evoked potentials of the loggerhead sea turtle (*Caretta caretta*). Copeia 1999(3):836-840.

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

Benson SR, Dutton PH, Hitipeuw C, Samber B, Bakarbessy J, Parker D. 2007a. Post-nesting migrations of leatherback turtles (*Dermochelys coriacea*) from Jamursba-Medi, Bird's Head Peninsula, Indonesia. Chelonian Conservation and Biology 6(1):150-154.

Benson SR, Eguchi T, Foley DG, Forney KA, Bailey H, Hitipeuw C, Samber BP, Tapilatu RF, Rei V, Ramohia P et al. . 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere 2(7):1-27.

Benson SR, Forney KA, Harvey JT, Carretta JV, Dutton PH. 2007b. Abundance, distribution, and habitat of leatherback turtles (*Dermochelys coriacea*) off California, 1990-2003. Fishery Bulletin 105(3):337-347.

Benson SR, Kisokau KM, Ambio L, Rei V, Dutton PH, Parker D. 2007c. 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(1):7-14.

Benson SR, Seminoff J. 2011. Aerial survey of distribution and abundance of western Pacific leatherback turtles (*Dermochelys coriacea*) in coastal waters of Oregon and Washington. SAIP Report.

Bostrom B, Jones TT, Hastings MD, Jones DR. 2010. Behavior and physiology: the thermal strategy of leatherback turtles. PLoS One 5:e13925.

Bouchard S, Moran K, Tiwari M, Wood D, Bolten A, Eliazar P, Bjorndal K. 1998. Effects of exposed pilings on sea turtle nesting activity at Melbourne Beach, Florida. Journal of Coastal Research 14(4):1343-1347.

Bourgeois S, Gilot-Fromont E, Viallefont A, Boussamba F, Deem SL. 2009. Influence of artificial lights, logs and erosion on leatherback sea turtle hatchling orientation at Pongara National Park, Gabon. Biological Conservation 142(1):85-93.

Bowlby CE, Green GA, Bonnell ML. 1994. Observations of leatherback turtles offshore of Washington and Oregon. Northwestern Naturalist 75:33-35.

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

Byrne R, Fish J, Doyle TK, Houghton JDR. 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(2):68-75.

Carretta JV, Forney KA. 1993. Report of the two aerial surveys for marine mammals in California coastal waters utilizing a NOAA DeHavilland twin otter aircraft: March 9-April 7, 1991 and February 8-April 6, 1992. NMFS, SWFSC.

Casey J, Garner J, Garner S, Williard AS. 2010. Diel foraging behavior of gravid leatherback sea turtles in deep waters of the Caribbean Sea. Journal of Experimental Biology 213(Pt 23):3961-71.

Caut S, Guirlet E, Girondot M. 2009. Effect of tidal overwash on the embryonic development of leatherback turtles in French Guiana. Marine Environmental Research in press(in press):in press.

Chacón Chaverri D. 1999. Anidacíon de la tortuga *Dermochelys coriacea* (Testudines: Dermochelyidae) en playa Gandoca, Costa Rica (1990 a 1997). Revista de Biologia Tropical 47(1-2):225-236.

Chan EH, Liew HC. 1989. The Leatherback Turtle: A Malaysian Heritage. Kuala Lumpur, Malaysia: Tropical Press.

Chan EH, Liew HC, Mazlan AG. 1988. The incidental capture of sea turtles in fishing gear in Terengganu, Malaysia. Biological Conservation 43(1):1-7.

Collard SB. 1990. Leatherback turtles feeding near a watermass boundary in the eastern Gulf of Mexico. Marine Turtle Newsletter 50:12-14.

Cowan E, Pennell J, Salmon M, Wyneken J, Cowan C, Broadwell A. Influence of filtered roadway lighting on the seaward orientation of hatchling sea turtles. In: Mosier A, Foley A, Brost B, editors. Twentieth Annual Symposium on Sea Turtle Biology and Conservation; 2002. p. 295-298.

Crognale MA, Eckert SA, Levenson DH, Harms CA. 2008. Leatherback sea turtle Dermochelys coriacea visual capacities and potential reduction of bycatch by pelagic longline fisheries. Endangered Species Research 5:249-256.

Davenport J, Balazs GH. 1991. “Fiery bodies” – are pyrosomas an important component of the diet of leatherback turtles? The British Herpetological Society Bulletin 31:33-38.

Deem SL, Boussamba F, Nguema AZ, Sounguet G, Bourgeois S, Cianciolo J, Formia A. 2007. Artificial lights as asignificant cause of morbidity of leatherback sea turtles in Pongara National Park, Gabon. Marine Turtle Newsletter 116:15-17.

Doyle TK, Houghton JDR, McDevitt R, Davenport J, Hays GC. 2007. The energy density of jellyfish: Estimates from bomb-calorimetry and proximate-composition. Journal of Experimental Marine Biology and Ecology 343(2):239-252.

Dutton DL, Bowen BW, Owens DW, Barragan A, Davis SK. 1999. Global phylogeography of the leatherback turtle (*Dermochelys coriacea*). Journal of Zoology 248:397-409.

Dutton PH, Hitipeuw C, Zein M, Benson SR, Petro G, Pita J, Rei V, Ambio L, Bakarbessy J. 2007. Status and genetic structure of nesting populations of leatherback turtles (*Dermochelys coriacea*) in the western Pacific. Chelonian Conservation and Biology 6(1):47-53.

Dutton PH, McDonald DB. 1994. Use of PIT tags to identify adult leatherbacks. Marine Turtle Newsletter 67:13-14.

Dutton PH, Squires D. 2008. Reconciling Biodiversity with Fishing: A Holistic Strategy for Pacific Sea Turtle Recovery. Ocean Development & International Law 39(2):200-222.

Eckert K, Luginbuhl C. 1988. Death of a giant. Marine Turtle Newsletter 43:2-3.

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

Eckert S, Bagley D, Kubis S, Ehrhart L, Johnson C, Stewart K, DeFreese D. 2006. Internesting and postnesting movements and foraging habitats of leatherback sea turtles (*Dermochelys coriacea*) nesting in Florida. Chelonian Conservation and Biology 5(2):239-248.

Eckert SA. 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 SA, Eckert KL, Ponganis P, Kooyman GL. 1989. Diving and foraging behavior of leatherback sea turtles (Dermochelys coriacea). Canadian Journal of Zoology 67:2834-2840.

Eckert SA, Liew HC, Eckert KL, Chan EH. 1996. Shallow water diving by leatherback turtles in the South China Sea. Chelonian Conservation and Biology 2:237-243.

Elcock LE, Stuart BP, Wahle BS, Hoss HE, Crabb K, Millard DM, Mueller RE, Hastings TF, Lake SG. 2001. Tumors in long-term rat studies associated with microchip animal identification devices. Experimental Toxicology and Pathology 52:483-491.

Ferraroli S, Georges J-Y, Gaspar P, Maho YL. 2004. Endangered species: Where leatherback turtles meet fisheries. Nature 429(6991):521-522.

Finkbeiner EM, Wallace BP, Moore JE, Lewison RL, Crowder LB, Read AJ. 2011. Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 and 2007. Biological Conservation 144(11):2719-2727.

Formia A, Tiwari M, Fretey J, Billes A. 2003. Sea turtle conservation along the Atlantic Coast of Africa. Marine Turtle Newsletter 100:33-37.

Fossette S, Corbel H, Gaspar P, Maho YL, Georges J-Y. 2007. An alternative technique for the long-term satellite tracking of leatherback turtles. Endangered Species Research 3:1-9.

Fossette S, Girard C, Bastian T, Calmettes B, Ferraroli S, Vendeville P, Blanchard F, Georges J-Y. 2009. Thermal and trophic habitats of the leatherback turtle during the nesting season in French Guiana. Journal of Experimental Marine Biology and Ecology.

Frazier JG. 2001. General natural history of marine turtles. Proceedings: Marine turtle conservation in the Wider Caribbean Region: A dialogue for effective regional management. Santo Domingo, Dominican Republic.

Fretey J, Billes A, Tiwari M. 2007. Leatherback, Dermochelys coriacea, nesting along the Atlantic coast of Africa. Chelonian Conservation and Biology 6(1):126-129.

Frid A, Dill L. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1).

Garcon JS, Grech A, Moloney J, Hamann M. 2010. Relative Exposure Index: an important factor in sea turtle nesting distribution. Aquatic Conservation: Marine and Freshwater Ecosystems 20(2):140-149.

Gill JA, Sutherland WJ. 2001. Predicting the consequences of human disturbance from behavioral decisions. In: Gosling LM, Sutherland WJ, editors. Behavior and Conservation. Cambridge: Cambridge University Press. p. 51-64.

Gless JM, Salmon M, Wyneken J. 2008. Behavioral responses of juvenile leatherbacks Dermochelys coriacea to lights used in the longline fishery. Endangered Species Research 5:239-247.
Goff GP, Stenson GB. 1988. Brown adipose tissue in leatherback sea turtles: a thermogenic organ in an endothermic reptile? Copeia 1988(4):1071-1075.
Green GA, Brueggerman JJ, Grotefendt RA, Bowlby CE, Bonnell ML, Balcomb III KC. 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.
Green GA, Grotefendt RA, Smultea MA, Bowlby CE, Rowlett RA. 1993. Delphinid aerial surveys in Oregon and Washington offshore waters. Final report. Seattle, Washignton: National Marine Fisheries Service, National Marine Mammal Laboratory.
Greer AE, Lazell JD, Wright RM. 1973. Anatomical evidence for a counter-current heat exchanger in a leatherback turtle (*Dermochelys coriacea)*. Nature 244(5412):181.
Gregory LF, Gross TS, Bolten AB, Bjorndal K, Guillette LJ. 1996. Plasma corticosterone concentrations associated with acute captivity stress in wild loggerhead sea turtles (*Caretta caretta*). General and Comparative Endocrinology 104:312-320.
Hamann M, Limpus C, Hughes G, Mortimer J, Pilcher N. 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.
Harms CA, Papich MG, Stamper MA, Ross PM, Rodriguez MX, Hohn AA. 2004. Pharmacokinetics of Oxytetracycline in Loggerhead Sea Turtles (Caretta Caretta) after Single Intravenous and Intramuscular Injections. Journal of Zoo and Wildlife Medicine 35(4):477-488.
Harris HS, Benson SR, Gilardi KV, Poppenga RH, Work TM, Dutton PH, Mazet JAK. 2011. Comparative health assessment of western Pacific leatherback turtles (*Dermochelys coriacea*) foraging off the coast of California, 2005-2007. Journal of Wildlife Diseases 47(2):321-337.
Harvey J, Benson S, Graham T. Foraging ecology of leatherbacks in the California Current. . In: Frick M, Panagopoulou A, Rees AF, Williams K, editors. Abstracts of the Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation; 2006; Athens, Greece. p. 192.
Hawkes LA, Broderick AC, Godfrey MH, Godley BJ. 2007. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology 13:1-10.
Hays GC. 2000. The implications of variable remigration intervals for the assessment of population size in marine turtles. J Theor Biol 206(2):221-7.
Hays GC, Houghton JDR, Myers AE. 2004. Endangered species: Pan-Atlantic leatherback turtle movements. Nature 429(6991):522-522.
HDLNR. 2002. Application for an individual incidental take permit pursuant to the Endangered Species Act of 1973 for listed sea turtles in inshore marine fisheries in the main Hawaiian Islands managed by the State of Hawaii. State of Hawaii, Division of Aquatic Resources.
Helmick KE, Papich MG, Vliet KA, Bennett RA, JAcobson ER. 2004. Pharmacokinetic disposition of a long-acting oxytetracycline formulation after single-dose intravenous and intramuscular administrations in the American alligator (*Alligator mississippiensis*). Journal of Zoo and Wildlife Medicine 35(3):341-346.

Hernandez R, Buitrago J, Guada H, Hernandez-Hamon H, Llano M. 2007. Nesting distribution and hatching success of the leatherback, Dermochelys coriacea, in relation to human pressures at Playa Parguito, Margarita Island, Venezuela. Chelonian Conservation and Biology 6(1):79-86.

Hitipeuw C, Dutton PH, Benson SR, Thebu J, Bakarbessy J. 2007. Population status and internesting movement of leatherback turtles, *Dermochelys coriacea*, nesting on the northwest coast of Papua, Indonesia. Chelonian Conservation and Biology 6(1):28-36.

Hodge RP, Wing BL. 2000. Occurrences of marine turtles in Alaska waters: 1960-1998. Herpetological Review 31(3):148-151.

James MC, Andrea Ottensmeyer C, Myers RA. 2005a. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecology Letters 8(2):195-201.

James MC, Eckert SA, Myers RA. 2005b. Migratory and reproductive movements of male leatherback turtles (Dermochelys coriacea). Marine Biology 147(4):845-853.

James MC, Eckert SA, Myers RA. 2005c. Migratory and reproductive movements of male leatherback turtles (*Dermochelys coriacea*). Marine Biology 147:845-853.

James MC, Ottensmeyer CA, Eckert SA, Myers RA. 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.

Jones T, Bostrom B, Carey M, Imlach J, Mickelson J, Ostafichuk P, Eckert S, Opay P, Swimmer Y, Seminoff J et al. . 2011. Determining transmitter drag and best practice attachment procedures for sea turtle biotelemetry studies.

Kastelein RA, van Schie R, Verboom WC, de Haan D. 2005. Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumetopias jubatus*). The Journal of the Acoustical Society of America 118(3):1820.

Ketten DR. 1997. Structure and function in whale ears. Bioacoustics 8:103-135.

Ketten DR, Bartol SM. 2006. Final report functional measures of sea turtle hearing. Office of Naval Research.

Laurance WF, Fay JM, Parnell RJ, Sounguet G, Formia A, Lee MD. 2008. Does rainforest logging threaten endangered sea turtles? Oryx 42:245-251.

Lewison RL, Crowder LB. 2007. Putting longline bycatch of sea turtles into perspective. Conserv Biol 21(1):79-86.

Lima SL. 1998. Stress and decision making under the risk of predation: recent developments from behavioral, reproductive, and ecological perspecitves. Advances in the Study of Behavior 27:215-290.

López-Mendilaharsu M, Rocha CFD, Domingo A, Wallace BP, Miller P. 2009. Prolonged deep dives by the leatherback turtle Dermochelys coriacea: pushing their aerobic dive limits. Marine Biodiversity Records 2(01).

Lutcavage ME, Plotkin P, Witherington BE, Lutz PL. 1997. Human impacts on sea turtle survival. In: Lutz PL, Musick JA, editors. Biology of sea turtles. New York, New York: CRC Press. p. 387-409.

Maison K. Do turtles move with the beach? Beach profiling and possible effects of development on a leatherback (Dermochelys coriacea) nesting beach in Grenada. In: Frick M, Panagopoulou A, Rees AF, Williams K, editors. Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation; 2006; Athens, Greece: International Sea Turtle Society. p. 145.

Márquez MR. 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.
McDonald MA, Hildebrand JA, Wiggins SM, Thiele D, Glasgow D, Moore SE. 2005. Sei whale sounds recorded in the Antarctic. ASA.
McMahon CR, Hays GC. 2006. Thermal niche, large-scale movements and implications of climate change for a critically endangered marine vertebrate. Global Change Biology 12:1330-1338.
Mooney TA, Hanlon RT, Christensen-Dalsgaard J, Madsen PT, Ketten DR, Nachtigall PE. 2010. Sound detection by the longfin squid (*Loligo pealeii*) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. Journal of Experimental Biology 213(21):3748-3759.
Moore JE, Wallace BP, Lewison RL, Žydelis R, Cox TM, Crowder LB. 2009. A review of marine mammal, sea turtle and seabird bycatch in USA fisheries and the role of policy in shaping management. Marine Policy 33(3):435-451.
Moore PWB, Schusterman RJ. 1987. Audiometric assessment of northern fur seals, *Callorhinus ursinus*. Marine Mammal Science 3(1):31-53.
Mrosovsky N, Hopkins-Murphy SR, Richardson JI. 1984. Sex ratio of sea turtles: seasonal changes. Science 225(4663):739-741.
Mrosovsky N, Ryan GD, James MC. 2009. Leatherback turtles: the menace of plastic. Mar Pollut Bull 58(2):287-9.
Paladino FV, O'Connor MP, Spotila JR. 1990. Metabolism of leatherback turtles, gigantothermy, and thermoregulation of dinosaurs. Nature 344(6269):858-860.
Parks SE, Ketten DR, O'Malley JT, Arruda J. 2007. Anatomical predictions of hearing in the North Atlantic right whale. The Anatomical Record 290(6):734-44.
Petersen SL, Honig MB, Ryan PG, Nel R, Underhill LG. 2009. Turtle bycatch in the pelagic longline fishery off southern Africa. African Journal of Marine Science 31(1):87-96.
Pitman RL, Dutton PH. 2004. Killer whale predation on a leatherback turtle in the Northeast Pacific. Northwest Science 58:497-498.
Price ER, Wallace BP, Reina RD, Spotila JR, Paladino FV, Piedra R, Velez E. 2004. Size, growth, and reproductive output of adult female leatherback turtles *Dermochelys coriacea*. Endangered Species Research 5:1-8.
Pritchard PCH. 1982. Nesting of the leatherback turtle, *Dermochelys coriacea* in Pacific Mexico, with a new estimate of the world population status. Copeia 4:741-747.
Rebel TP. 1974. Sea turtles and the turtle industry ofthe West Indies, Florida and the Gulf of Mexico. . Coral Gables, Florida: University Miami Press.
Reina RD, Mayor PA, Spotila JR, Piedra R, Paladino FV. 2002. Nesting ecology of the leatherback turtle, *Dermochelys coriacea*, at Parque Nacional Marino Las Baulas, Costa Rica: 1988-1989 to 1999-2000. Copeia 2002(3):653-664.
Rivalan P, Godfrey MH, Prevot-Julliard A-C, Girondot M. 2005a. Maximum likelihood estimates of tag loss in leatherback sea turtles. Journal of Wildlife Management 69:540-548.
Rivalan P, Prevot-Julliard AC, Choquet R, Pradel R, Jacquemin B, Girondot M. 2005b. Trade-off between current reproductive effort and delay to next reproduction in the leatherback sea turtle. Oecologia 145(4):564-74.
Romero LM. 2004. Physiological stress in ecology: lessons from biomedical research. Trends in Ecology and Evolution 19(5):249-255.

Rostal DC, Robeck TR, Owens DW, Kraemer DC. 1990. Ultrasound imaging of ovaries and eggs in Kemp's Ridley sea turtles (*Lepidochelys kempi*). Journal of Zoo and Wildlife Medicine 21(1):27-35.

Ryder CE. 2004. Report of the workshop on marine turtle longline post-interaction mortality. In: US Department of Commerce N, editor. p. 36.

Sadove SS, Morreale SJ. 1990. Marine mammal and sea turtle encounters with marine debris in the New York bight and northeast Atlantic. In: US Department of Commerce N, editor. NOAA Technical Memorandum. Panama City.

Santidrián Tomillo P, Vélez E, Reina RD, Piedra R, Paladino FV, Spotila JR. 2007. Reassessment of the leatherback turtle (*Dermochelys coriacea*) nesting population at Parque Nacional Marino Las Baulas, Costa Rica: Effects of conservation efforts. Chelonian Conservation and Biology 6(1):54-62.

Sarti Martinez A. 2000. *Dermochelys coriacea*. IUCN Red List of Threatened Species. Version 2011.2 ed.: IUCN 2011.

Sarti Martinez L, Barragan A, Garcia Munoz D, Garcia N, Huerta P, Vargas F. 2007. Conservation and biology of the leatherback turtle in the Mexican Pacific. Chelonian Conservation and Biology 6(1):70-78.

Sherrill-Mix SA, James MC. 2008. Evaluating potential tagging effects on leatherback sea turtles. Endangered Species Research 4:187-193.

Shillinger GL, Palacios DM, Bograd S, Swithenbank AM, Gaspar P, Wallace BP, Spotila JR, Paladino FV, Piedra R, Eckert S et al. . 2008. Persistent leatherback turtle migrations present opportunities for conservation. PLoS Biology 6(7):1408-1416.

Southwood AL, Andrews RD, Lutcavage ME, Paladino FV, West NH, George R, Jones DR. 1999. Heart rates and dive behavior of leatherback sea turtles in the eastern Pacific Ocean. Journal of Experimental Biology 202:1115-1125.

Spotila JR, Dunham AE, Leslie AJ, Steyermark AC, Plotkin PT, Paladino FV. 1996. Worldwide population decline of *Dermochelys coriacea*: Are leatherback turtles going extinct? Chelonian Conservation and Biology 2(2):209-222.

Spotila JR, Reina RD, Steyermark AC, Plotkin PT, Paladino FV. 2000. Pacific leatherback turtles face extinction. Nature 405:529-530.

Standora EA, Spotila JR, Keinath JA, Shoop CR. 1984. Body temperatures, diving cycles, and movement of a subadult leatherback turtle, Dermochelys coriacea. Herpetologica 40:169-176.

SWFSC. 2008. Annual report of research activities conducted under NMFS Permit No. 1596 by the SWFSC for the period of 1 January to 31 December 2007.

SWFSC. 2009. NMFS scientific research permit #1596, annual report #2.

Tapilatu RF, Tiwari M. 2007. Leatherback Turtle, Dermochelys coriacea, Hatching Success at Jamursba-Medi and Wermon Beaches in Papua, Indonesia. Chelonian Conservation and Biology 6(1):154-158.

TEWG. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555. 116p.

Troëng S, Solano R, Diaz-Merry A, Ordonez J, Taylor J, Evans D, Godfrey D, Bagley D, Ehrhart L, Eckert SA. 2006. Report on long-term transmitter harness retention by a leatherback turtle. Marine Turtle Newsletter 111:6-7.

van Dam RP, Diez CE. 1999. Differential tag retention in Caribbean hawksbill turtles. Chelonian Conservation and Biology 3(2):225-229.

Vascellari M, Melchiotti E, Mutinelli F. 2006. Fibrosarcoma with typical features of postinjection sarcoma at site of microchip implant in a dog: histologic and immunohistochemical study. Vet Pathol 43(4):545-8.

Wahlberg M, Westerberg H. 2005. Hearing in fish and their reactions to sounds from offshore wind farms. Marine Ecology Progress Series 288:295-309.

Wallace BP, George RH. 2007. Alternative techniques for obtaining blood samples from leatherback turtles. Chelonian Conservation and Biology 6(1):147-149.

Wallace BP, Kilham SS, Paladino FV, Spotila JR. 2006. Energy budget calculations indicate resource limitation in Eastern Pacific leatherback turtles. Marine Ecology Progress Series 318(318):263-270.

Wallace BP, Sotherland PR, Tomillo PS, Reina RD, Spotila JR, Paladino FV. 2007. Maternal investment in reproduction and its consequences in leatherback turtles. Oecologia 152(1):37-47.

Witherington BE. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48(1):31-39.

Witherington BE, Bjorndal KA. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles Caretta caretta. Biological Conservation 55:139-149.

Witt MJ, Augowet Bonguno E, Broderick AC, Coyne MS, Formia A, Gibudi A, Mounguengui Mounguengui GA, Moussounda C, M NS, Nougessono S et al. . 2011. Tracking leatherback turtles from the world's largest rookery: assessing threats across the South Atlantic. Proc Biol Sci 278(1716):2338-47.

Witt MJ, Baert B, Broderick AC, Formia A, Fretey J, Gibudi A, Mounguengui GAM, Moussounda C, Ngouessono S, Parnell RJ et al. . 2009. Aerial surveying of the world's largest leatherback turtle rookery: A more effective methodology for large-scale monitoring. Biological Conservation 142(8):1719-1727.

Wyneken J, Epperly SP, Higgins B, McMichael E, Merigo C, Flanagan JP. 2010. PIT tag migration in seaturtle flippers. Herpetological Review 41(4):448-454.