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 permits No. 15661 and 15685, and a modification to the existing permit No. 10027-04 which would characterize the population structure, movements and spatial distribution of green and hawksbill sea turtles in nearshore habitats off the Northern Mariana Islands (NMI), the Hawaiian Islands, and Palmyra Atoll pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973**

Prepared by: **ESA Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service**

Approved by: ______________________

Date: JAN 18 2012

Section 7(a)(2) of the Endangered Species Act (ESA; 16 U.S.C. 1531 et seq.) requires each federal agency to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When an action of a federal agency "may affect" endangered or threatened species or 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. This biological opinion is the result of an intra-agency consultation between the Permits and Conservation Division and the ESA Interagency Cooperation Division of the NMFS Office of Protected Resources. This opinion describes whether Permits and Conservation Division's issuance of scientific research permits 15661 (Responsible Party: Arnold Palacios) 156875 (Responsible Party: Samuel Pooley) and modification to existing permit 10027-04 (Responsible Party: Eleanor Sterling) would likely jeopardize the existence of the threatened green and endangered hawksbill turtles.

This biological opinion has been prepared in accordance with section 7 of the ESA and regulations promulgated to implement that section of the ESA. This biological opinion is based on information provided in the research permit application, the *Draft Environmental Assessment and Supplemental Environmental Assessment on the Effects of Issuing a Permit and a Permit Modification for Scientific Research on Protected Sea Turtles in the Western Pacific Ocean*, and the *Draft Environmental Assessment on Effects of Issuing a Permit for Scientific Research on*

Protected Sea Turtles in the Hawaiian Islands, published and unpublished scientific information on the biology and ecology of endangered and threatened turtles, and other sources of information.

A brief account of the consultation history precedes the biological opinion. The biological opinion first describes the proposed permit and research activities, including activities that may affect listed species, and the action areas. Accounts of the various sea turtles, their life histories, population status and trends, and major threats follow. The *Environmental Baseline* section contains a discussion of the past and present activities that have affected these species in the action areas. The *Status of the Species* and the *Environmental Baseline* serve as the context for the analysis of the effects of the proposed action on these species. The *Effects of the Action* section describes the evidence and rationale behind our conclusion that these species are not likely to be jeopardized by issuance of the proposed research permit.

Consultation History

The Permits and Conservation Division requested a consultation under the ESA in a memorandum dated August 23, 2011, on its proposal to issue scientific research permits 15661 and 15685 for a five-year period. The modification to the existing permit 10027-04 would be valid until the permit expires on July 31, 2013. The applicants would be conducting research on listed green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles in nearshore habitats off the Northern Mariana Islands (NMI), the Main Hawaiian Islands, and Palmyra Atoll. Consultation was initiated on August 23, 2011.

Biological Opinion

Description of the Proposed Action

The Permits and Conservation Division of the NMFS Office of Protected Resources proposes to issue two scientific research permits and a permit modification pursuant to section 10(a)(1)(A) of the ESA.

Permit 15661

The proposed action is issuance of a scientific research permit to Arnold Palacios, of the Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife, pursuant to the ESA. The primary goal of the CNMI's research is to characterize population structure, size class composition, foraging ecology and migration patterns of these threatened and endangered species within the nearshore waters of the Northern Mariana Islands (NMI). The proposed research would result in collection of baseline data to help determine the decline or recovery of these populations.

Researchers would be authorized to annually capture up to 300 green (*Chelonia mydas*) and 50 hawksbill (*Eretmochelys imbricata)* sea turtles by hand capture using snorkelers and SCUBA divers. All green sea turtles would be measured, photographed/videoed, weighed, shell etched with an identification mark, tissue sampled, passive integrated transponder (PIT) tagged, and flipper tagged. Hawksbill sea turtles would be measured, weighed, PIT tagged, flipper tagged, shell etched, tissue sampled, and released at the capture site. A subset of green and hawksbill sea turtles would additionally have a transmitter attached to them. All animals would be released. The annual take is summarized in the table that follows.

The annual take for permit 15661:

No. of Turtles	Life Stage	Species	In-water Take Activity(ies)**
285	Juvenile/subadult/ adult	Green	Count/survey, capture, measure, temporary carapace marking, weigh, flipper tag, PIT tag, tissue sample, photograph/video, release
15*	Juvenile/subadult/ adult	Green	Count/survey, capture, measure, temporary carapace marking, weigh, flipper tag, PIT tag, tissue sample, photograph/video, epoxy attachment of transmitter, gear removal if recaptured, transport, release and tracking
45	Juvenile/subadult/ adult	Hawksbill	Count/survey, capture, measure, temporary carapace marking, weigh, flipper tag, PIT tag, tissue sample, photograph/video, release
5*	Juvenile/subadult/ adult	Hawksbill	Count/survey, capture, measure, temporary carapace marking, weigh, flipper tag, PIT tag, tissue sample, photograph/video, epoxy attachment of transmitter, gear removal if recaptured, transport, release and tracking
5	Juvenile/subadult/ adult	Green	Salvage of carcass, tissue and parts from dead animals
5	Juvenile/subadult/ adult	Hawksbill	Salvage of carcass, tissue and parts from dead animals

*** = Two takes per animal; initial tagging and gear removal.**
**** = Hand captured by snorkel or SCUBA.**

The new permit, if issued, would authorize the proposed research over a five-year period starting from the date of approval. The applicant currently holds a permit with NMFS (file no. 1556; with an expiration date of June 01, 2012).

Permit 15685

The proposed action is issuance of a scientific research permit to Dr. Samuel Pooley of the Pacific Islands Fisheries Science Center, pursuant to the ESA. The purpose of the research would be to continue long-term monitoring of the status of green and hawksbill turtles in the Hawaiian Islands. A primary goal is to continue long-term monitoring to determine growth rates, health status, population structure, foraging ecology, habitat use, and migration patterns for green and hawksbill sea turtles in the Hawaiian Islands and contribute to the overall understanding of sea turtle stock structure in the Pacific Ocean. Issuance of this permit would help sea turtle conservation and management as well as ecosystem management.

Researchers would be authorized to annually capture up to 600 green and 25 hawksbill sea turtles by hand, scoop net, and entanglement net. All green sea turtles would be measured, weighed, passive integrated transponder (PIT) tagged, flipper tagged, and released at the capture site. A subset of green sea turtles would have their shell etched with an identification mark, be blood sampled, tissue sampled, lavaged, and have a transmitter attached to them. Hawksbill sea turtles would be measured, weighed, PIT tagged, flipper tagged, shell etched, blood sampled, tissue sampled, and released at the capture site. A subset of hawksbills would have transmitters attached to them. All animals would be released. The annual take is summarized in the table that follows.

The annual take for permit 15685:

No. of Turtles	Life Stage	Species	In-water Take Activity(ies)**
250	Juvenile/subadult/ adult	Green	Capture, measure, temporary carapace mark, weigh, flipper tag, PIT tag, release
100	Juvenile/subadult/ adult	Green	Capture, measure, temporary carapace mark, weigh, flipper tag, PIT tag, shell etch, release
200	Juvenile/subadult/ adult	Green	Capture, measure, temporary carapace mark, weigh, flipper tag, PIT tag, blood sample, lavage, scute crape sample, shell etch, tissue sample, tumor sample, release
50*	Juvenile/subadult/ adult	Green	Capture, measure, temporary carapace mark, weigh, flipper tag, PIT tag, blood sample, lavage, scute scrape sample, shell etch, tissue sample, tumor sample, epoxy attachment of transmitter, transport, release and gear removal if recaptured
20	Juvenile/subadult/ adult	Hawksbill	Capture, measure, weigh, temporary carapace mark, shell etch, flipper tag, PIT tag, blood sample, tissue sample, scute crape sample, and release
5*	Juvenile/subadult/ adult	Hawksbill	Capture, measure, weigh, temporary carapace mark, shell etch, flipper tag, PIT tag, blood sample, scute scrape sample, tissue sample, epoxy attachment of transmitter, release and gear removal if recaptured

*** = Two takes per animal; initial tagging and gear removal.**
**** = Hand captured by snorkel or SCUBA, tangle nets or dip nets.**

The new permit, if issued, would authorize the proposed research over a five-year period starting from the date of approval. The applicant currently holds a permit with NMFS (file no. 1581; with an expiration date of December 31, 2011).

Permit Modification 10027-04

The proposed action is the modification (#4) of the existing scientific research permit 10027, issued to Dr. Eleanor Sterling of the American Museum of Natural History (AMNH), Center of Biodiversity and Conservation, pursuant to the ESA. Knowledge of sea turtle population biology and connectivity is required for the effective management of these species and their ecosystems at Palmyra. This work would address three research priorities identified in the recovery plans for these sea turtle species: 1) identifying important feeding grounds; 2) determining distribution, abundance, and status; and 3) characterizing population relationships using genetic analysis. This study would provide ecological information needed for an ecosystem management approach for the Palmyra Atoll National Wildlife Refuge (PANWR). The results would also help form the basis of a sea turtle management plan for the PANWR.

Researchers would be authorized to annually additionally capture up to 150 green sea turtles by hand, scoop net, and entanglement net. All green sea turtles would be captured, measured, weighed, passive integrated transponder (PIT) tagged, flipper tagged, tissue, blood, carapace and fecal sampled, shell etched/paint, measure temperature and released at the capture site. Of those 150 animals, 10 would additionally have a transmitter attached to them. The researchers are also requesting a minor modification to the lavage method, using a forceps grasper to gently remove a small sample of contents from the sea turtle's crop rather than flushing the crop with water. All animals would be released. The annual take is summarized in the table that follows. The text in bold indicates the take rows affected by the modification.

The annual proposed increase in takes for permit 10027-04:

Current takes*	**Proposed takes***	**Life Stage**	**Species**	**In-water Take Activity(ies)****
4	**144**	Juvenile/subadult/ adult	Green	Capture*, measure, weigh, photograph, flipper and PIT tag, tissue biopsy, blood sample, carapace sample, shell etch and paint, fecal sample, measure temperature, and release
50	50	Juvenile/subadult/ adult	Green	Capture*, measure, weigh, photograph, flipper and PIT tag, tissue biopsy, blood sample, carapace sample, shell etch and paint, fecal sample, measure temperature, gastric lavage, and release
16	16	Juvenile/subadult/ adult	Green	Capture*, measure, weigh, photograph, flipper and PIT tag, tissue biopsy, blood sample, carapace sample, shell etch and paint, fecal sample, measure temperature, satellite tag, and release

30	**40**	Juvenile/subadult/ adult	Green	Capture*, measure, weigh, photograph, flipper and PIT tag, tissue biopsy, blood sample, carapace sample, shell etch and paint, fecal sample, measure temperature, sonic and/or radio tag, tracking, and release
6	6	Juvenile/subadult/ adult	Green	Salvage dead carcass, tissue, and parts

[*] = A maximum of 25 green sea turtles may have a satellite transmitter attached over the course of the permit; and a maximum of 200 turtles may be gastric lavaged/stomach sampled over the course of the permit.
**** = Hand captured by rodeo capture, hand capture, tangle nets, dip nets, throw nets, and scoop nets.**

The following conditions would be removed from the permit that capped take numbers for specific activities:

- A maximum of 60 green sea turtles may have acoustic tags attached over the course of the permit.
- A maximum of 350 green sea turtles may be skin and blood sampled over the course of the permit.

These conditions are being removed because the proposed modification would only be valid for the last year of the permit by the time the permit modification could be issued, resulting in overall lower level of takes than would be authorized with the caps in place. In addition, conditions for gastric lavage would be slightly reworded to acknowledge that the forceps grasper can be used in place of lavage flushing to sample stomach contents.

No other changes to Permit No. 10027-04 would occur. The modification to the existing permit 10027-04, if issued, would be valid until the permit expires on July 31, 2013

The following provides additional detail on the methodologies that would be used under the proposed action:

Turtle Capture, Experimental Procedures and Minimization of Impacts

The following sections will describe how turtles will be captured and handled as well as the experimental procedures that will be carried out under the proposed permits. This section will also note actions that will be taken to minimize the impact of these activities. All invasive sampling methods will be performed by trained personnel.

Permit 15661

Visual Counts and Capture

Visual counts of sea turtles would be recorded during vessel surveys. Researchers would hand-collect sea turtles by snorkeling or SCUBA in shallow coastal and reef waters. Turtles would be released at or very close to the capture site.

Hand, Snorkeling, and Scuba Diving – Researchers using SCUBA or snorkeling equipment would capture resting/free-swimming hard shell sea turtles by hand, carefully ascending to the surface (no decompression required) where they would hand individual turtles to an assistant on board the research vessel. Each captured turtle would be carefully brought on board, taking precautions to minimize stress. Boats would not be used to chase turtles into the shallows for easier capture. The shallow areas would be avoided so as to not impact corals and sea grasses and damage the vessel. Only one turtle would be captured and worked up during any given tagging event. If any procedural difficulties would occur during the capture process the turtle would be immediately released in a manner that would ensure its safety.

Handling, Measuring, and Weighing

Researchers would use care when handling animals to minimize any possible injury. Calipers would be used to measure straight carapace measurements and flexible tape measures would be used for curved carapace measurements. Measurements would include total straight-line carapace length (SCL), standard straight-line carapace length, minimum straight-line carapace length, minimum curved carapace length, and straight-line carapace width at the widest point. All turtles would be measured quickly and would be protected from extreme environmental conditions (e.g., too much heat). Turtles would be weighed in an animal carrier using an electronic scale. Researchers would exercise caution so as to ensure that turtles are not dropped or injured during the weighing activities. Turtles would also be photographed/video and carefully examined. During external examinations, notes on the condition of the turtle would be recorded such as the size and location of any tumors characteristic of fibropaillomastosis (FP), tag scars, carapace and flipper wounds, etc. Turtles with FP will be kept separate from other turtles and separate sets of measuring, weighing and tagging gear will be used. Each set of equipment would be used to measure and weigh turtles would be cleaned and disinfected with a mild disinfectant solution before each turtle is measured.

Tissue Sampling

Tissue samples would be collected, preserved and archived for future genetic analysis, disease related studies, and foraging ecology studies using stable isotope analysis. The tissue biopsy is obtained using a sterile biopsy punch from the trailing edge of a rear flipper when possible. Prior to the biopsy, the site would be prepared by swabbing it with an antiseptic solution such as Betadine or isopropyl alcohol. Following the biopsy, an additional antiseptic wipe will be used with modest pressure to stop any bleeding. A new sterile biopsy punch would be used on each animal. To ensure that turtles are not sampled multiple times, captured turtles with existing tags will not be sampled.

Flipper and Passive Integrated Transponder (PIT) Tagging

All turtles would be checked for existing flipper tags and scanned for existing internal Passive Integrated Transponders (PIT) tags. If any turtle has not been previously tagged, an oxidation and corrosion resistant metal tag (Inconel) would be applied to the trailing edge of a front or hind flipper typically in either the first (closest to the body) or second scale, using the standard technique described in the Marine Turtle Specialist Group Manual on Research Techniques (Eckert et al. 1999). These tags are expected to last up to several years. If the recommended tagging site is damaged or is unsuitable for tag application, then an alternative site would be used. The applicator is similar to that used to ear-tag livestock; the pointed end of the tag goes through the flipper and connects on the underside. Prior to flipper tagging, tags would be cleaned and soaked to remove any residue. The tagging site would be swabbed thoroughly with disinfectant prior to tagging. Antibiotic ointment would be applied to the cutting tip of each tag just prior to attachment. A separate set of applicators will be used with turtles afflicted with FP. The applicant will make certain that the locking mechanisms are correctly aligned and that the tag locks in place. However, care should be taken to ensure tags are not cinched too tight against the flipper without room to move freely, and that the tag is not applied too far into the edge of the flipper. Ideally, 25-33% of the tag should extend beyond the edge of the flipper after application. This is especially important when applying tags to immature turtles that are still growing. Tag applicators (pliers) would be cleaned and disinfected with alcohol swabs between turtles to avoid cross contamination. Tag applicators would also be routinely inspected and discarded when they cease to function properly.

Should a turtle not have a PIT tag [small (14 mm length x 2 mm diameter) electromagnetically-coded glass encased "microchips"], a tag would be inserted subcutaneously into a rear flipper per established protocols (Wyneken et al. 2010) using a disposable pre-sterilized needle applicator to eliminate the possibility of cross contamination. Prior to the insertion of any tag, the skin in the target area would be scrubbed with an antiseptic. PIT needles are then disposed of after each application. PIT tags are read with a scanner, and are designed to last the life of the turtle. If a previously tagged turtle is missing any of its original tags, replacement tags would be applied.

Satellite Tagging, Sonic tag, TDR, Radio tag

A subset of 15 greens and 5 hawksbill turtles will be fitted with a transmitter, attached with a silicone elastomer, minimizing the resin's contact with sutures. The weight of the transmitters would not exceed five percent of the turtle's body mass. Tags would be adhered to the animals by lightly sanding the carapace to remove algae and cleaned with alcohol. The transmitter would be attached to the carapace using a resin that cures releasing little heat that would not be injurious to animals. Each attachment would be made as hydrodynamic as possible, so that there is no risk of entanglement. During transport in the boat (approximately 45 minutes), the turtles would be covered with a moist towel (to cover the head and eyes, not covering the nares) and supported on soft moist padding. Tag attachment would be conducted at a land-based workstation (adjacent to capture location) and extreme care would be taken to ensure that no resin drips onto the skin of the turtle, and that there is adequate ventilation around the turtle's head during the attachment. Turtles are held for up to 2.5 hours until resin has cured in a plastic pen and kept in the shade during transmitter attachment. Once the resin is properly cured, turtles would be transported (as previously described) by boat and released back into the water at the point of capture during daylight hours. Release would take place within 4 hours of capture. Handling time during capture activities should be minimized to reduce the potential for additional stress.

Marking and Carapace Etching

Carapace marking is a minimally invasive technique that involves the shallow (1-2mm deep) etching and painting of a number into the animal's carapace for identification. An etching tool with a bit would be used to place a groove or etch in the carapace. The bit would be disinfected before each use. The groove would only be made in the scute and not go through the scute into the underlying living tissue. Turtles with scutes too thin to be etched without risk of affecting underlying living tissue would not be etched. Each turtle will have a unique ID painted on the dorsal carapace to enable observers to quickly identify individuals after release, using non-toxic epoxy white spray paint that will be applied without crossing suture lines. The applicant will not use paints with exothermic set-up reactions in order to ensure that there is no excessive heat that could affect the turtle as the paint cures. The expected life span of this number is of several weeks to months.

Transport and Holding

Holding time for each animal would not exceed the amount of time necessary to measure, weigh, tag, examine, and collect samples. When biotelemetric instruments are attached, holding time would increase to 4 hours (2.5 hours at land-based workstation, and maximum of 45 minutes travel time each way). A plastic pen would be used for transport and short-term holding of turtles, only one turtle will be captured and tagged on any given tagging event. If an animal is captured that requires veterinary treatment, it would be transported to the veterinary facility in a certified large animal carrier with a wet absorbent pad covering it to keep it cool.

Release

Turtles would be released where they were captured, during release turtles would be lowered as close to the water's surface as possible to prevent potential injuries. All newly released turtles would be observed by researchers and researchers would record observations on the turtle's apparent ability to swim and dive in a normal manner.

At the conclusion of the study, turtles that are tagged with transmitters may be recaptured to remove the transmitter gear. Removal of the transmitters at the end of the experiment is a non-invasive procedure. These animals would not be sampled again to minimize impacts to the animals. Should they not be recaptured, the transmitters will eventually be shed by normal surface flaking of the carapace scutes. Satellite tags generally remain on a turtle from 4 to 6 months to less than two years.

<u>Permit 15685</u>*:*

Capture

Turtles would be captured by various methods including: hand/scoop net capture in shallow coastal and reef waters, hand capture/snorkeling, hand capture while diving from a slow moving boat, entanglement net capture, or scoop net capture (Balazs *et al.*, 1987; Balazs *et al.*, 1998). Turtles would be released at or very close to the capture site.

Hand, Snorkeling, and Scuba Diving – Researchers using SCUBA or snorkeling equipment would capture resting juvenile hard shell sea turtles by hand, carefully ascend to the surface and hand individual turtles to an assistant on board the research boat. Each turtle would be carefully lifted aboard by its carapace, taking precautions to minimize stress. If any procedural difficulties would occur during the capture process the turtle would be immediately released in a manner that would ensure its safety.

Scoop Net – A scoop net would be placed under the turtle and it would be carefully and safely lifted or "scooped" out of the water and onto the deck of the research vessel.

Entanglement Net – Large-mesh entanglement nets would be constructed of 2 mm diameter nylon twine with a stretched diagonal mesh of 46 cm. The lengths of the nets range from 20 to 100 m and the depths range from 1.5 to 3.5 m. Researchers would set the nets at the surface extending vertically through the water column. Floats would be embedded in the top line of the net and the bottom line is weighted. Researchers would deploy the nets close to shore (< 100 m) in shallow, sandy, hard-bottom (rock and reef) habitats. Snorklers would continuously monitor the nets. Entangled turtles would be promptly removed from the net and brought to shore in large inner tubes with a plywood bottom (Balazs *et al*. 1987). A net might be set more than once per day at several locations within a study area, however, only one net would be set at a time. Set times vary by location, but typically do not exceed one hour. No other species would be regularly caught in the tangle nets.

Lavage

Researchers would extract dietary samples from 200 green turtles immediately after capture in order to collect food samples annually to provide insight into feeding habits, consumption levels, and diet selection as described in several previous studies (Balazs 1980; Legler 1977; Makowski et al. 2006; Seminoff et al. 2002). The lavage process flushes food items that are in the esophagus and mouth areas (Legler, 1977; Balazs, 1980; Forbes and Limpus, 1993). Turtles would be held on their back with their posterior end slightly elevated. After the turtle's mouth was opened, a standard veterinary canine oral speculum or similar mouth gag (small or medium, depending on the size of the turtle) would be inserted just posterior to the anterior tip of the rhamphotheca to keep the jaws from closing. Soft plastic 3/4 inch diameter soft plastic tubing would be lubricated with vegetable oil and cautiously inserted into the mouth and down the length of the esophagus to the "pre-stomach,". Tube sizes would vary with the size of the individual turtle to avoid esophageal damage. Two set of surgical tubes would be available, one for FP turtles and a set for non-FP turtles. Seawater would be pumped through the tube, and the tube would then be gently moved back and forth along the length of the esophagus. The returning flow or the injected water out of the mouth carrying food particles would be collected in a sampling container held below.

Generally, the lavage process itself lasts under 30 seconds. The lavage process would be restricted to no more than 45 seconds. After completion of lavage, the water flow would be stopped and the posterior of the turtle would be slightly elevated to allow the tube to drain. Once drained, the tube would be removed first, followed by the mouth gag or PVC pipe. The anterior part of the turtle's body would then be slightly elevated relative to the posterior to allow any remaining water to drain into the esophagus, away from the glottis, so that the turtle could take a breath. Only one sample would be obtained per individual. All lavage equipment would be disinfected between animals. The whole complete procedure takes 5 - 10 minutes, and if done properly poses no risk to the animal.

Handling, Measuring, and Weighing

Researchers would use care when handling animals to minimize any possible injury. Calipers would be used to measure straight carapace measurements and flexible tape measures would be used for curved carapace measurements. All turtles would be measured quickly and would be protected from extreme environmental conditions (e.g. too much heat). Turtles would be weighed in an animal carrier using an electronic scale. Researchers would exercise caution so as to ensure that turtles are not dropped or injured during the weighing activities. Turtles would also be photographed/video and carefully examined. Turtles with FP will be kept separate from other turtles and separate sets of measuring, weighing and tagging gear will be used. Each set of equipment would be used to measure and weigh turtles would be cleaned and disinfected with a mild disinfectant solution before each turtle is measured.

Tissue Sampling

Tissue samples would be collected, preserved and archived for future genetic analysis, disease related studies, and foraging ecology studies using stable isotope analysis. Researchers would collect a tissue sample (6 mm disc) from each newly tagged turtle using a new sterile biopsy punch from the trailing edge of a rear flipper when possible. Prior to the biopsy, the site would be prepared by swabbing it with an antiseptic solution and applying lidocane (injected or topically) to minimize discomfort. Following the biopsy, an additional antiseptic wipe will be used with modest pressure to stop any bleeding. A new sterile biopsy punch would be used on each animal. Tumor samples may be taken in addition to a skin sample if necessary using the same procedure; however, tumor samples would not be taken from every turtle with FP.

Blood

Blood samples from all turtles will be taken for genetic analysis, and sex ratios. They will be collected within the first five minutes of capture so as not to bias the samples. Researchers would take a blood sample by inserting a sterile needle, attached to a vacuum syringe, into the dorsocervical sinus, using the technique described in Bentley and Dunbar-Cooper (1980) and Owens and Ruiz (1980). The area will be thoroughly sterilized with an antiseptic before needle insertion. An appropriate gauge needle relative to turtle-size would be used.

Flipper and Passive Integrated Transponder (PIT) Tagging

All turtles would be checked for existing flipper tags and scanned for existing internal Passive Integrated Transponders (PIT) tags. If any turtle has not been previously tagged, an oxidation and corrosion resistant metal tag (Inconel) would be applied to the trailing edge of a front or hind flipper typically in either the first (closest to the body) or second scale, using the standard technique described in the Marine Turtle Specialist Group Manual on Research Techniques (Eckert et al. 1999). These tags are expected to last up to several years. If the recommended tagging site is damaged or is unsuitable for tag application, then an alternative site would be used. Prior to flipper tagging, tags would be cleaned and soaked to remove any residue. The tagging site would be swabbed thoroughly with disinfectant prior to tagging. Antibiotic ointment would be applied to the cutting tip of each tag just prior to attachment. A separate set of applicators will be used with turtles afflicted with FP. The applicant will make certain that the locking mechanisms are correctly aligned and that the tag locks in place. However, care should be taken to ensure tags are not cinched too tight against the flipper without room to move freely, and that the tag is not applied too far into the edge of the flipper. Ideally, 25-33% of the tag should extend beyond the edge of the flipper after application. This is especially important when applying tags to immature turtles that are still growing. Tag applicators (pliers) would be cleaned and disinfected with alcohol swabs between turtles to avoid cross contamination. Tag applicators would also be routinely inspected and discarded when they cease to function properly.

Should a turtle not have a PIT tag, one will be inserted subcutaneously into a rear flipper per established protocols (Wyneken et al. 2010) using a disposable pre-sterilized needle applicator to eliminate the possibility of cross contamination. Prior to the insertion of any tag, the skin in the target area would be scrubbed with an antiseptic. PIT needles are then disposed of after each application. PIT tags are read with a scanner, and are designed to last the life of the turtle. If a previously tagged turtle is missing any of its original tags, replacement tags would be applied.

Satellite Tagging, Sonic tag, TDR, Radio tag
A subset of 15 greens and 5 hawksbill turtles will be fitted with transmitters. Transmitters would be attached alone or as a combination of the following: 1) satellite tag + one (or 2) Time Depth Recorders (TDRs); or 2) sonic tag + one (or 2) TDRs. Transmitters (satellite, sonic and TDR) would be attached to the carapace with thin coats of fiberglass resin as described in Balazs et al. (1996), minimizing the resin's contact with sutures.. The attachment area on the carapace would be lightly sanded to remove algae and cleaned with alcohol. A non-toxic elastomer compound would be used to "cushion" the transmitter and hold it in place during the attachment procedure. A thin coat of laminating resin would be applied to the carapace and transmitter and 4-6 strips of fiberglass cloth would be pasted over the transmitter to attach it. This technique has been widely used and is an accepted safe and effective method for transmitter attachment (Balazs *et al.*, 1996). The turtles would be held on the shore (adjacent to capture location) for 3-12 hours until resin has cured and then released back into the water at the point of capture. Turtles would be held in a certified large animal carrier and kept in the shade (natural or canvas tarp) during transmitter attachment. Once the resin is properly cured, turtles are released back into the water at the point of capture. Handling time during capture activities should be minimized to reduce the potential for additional stress. Satellite tags remain on a turtle for less than two years. If tagged animals are opportunistically recaptured, transmitters (gear) may be removed.

Marking and Carapace Etching
A simple and durable carapace marking method to individually recognize turtles from a distance reduces the level of disturbance during encounters after the initial flipper tagging. Shell etching would be conducted using a dremel tool to engrave a shallow (1-2mm deep and approximately 2 inches tall) groove (ie. numbers, letters or symbols) into a carapacial scute; a light-colored non-toxic paint is then applied to the inscription (Balazs 1992). The bit would be disinfected before each use. The groove would only be made in the scute and not go through the scute into the underlying living tissue. Turtles with scutes too thin to be etched without risk of affecting underlying living tissue would not be etched. The applicant will not use paints with exothermic set-up reactions in order to ensure that there is no excessive heat that could affect the turtle as the paint cures.

Transport and Holding
Holding time for each animal would not exceed the amount of time necessary to measure, weigh, tag, examine, and collect samples. Under normal circumstances, an individual would be held for approximately 1-2 hours. When biotelemetric instruments are attached, holding time would increase to 3-12 hours. Certified large animal carriers would be used for transport and short-term holding of turtles. If an animal is captured that requires veterinary treatment, it would be transported to the veterinary facility in a certified large animal carrier with a wet absorbent pad covering it to keep it cool.

<u>Permit 10027-04:</u>

Researchers will continue with the sampling methods outlined and approved for permit No. 10027-03, which are similar to the methods mentioned above, with the exceptions/modifications outlined below.

Lavage (Modification)
Researchers would extract dietary samples from 50 green turtles immediately after capture in order to collect food samples annually to provide insight into feeding habits, consumption levels, and diet selection as described in several previous studies (Balazs 1980; Legler 1977; Makowski et al. 2006; Seminoff et al. 2002). The researcher has requested a minor modification to change the manner of sampling stomach contents based on their veterinarian's guidance and lack of successful results from the standard lavage method. This change would involve the use of a forceps grasper to gently remove a small sample of contents from the sea turtle's crop rather than flushing the crop with water.

Prior to commencing, the grasper would be inserted into the stomach tube (length depending on size of turtle), which has a beveled end with a subterminal perforation, advancing the grasper so that the forceps are just inside the perforated end of the tube. Lubricant would be applied to the perforated end of the tube. Tube would be cut to appropriate length. To do this, the researcher would measure from the tip of the nose to the third plastral seam of an adult turtle and add ca. 5 cm. This should be adequate for most sizes of turtles.

Two researchers would hold the turtle on their back and gently pull the head away from body, maintaining the esophagus as straight as possible, holding the head so the neck and esophagus remain in line with the longitudinal axis of the body. Once the turtle's mouth was opened, a standard veterinary canine oral speculum or similar mouth gag (small or medium, depending on 88the size of the turtle) would be inserted just posterior to the anterior tip of the rhamphotheca to keep the jaws from closing. PVC pipe wrapped with soft rubber tape or tubing would then be inserted and the speculum removed once PVC is secure.

Prior to insertion, the researcher must ensure that the forceps are completed covered by the lubricated tubing. The stomach tube and forceps will then be cautiously inserted through the PVC pipe (forceps facing into turtle) and with a gentle back and forth motion down the length of the esophagus to the "pre-stomach,". This procedure is facilitated by extending the head (apply gentle constant traction). Once the tube is in place, the tube will pulled over the grasper to the flange thus exposing the forceps for sampling. The forceps would be reinserted for a total of a maximum of four attempts, while the stomach tube remains in place, should the first few attempts provide insufficient samples. This gastric sampling will last no longer than three minutes. Should any procedural difficulties occur during the procedure, the sampling would be immediately stopped, to ensure the turtles' safety. Two set of stomach tubes would be available, one for FP turtles and a set for non-FP turtles. Only one sample would be obtained per individual. All lavage equipment would be disinfected between animals.

Carapace Sampling
Carapace samples would be taken from the central part of the dorsal and marginal scutes as described in Revellas et al. (2007). Prior to sampling, the carapace would be disinfected with Betadine. Carapace samples would be taken from the lateral posterior scutes by cutting a 1 mm v-shaped sample from the edge of the scute using a new razor blade for each animal. Samples would be stored frozen until analysis. To explore ecological interactions, algae and other

organisms affixed on the carapace would be sampled when possible and according to refuge permitting, then identified and analyzed.

Fecal collection
If possible, scat samples would be collected from both immature (weighing > 5 kg) and mature turtles using a fecal loop (2 x 0.20 cm), or opportunistically from the water when observed floating. A sub-sample would be stored frozen or in 10 percent formalin until analysis (for prey items) and a separate sub-sample would be taken for genetic analysis if the sample is collected from floating material and there is no accompanying blood or tissue sample available, and dried in the sun or stored in ethanol.

Sonic tag and/or Radio tag
A subset of 40 green turtles will be fitted with transmitters. Transmitters would be attached to the right M11 and M12 scutes of sea turtles, a standard location for telemetry studies on hard-shelled sea turtles (Addison et al. 2002, Gitschlag 1996). Transmitters would be placed on the carapace following the natural curve of the shell and with the transducer end of the transmitter facing slightly aft to facilitate optimal signal reception capability if the animal was swimming away from a tracking vessel. Prior to attachment, the area where the transmitter would be attached would be sanded and dried/cleaned with an ethanol or isopropanol-damped gauze. To ensure proper placement of the transmitter, a silicone elastomer base would be used to provide a level surface on the carapace. Strips of fiberglass cloth would be placed over the transmitter. Fiberglass resin would be then applied to the fiberglass cloth to bond the transmitter to the carapace. Materials would be allowed to dry for 10-30 minutes between applications. Acoustic or radio tagging would take no longer than 90 minutes.

Precautions would be taken to avoid any of these materials dripping onto or otherwise touching the rest of the turtle. Adequate ventilation around the head of the turtle would be provided during the attachment of the transmitter in order to ensure that any fumes are not inhaled. The turtle's head would also be protected using a towel, and researchers would wipe off any materials that might be dripping. After drying, tape and other materials would be removed, and any sharp edges on the attached transmitter would be lightly sanded. Once the resin is properly cured, turtles are released back into the water at the point of capture.

Tagged turtles would be actively tracked from land or water by boat or kayak during each field visit. Passive receivers would be placed in areas of tangle netting to pick up any transmissions from tagged turtles. Animals would be tracked for the life of the transmitter and when in water, at a distance of 25 meters.

Permit Conditions

The following information outlines the main mitigation measures researchers would employ to minimize the potential for any adverse impacts to the target species (green and hawksbill sea turtles) as well as any additional ESA-listed species in the action area. The research project is designed to minimize the potential of any stress, pain or suffering. All the investigators and personnel involved are experienced in capturing sea turtles and will undertake the following precautions. Turtles will be handled carefully so they do not incur additional injury during or after research procedures. Antiseptic methods such as sterilizing equipment with bleach solution and the use of antiseptic solutions such as 10% povidone-iodine at tag sites will be standard protocol to prevent the transmittal of disease and prevent infection. Turtles found to have serious injuries will be evaluated for possible transport to a rehabilitation facility. The following specific research conditions will be placed on the research should permits (No. 15661 and 15685) and permit modification (No. 10027-04) be issued to ensure compliance with appropriate research protocols:

1. The Permit Holder would ultimately be responsible for all activities of any individual who is operating under the authority of the proposed permit. The Principal Investigator (PI) would share this responsibility. Individuals operating under the specified Permit and conducting the activities authorized herein, must be approved by NMFS. Alternatively, there must be a NMFS approved individual present to supervise these activities until such time that the other individuals have been approved by NMFS.

2. Accidental Mortality of Authorized Sea Turtles: If a turtle is seriously injured or dies during sampling, the Permit Holder must cease research immediately and notify the Chief, Permits and Conservation Division by phone (301-427-8401) as soon as possible, but no later than two days following the event. The Permit Holder must re-evaluate the techniques that were used and those techniques must be revised accordingly to prevent further injury or death. The Permit Holder must submit a written report describing the circumstances surrounding the event. The Permit Holder must send this report to the Chief, Permits and Conservation Division, F/PR1, 1315 East-West Highway, Silver Spring, MD 20910. Pending review of these circumstances, NMFS may suspend authorization of research activities or amend the Permit in order to allow research activities to continue.

3. An annual report would be submitted and reviewed by NMFS for each year the permit is valid. In addition to an account of actual 'take' that occurred, the reports would include detailed descriptions of the animals' reactions, measures taken to minimize disturbance, research plans for the forthcoming year, and an indication as to when or if any results have been published or otherwise disseminated during the year. At the end of the proposed permit, the Permit Holder would submit a final report that includes: (1) a reiteration of the objectives and summary of results of the research and how they pertain to or further the research goals stated in the Permit application and NMFS conservation plan; and (2) an indication of where and when the research results would be published.

4. Instruments and equipment that are used for invasive procedures must be sterilized or disinfected with an appropriate disinfectant (e.g. mild bleach solution or 10% povidone-iodine) between animals, and shall be the appropriate weight/size ratio to the receiving animal.

5. When handling and/or tagging turtles displaying fibropapilloma tumors and/or lesions, researchers will use the following procedures:

    - Clean all equipment that comes into contact with the turtle (tagging equipment, tape measures, etc.) with a mild bleach solution, between the processing of each turtle, and

- Maintain a separate set of sampling equipment for handling animals displaying fibropapilloma tumors and/or lesions.

- Limit procedures conducted on compromised turtles.

6. All turtles shall be examined for existing tags, including PIT tags, before attaching or inserting new ones.

7. Flipper Tagging with Metal Tags – All tags shall be cleaned (e.g. oil residue) and disinfected before being used.

8. Netting Special Conditions

   - Nets used to catch turtles must be of large enough to diminish bycatch of other species.

   - Highly visible buoys shall be attached to the float line of each net such that they are spaced at an interval of every 10 yards or less. Each float shall be attached to the net as it is being deployed.

   - Nets must be checked at least every 30 minutes, and more frequently whenever turtles or other bycatch organisms are observed in the net. The float line of all nets shall be observed at all times for movements that indicate an animal has encountered the net. When this occurs the net must be immediately checked. “Net checking” is defined as a complete and thorough visual check of the net either by snorkeling in clear water or by pulling up on the top line such that the full depth of the net is viewed along the entire length. If water temperatures are equal to or less than $10^{o}C$ or equal to or greater than $30^{o}C$, nets must be checked at least every twenty minutes.

   - The float line of all nets must be observed at all times for movements that indicate an animal has encountered the net. When this occurs the net must be immediately checked.

   - Researchers must plan for unexpected circumstances or demands of the research activities and have the ability and resources to meet net checking requirements at all times (e.g. if one animal is very entangled and requires extra time and effort to remove from the net, researchers must have sufficient staff and resources to continue checking the rest of the net at the same time).

   - Nets must not be put in the water when marine mammals are observed within the vicinity of the research, and the marine mammals must be allowed to either leave or pass through the area safely before net setting is initiated. Should any marine mammals enter the research area after the nets have been set, the lead line must be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net. If marine mammals remain within the vicinity of the research area, nets must be removed.

- If a marine mammal is entangled, researchers must stop netting activities and immediately free the animal; notify the appropriate NMFS Regional Stranding Coordinator as soon as possible; and report the incident as specified.

9. Lavage: The actual lavaging of an individual turtle must not exceed 45 seconds. Once the samples have been collected, water must be turned off and water and food allowed to drain until all flow has stopped. The posterior of the turtles will be elevated slightly to assist in drainage.

   - In the modified lavage, no more than 4 tries to collect a sample (using forceps) per turtle is allowed.

   - Observations and results on the use of the forceps (modified lavage) must be included in annual reports. This should include the effectiveness of the technique and observations on the health and disposition of the animal immediately following the procedure and upon later sightings and recaptures.

   - Equipment (e.g., lavage tubes) that will come in contact with sea turtles must be disinfected between animals. Additionally, a separate set of sampling equipment for handling animals displaying fibropapilloma tumors and/or lesions. Disinfection can be compromised (incomplete) if items are contaminated with debris and/or have rough or porous surfaces. Researchers shall clean items prior to disinfection and increase the exposure time for rough and/or porous items.

   - Disinfectants shall be used according to directions, however researchers shall ensure that contact time with disinfectant is sufficient (according to label directions; a dip and rinse is not sufficient) and lavage tubes shall be thoroughly physically cleaned prior to disinfection (viruses can remain protected in organic matter, the disinfectant can't get to them if they're protected in this matter).

   - Care shall be taken that disinfecting solutions are clean and active and that proper rinsing occurs after disinfection.

10. Blood sampling:

    - Blood samples must be taken by experienced personnel.

    - New disposable needles must be used on each animal.

    - Collection sites must always be scrubbed with alcohol or another antiseptic prior to sampling.

    - Care should be taken to ensure no injury results from the sampling. If an animal cannot be adequately immobilized for blood sampling or conditions on the boat preclude the safety and health of the turtle, samples must not be taken.

- Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side.

- A single sample must not exceed 3 ml per 1 kg of animal.

- Sampling period. Within a 45-day period of time, the cumulative blood volume taken from a single turtle must not exceed the maximum safe limit described above. If more than 50% of the maximum safe limit is taken, in a single event or cumulatively from repeat sampling events, from a single turtle within a 45-day period that turtle must not be re-sampled for 3 months from the last blood sampling event.

- Research coordination. Researchers must, to the maximum extent practicable, attempt to determine if any of the turtles they blood sample may have been sampled within the past 3 months or will be sampled within the next 3 months by other researchers. The permit holder must contact the other researchers working in the area that could capture the same turtles to ensure that none of the above limits are exceeded.

11. Biopsy (tissue-skin) Sampling:

- A new biopsy punch must be used on each turtle.

- Sterile techniques must be used at all times. Samples must be collected from the trailing edge of a flipper if possible and practical (preference should be given to a rear flipper if practical). The tissue surface must be thoroughly swabbed once with both Betadine and alcohol, sampled, and then thoroughly swabbed again with just Betadine. The procedure area and hands must be clean.

- If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured and has been already sampled by this permit, no additional biopsy samples may be collected from the animal over the permit year.

12. Sonic Tagging:

- Great care shall be taken to ensure that no resin, silicone, or epoxy drips onto the skin of the turtle.

- Adequate ventilation around the head of the turtle must be provided during the attachment of satellite tags or attachment of radio/sonic tags if attachment materials produce fumes and that the epoxy that is chosen, cures releasing little head that would not be injurious to animals. To prevent skin or eye contact with harmful chemicals used to apply tags, turtles must not be held in water during the application process.

- The weight of the transmitters would not exceed 5 percent of the turtle's body mass.

- Each attachment must be made so that there is no risk of entanglement. The transmitter attachment must either contain a weak link (where appropriate) or have no gap between the transmitter and the turtle that could result in entanglement. The lanyard length (if used) must be less than 1/2 of the carapace length of the turtle. It must include a corrodible, breakaway link that will corrode and release the tag-transmitter after the tag-transmitter life is finished.

- Researchers must make attachments as hydrodynamic as possible.

13. Painting of Carapace

    - Researchers must use non-toxic paints that do not generate heat or contain xylene or toluene.

    - For turtles < approximately 4 years old, paint must be applied without crossing suture lines (margins) if the paint will remain on the shell for 3 months or more.

    - For juvenile turtles > approximately 4 years old, paint must be applied without crossing suture lines (margins) if the paint will remain on the shell for 1 year or more.

    - For adult turtles, paint must be applied without crossing suture lines (margins) if the paint will remain on the shell for 2 years or more.

14. General Handling and Releasing of Turtles: The Principal Investigator, Co-investigator(s), or Research Assistant(s) acting on the Permit Holder’s behalf must use care when handling live animals to minimize any possible injury, and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. Whenever possible, stressed or injured animals should be transferred to rehabilitation facilities and allowed an appropriate period of recovery before return to the wild. An experienced veterinarian, veterinary technician, or rehabilitation facility must be named for emergencies. All turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).

15. Turtles are to be protected from temperature extremes of heat and cold, and kept moist during sampling. The turtle will be placed on pads for cushioning and this surface will be disinfected between turtles. The area surrounding the turtle may not contain any materials that could be accidentally ingested.

16. During release, turtles shall be lowered as close to the water’s surface as possible, to prevent potential injuries.

17. Transport and Holding:

    - Turtles are to be transported via a climate-controlled environment, protected from temperature extremes of heat and cold, and kept moist. The turtle will be placed on pads for cushioning. The area surrounding the turtle may not contain any material that could be accidentally ingested.

- Turtles transported to a facility and held (e.g. for rehabilitation) must be maintained and cared for under the "Care and Maintenance Guidelines for Sea Turtles Held in Captivity" issued by the U.S. Fish and Wildlife Service.

18. Bycatch: All incidentally captured species (e.g. fishes) must be released alive as soon as possible.

19. Researchers must take all practicable steps to identify submerged aquatic vegetation (SAV), coral communities, and live/hard bottom habitats and avoid setting gear in such areas. Researchers must use strategies to identify SAV, coral and live or hard bottom types and avoid adverse impacts to Essential Fish Habitat (EFH), including the use of tools such as charts, GIS, sonar, fish finders, or other electronic devices to help determine characteristics and suitability of bottom habitat prior to using gear. If research gear is lost, diligent efforts must be made to recover the lost gear to avoid further damage to benthic habitat and impacts related to "ghost fishing".

20. *Coral and hard/live bottom*. No gear may be set, anchored on, or pulled across coral or hard/live bottom habitats.

21. *Sea grass species*. Researchers will avoid conducting research over or immediately adjacent to any non-listed sea grass species. If these non-listed species cannot be avoided, then the following avoidance/minimization measures shall be implemented:

    - In order to reduce the potential for sea grass damage, anchors will be set by hand when water visibility is acceptable. Anchors must be placed in unvegetated areas within seagrass meadows or areas having relatively sparse vegetation coverage. Anchor removal must be conducted in a manner that would avoid the dragging of anchors and anchor chains.
    - Researchers will take great care to avoid damaging any sea grass species and if the potential for anchor or net drag is evident researchers will suspend research activities immediately.
    - Researchers must be careful not to tread or trample on seagrass and coral reef habitat.

22. Hawaiian Monk Seals. To minimize disturbance of Hawaiian monk seals the Permit Holder must:

    - Consult with the NMFS monk seal research program and the U.S. Fish and Wildlife Service (USFWS) at Midway for approval of any land-based activities to avoid harassment of monk seals;

- Not enter the water when monk seals are present, and if approached by a seal, leave the area; and not approach/use a beach for transmitter attachment when monk seals are present.

- Report any opportunistic monk seal sightings to: Thea Johanos, NMFS Pacific Islands Fisheries Science Center, Marine Mammal Research Program, 1601 Kapiolani Boulevard, Suite 1110, Honolulu, HI 96814-4700; phone (808)944-2174; email Thea.Johanos-Kam@noaa.gov; fax (808)944-2200.

23. Humpback Whales:

- If a humpback whale is observed in the area, Researchers and vessels must maintain a distance of at least 91.4 meters (100 yards) and aircraft must maintain a distance of at least 300 meters (1,000 feet).

Approach to the Assessment

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

The final steps of our analyses – establishing the risks those responses pose to listed resources – are different for listed species and designated critical habitat (these represent our risk analyses). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct populations of vertebrate species. Because the continued existence of species depends on the fate of the populations that comprise them, the continued existence of these "species" depends on the fate of the populations that comprise them.

Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them; populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by

identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population level risks to the species those populations comprise.
We measure risks to listed individuals using the individuals' "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our response analyses) are likely to have consequences for the individual's fitness.

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

Although reductions in fitness of individuals 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 determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our 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 and Conservation Division when it initiates formal consultation, and the general scientific literature.

During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar, ScienceDirect, BioOne*, *Conference Papers Index, JSTOR,* and *Aquatic Sciences and Fisheries Abstracts* search engines. We supplement these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically try to identify data or other information that supports a particular conclusion (for example, a study that suggests sea turtles will exhibit a particular response to tagging) as well as data that does not support that conclusion. 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.

We rank the results of these searches based on the quality of their study design, sample sizes, level of scrutiny prior to and during publication, and study results. Carefully designed field experiments (for example, experiments that control potentially confounding variables) are rated higher than field experiments that are not designed to control those variables. Carefully designed field experiments are generally ranked higher than computer simulations. Studies that produce large sample sizes with small variances are generally ranked higher than studies with small sample sizes or large variances.

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:

File No. 15661: The proposed research would take place in the near shore waters of the NMI. Activities would occur around the islands of Saipan, Tinian, Guam and Rota (see Appendix 1 for maps). Sampling would include Aguigan, Farallon de Medinilla, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Uracas, and Maug should the opportunity arise.

File No. 15685: The proposed research would take place in the coastal waters of the Hawaiian Islands including Hawaii, Maui, Lanai, Molokai, Oahu, Kauai, and Midway Atoll. For specific study site maps see Appendix 2.

File No. 10027-04: The proposed modification to the permitted research would occur at the Palmyra Atoll National Wildlife Refuge (PANWR) (Appendix 3).

Status of the Species

The following listed species under the jurisdiction of NMFS may occur in the action areas that would be covered under the proposed issuance of Section 10 research permits & modification (15661, 15685 & 10027-04) to the applicants and may be affected:

Common Name	Scientific Name	Listing Status
Sea Turtles		
Green sea turtle*	*Chelonia mydas*	Endangered/Threatened
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle (N. Pacific DPS)	*Caretta caretta*	Endangered
Olive ridley sea turtle	*Lepidochelys olivacea*	Endangered/Threatened
Marine Mammals		
Hawaiian monk seal	*Monachus schauinslandi*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Gray whale (Western Pacific population)	*Eschrichtius robustus*	Endangered
Humpback whales	*Megaptera novaeangliae*	Endangered
North Pacific right whale	*Eubalaena japonica*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered

* Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Because we are unable to distinguish between the populations away from the nesting beaches, green sea turtles are considered endangered wherever they occur in U.S. waters.

Critical Habitat

Critical habitat has been designated for three sea turtles: green (50 CFR Section 226.208), hawksbill (50 CFR Section 226.209) and leatherback (50 CFR Section 226.207). No critical habitat for any of these sea turtles or any other species would be affected by the proposed action.

Except for the Hawaiian monk seal, no critical habitat has been designated for any of these threatened or endangered marine mammal species in the Pacific Ocean. Critical habitat was originally designated on April 30, 1986 (51 FR 16047), and was extended on May 26, 1988 (53 FR 18988; CFR 226.201). NMFS designated critical habitat for the Hawaiian monk seal out from shore to 20 fathoms in 10 areas of the northwestern Hawaiian Islands. Critical habitat for monk seals includes all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 20 fathoms around the following: Kure Atoll, Midway Islands, except Sand Island and its harbor, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island (50 CFR 226.201). NMFS has proposed a revision to the current critical habitat by extending the current designation in the Northwestern Hawaiian Islands out to the 500-m depth contour and including Sand Island at Midway Islands; and by designating six new areas in the main Hawaiian Islands (MHI). Specific areas proposed for the MHI include terrestrial and marine habitat from 5 m inland from the shoreline extending seaward to the 500-m depth contour around: Kaula Island, Niihau, Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui, and Molokai), and Hawaii (except those areas that have been identified as not included in the designation). Research could occur in designated critical habitat for the Hawaiian monk seal (*Monachus schauinslandi*). Although work could occur in this area, with the mitigation measures in place against impacting submerged aquatic vegetation (SAV), coral communities, and live/hard bottom habitats, and since no terrestrial habitat will be affected, the proposed permit would not affect critical habitat in a way as to modify, damage or destroy habitat, and will not be further considered in this opinion.

Species not considered further in this opinion

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

Blue, fin, gray (Western population), humpback, North Pacific right, sei, and sperm whales occur in the action areas. However, since most research will take place in near-shore habitat, encounters with most of these whale species are rare; however, if the investigators encounter a whale species by boat, they would maintain a minimum distance of 100 yards for whale species to minimize the probability of adversely affecting the species. Hawaiian monk seal also occur in permit no. 15685's action area. Monk seals in general are solitary and skittish, and the majority occur in isolated areas, often seen resting on beaches during the day. Should the investigators encounter Hawaiian monk seals by boat, they would maintain a minimum distance of 50 yards to minimize the probability of adversely affecting the species. Encounters with Monk seals should be rare, since research would occur mostly in near-shore waters off the Main Hawaiian Islands during the day, and researchers would avoid a beach where a seal is hauled out on.

Loggerhead, Olive ridley, and leatherback sea turtles occur within the action areas and could be subject to disturbance from snorkelers, divers, entanglement nets and the research vessel. The permit would be conditioned so that larger nets would not be set if marine mammals are observed in the area, as well as minimizing the effects to other non-targeted species. Researchers will be targeting green and hawksbill turtles only. These methods are a directed capture method which allows them to be very selective as to what species they interact with and capture. No other species will be affected by the activities authorized under the proposed actions. Because of the mitigation measures, we conclude that the proposed action may affect but is not likely to adversely affect these species, so they will not be considered further in this Opinion.

Species Likely to be Adversely Affected

NMFS has determined that the action being considered in the Opinion is likely to adversely affect green and hawksbill sea turtles. Background information on the range-wide status of these species can be found in a number of published documents including recovery plans and other information on sea turtles. Summary information on the biology and status of this species is provided below.

Green Sea Turtles *(Chelonia mydas)*

Listing Status and Critical Habitat
The green sea turtle was listed in 1978 as threatened, except for the Florida and Pacific coast of Mexico breeding populations which were listed as endangered. It is also listed as endangered under the internationally recognized IUCN Red List of Threatened Species. Causes for this decline include harvest of eggs, sub adults and adults, incidental capture by fisheries, loss of habitat, and disease.

Critical habitat for the green sea turtle has been designated for the waters surrounding Isla Culebra, Puerto Rico and its associated keys.

Taxonomy
The genus Chelonia is composed of two taxonomic units at the subspecies/subspecific level: the east Pacific green turtle (also known as the "black turtle," *C. mydas agassizii*), which ranges (including nesting) from Baja California south to Peru and west to the Galapagos Islands, and the nominate C. m. mydas in the rest of the range (insular Pacific, including Hawaii).

Physical Description
Green turtles are distinguished from other sea turtles by their smooth carapace with four pairs of lateral scutes, a single pair of prefrontal scales, four post-orbital scales, and a serrated upper and lower jaw. Adult green turtles have a light to dark brown carapace, sometimes shaded with olive, and can exceed one meter in carapace length and 200 kilograms (kg) in body mass. Females nesting in Hawaii averaged 92 cm in straight carapace length (SCL), while at the Olimarao Atoll in Yap, females averaged 104 cm in curved carapace length (CCL) and approximately 140 kg. Eastern Pacific green turtles are conspicuously smaller and lighter than their counterparts in the central and western Pacific. At the rookeries of Michoacán, Mexico, females averaged 82 cm in CCL, while males averaged 77 cm CCL (in NMFS and USFWS 1998a).

Diet
Although most adult green turtles appear to have a highly herbivorous diet, consisting primarily of sea grass and algae (Wetherall *et al.* 1993), those along some areas of the east Pacific coast seem to have a more carnivorous diet. Analysis of stomach contents of green turtles found off Peru revealed a large percentage of molluscs and polychaetes, while fish and fish eggs, and jellyfish and commensal amphipods comprised a lesser percentage (Bjorndal 1997). Black turtles studied in the Magdalena Bay region of the Baja California Peninsula were found to feed predominantly on red algae, Gracilariopsis, and to a lesser extent, sea lettuce (*Ulva lactuca*)

(Hilbert *et al.* 2002). These turtles locate algae in the rocky coasts and marine grasses plentiful in the shallow waters of the coastal areas, including lagoons and bays (Millan and Carrasco 2003). Black turtles foraging in areas adjacent to Magdalena Bay fed primarily on sea grass. The stomach contents of one turtle in this area contained more than 82% red crabs (*Plueroncodes planipes*), perhaps the first record of this species feeding predominantly on crustaceans (Mendilaharsu *et al.* 2003). In the Hawaiian Islands, green turtles are site-specific and consistently feed in the same areas on preferred substrates, which vary by location and between islands (in Landsberg *et al.* 1999).

General Distribution
Green turtles are found throughout the world, occurring primarily in tropical, and to a lesser extent, subtropical waters. The species occurs in five major regions: the Pacific Ocean, Atlantic Ocean, Indian Ocean, Caribbean Sea, and Mediterranean Sea. These regions can be further divided into nesting aggregations within the eastern, central, and western Pacific Ocean; the western, northern, and eastern Indian Ocean; Mediterranean Sea; and eastern, southern, and western Atlantic Ocean, including the Caribbean Sea. Primary nesting aggregations of green turtles (i.e. sites with greater than 500 nesting females per year) include: Ascension Island (south Atlantic Ocean), Australia, Brazil, Comoros Islands, Costa Rica, Ecuador (Galapagos Archipelago), Equatorial Guinea (Bioko Island), Guinea-Gissau (Bijagos Archipelago), Iles Eparses Islands (Tromelin Island, Europa Island), Indonesia, Malaysia, Myanmar, Oman, Philippines, Saudi Arabia, Seychelles Islands, Suriname, and United States (Florida) (Seminoff 2002).

Smaller nesting aggregations include: Angola, Bangladesh, Bikar Atoll, Brazil, Chagos Archipelago, China, Cuba, Cyprus, Democratic Republic of Yemen, Dominican Republic, d'Entrecasteaux Reef, French Guiana, Ghana, Guyana, India, Iran, Japan, Kenya, Madagascar, Maldives Islands, Mayotte Archipelago, Mexico, Micronesia, Pakistan, Palmerston Atoll, Papua New Guinea, Primieras Islands, Sao Tome é Principe, Sierra Leone, Solomon Islands, Somalia, Sri Lanka, Taiwan, Tanzania, Thailand, Turkey, Scilly Atoll, United States (Hawaii), Venezuela, and Vietnam (Seminoff 2002).

Green turtles appear to prefer waters that usually remain around 20 degrees C in the coldest month. During warm spells (e.g., El Nino), green turtles may be found considerably north of their normal distribution. Stinson (1984) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18 degrees C. An east Pacific green turtle equipped with a satellite transmitter was tracked along the California coast and showed a distinct preference for waters with temperatures above 20 degrees C (Eckert, unpublished data).

Additionally, it is presumed that drift lines or surface current convergences are preferential zones due to increased densities of likely food items. In the western Atlantic, drift lines commonly contain floating sargassum capable of providing small turtles with shelter and sufficient buoyancy to raft upon (NMFS and USFWS 1998a). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance from natural predators and humans. Available information indicates that green turtle resting areas are in proximity to their feeding pastures (NMFS, 2000e).

Molecular genetic techniques have helped researchers gain insight into the distribution and ecology of migrating and nesting green turtles. Throughout the Pacific, nesting assemblages group into two distinct regional clades: 1) western Pacific and South Pacific islands, and 2) eastern Pacific and central Pacific, including the rookery at French Frigate Shoals, Hawaii. In the eastern Pacific, greens forage coastally from San Diego Bay, California in the north to Mejillones, Chile in the South. Based on mtDNA analyses, green turtles found on foraging grounds along Chile's coast originate from the Galapagos nesting beaches, while those greens foraging in the Gulf of California originate primarily from the Michoacan nesting stock. Green turtles foraging in San Diego Bay and along the Pacific coast of Baja California originate primarily from rookeries of the Islas Revillagigedos (Dutton, 2003).

Life History

Sea turtles are long-lived species with delayed maturity and have a life history that includes large numbers of early stage individuals (as a result of high fecundity in the adult life stages) of which relatively few survive through the rigors of natural mortality from predation, environmental variation, and individual fitness to older reproductive stages (Crouse 1999a). Compared to all other sea turtles, green turtles exhibit particularly slow growth rate, and age to maturity appears to be the longest. Based on age-specific growth rates, green turtles are estimated to attain sexual maturity beginning at age of between 25 to 50 years (Limpus and Chaloupka 1997, Bjorndal et al. 2000, Chaloupka et al., in press, all in Seminoff 2002, Zug et al. 2002). The length of reproductivity has been estimated to range from 17 to 23 years (Carr et al. 1978, Fitzsimmons et al. 1995 in Seminoff 2002).

The basic life cycle of green turtles (based on Chaloupka 2002) can be broken into six life stages: (1) egg/neonate; (2) pelagic juvenile; (3) benthic juvenile; (4) sub-adult; (5) maturing adult; and (6) adult, each with their own expected survival rate. The earliest life stages (Stages 1 and 2) have the highest proportion of individuals but the lowest survival probabilities. Despite low abundances in the mature life stages, mature individuals have more chances to reproduce and replace themselves. Consequently, changes in the survival rates of adults would be expected to have significant effect on the growth and persistence of this population. Persistence of long-lived species with delayed maturity would be most vulnerable to impacts that preclude individuals from attaining age and sexual maturity.

The observed declines in the green turtle populations attest to the effect of changing these survival rates on species' persistence. Green turtles have long survived natural fluctuations in environmental conditions (environmental stochasticity) such as changes in climate, coastal erosion, or destruction of nesting beaches by hurricanes and typhoons. Green turtles have survived these phenomena by evolving a life history strategy that allows their populations to withstand periodic, and often significant, losses in the life stages that would be most vulnerable to environmental change (that is, eggs, hatchlings, and juveniles) while buffering the adult life stages from these environmental changes through ocean dispersal. Although adult females on nesting beaches are also vulnerable to phenomena like beach erosion, hurricanes, and typhoons, the reproductive pattern in which adult females only nest every two or more years exposes only a portion of the breeding population to these risks. Conversely, most anthropogenic activities such as harvest and poaching of eggs and adults, incidental capture in fisheries, or human destruction or encroachment of nesting habitat place these populations under constant pressure, can affect entire regions in short periods of time, and can affect all life stages simultaneously.

For example, green turtle eggs and hatchlings are vulnerable to many of the same factors affecting other sea turtle populations: beach erosion, human or wildlife poaching and predation, and widely fluctuating beach temperatures. Once the green turtles transition into the oceanic environment, however, individual life stages are vulnerable to different impacts based on the habitats they inhabit. Pelagic individuals are incidentally captured in pelagic fisheries such as longlines. Benthic life stages are injured or killed by coastal fisheries (e.g., trawling or gill netting) and other hazards associated with the nearshore environment. While relatively few green turtles are taken by Pelagics fisheries, based on past observations in the Hawaii-based longline fishery, sub-adult and adult green turtles are the life stage most commonly captured and injured or killed. Because changes in the survival rates of these stages have the highest proportional effect on a population's finite growth rate (λ), the consequences of these fisheries on the survival and recovery of green turtle populations would be significant, particularly when these losses are added to losses in other life stages. The combined effect of these activities, which affect most or all life stages of most green turtle populations, would cause these populations to have λs that would reflect declining populations.

Migration

The nonbreeding range of green turtles is generally tropical, and can extend thousands of miles from shore in certain regions. Hawaiian green turtles monitored through satellite transmitters were found to travel more than 1,100 km from their nesting beach in the French Frigate Shoals, south and southwest against prevailing currents to numerous distant foraging grounds within the 2,400 kilometer span of the archipelago (Balazs 1994; Balazs et al. 1994; Balazs and Ellis 1996). Three green turtles outfitted with satellite tags on the Rose Atoll (the easternmost island at the Samoan Archipelago) traveled on a southwesterly course to Fiji, approximately 1,500 km distance (Balazs et al. 1994; Craig et al. 2004).

Tag returns of eastern Pacific green turtles establish that these turtles travel long distances between foraging and nesting grounds. In fact, 75 percent of tag recoveries from 1982-90 were from turtles that had traveled more than 1,000 kilometers from Michoacán, Mexico. Even though these turtles were found in coastal waters, the species is not confined to these areas, as indicated by 1990 sightings records from a NOAA research ship. Observers documented green turtles 1,000-2,000 statute miles from shore (Eckert 1993). The east Pacific green is also the second-most sighted turtle in the east Pacific during tuna fishing cruises; they are frequent along a north-south band from 15 degrees N to 5 degrees S along 90 degrees W, and between the Galapagos Islands and Central American Coast (NMFS and USFWS 1998a). In a review of sea turtle sighting records from northern Baja California to Alaska, Stinson (1984) determined that the green turtle was the most commonly observed sea turtle on the U.S. Pacific Coast, with 62% reported in a band from southern California and southward.

The northernmost reported resident population of green turtles occurs in San Diego Bay, where about 50-60 mature and immature turtles concentrate in the warm water effluent discharged by a power plant (McDonald et al. 1994). These turtles appear to have originated from east Pacific nesting beaches of the Revillagigedo Islands Archipelago (west of Baja California) (NMFS 2007).

Population Status and Trends

Seminoff (2004) estimated that analyses of subpopulation changes at 32 Index Sites distributed globally showed a 48% to 67% decline in the number of mature females nesting annually over the last 3-generations. These estimates are, however, based on a conservative approach; actual declines were thought to possibly exceed 70%. However, NMFS and USFWS (2007a) analyzed 23 threatened nesting concentrations among 11 ocean regions around the world that included both large and small rookeries and are believed to be representative of the overall trends for their respective regions. Of these 23 sites for which assessment of current trends was possible, 10 nesting populations are increasing, 9 are stable, and 4 are decreasing. Continuous datasets $\geq$ 20 years are available for 9 threatened population sites, all of which are either increasing or stable. However, the review cautioned that despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously since trend data are available for just over half of all sites examined. Nesting populations are doing relatively well in the Pacific, Western Atlantic, and Central Atlantic Ocean but are doing relatively poorly in Southeast Asia, Eastern Indian Ocean, and perhaps the Mediterranean (NMFS and USFWS 2007a). NMFS and USFWS (2007a) also reviewed the endangered breeding populations' status and found that the nesting population of Florida appears to be increasing based on 18 years of index nesting data from throughout the state. Data for the largest nesting concentration in Pacific Mexico where nesting beach monitoring has been ongoing every year since the 1981-1982 nesting season shows an increase in nesting.

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, as a direct consequence of a historical combination of overexploitation and habitat loss (Eckert, 1993; Seminoff, 2002). A more detailed description of the abundance, distribution, and population trends for green turtles in the Pacific Ocean is presented in the following subsections.

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

— American Samoa

The U.S. territory of American Samoa is located east of Samoa in the south Pacific and consists of the main island of Tutuila, the Manu`a group (Ofu, Olosega, and Ta`u Islands), Swains Island, and Rose Atoll (Tuato'o-Bartley et al 1993). In American Samoa, sub-adult and adult green turtles occur in low abundance in nearshore waters around Tutuila, Ofu, Olosega, Ta`u and Swains Islands with sporadic, low-level green turtle nesting occurring on Tutuila and Swains Islands (Tagarino et al. 2008; Tagarino and Utzurrum 2010). A May 2009 survey at Swains identified a total of 56 locations of pits/possible nests, turtle tracks, and evidence of pig activity (wallows) (Tagarino and Utzurrum 2010). However, the primary green turtle nesting location is at Rose Atoll with up to several dozen nests laid annually between October and March (review provided by Balazs 2009). No nesting trend data are available, but anecdotal information suggests major declines in the last 50 years (Tuato'o-Bartley et al 1993, Utzurrum 2002). S ince 1971, 42 individual nesting green turtles have been flipper tagged on Rose Atoll during various trips (Grant et al. 1997). Of seven post-nesting green turtles satellite-tagged in 1993-95, six migrated nearly directly to Fiji, possibly to feed on Fiji's extensive seagrass beds (Craig et al. 2004). Several surveys cited in a summary of nesting observations at Rose Atoll 1839-1993 (Balazs 2009) documented pits on Sand and Rose Islands (up to 301 in one survey), however, it is unclear how that relates to numbers of individuals because some pits could be from prior nesting seasons.

In addition to protection under the federal ESA, sea turtles in American Samoa are protected by the Fishing and Hunting Regulations for American Samoa (DMWR 1995) which prohibit the import, export, sale, possession, transport, or trade of sea turtles or their parts and take (as defined by the ESA) and carry additional penalties for violations at the local government level. The Department of Marine and Wildlife Resources (DMWR) is the agency with vested authority and responsibility for conservation of protected species and enforcement of protected species regulations in American Samoa.

— Commonwealth of the Northern Mariana Islands

The Commonwealth of the Northern Mariana Islands (CNMI) consists of 15 volcanic islands in the Marianas archipelago (excluding Guam). The three largest and southernmost islands are Saipan, Rota, and Tinian with the majority of the human population residing on Saipan. In CNMI, green turtle nesting occurs from March through August with some year round nesting documented. It is estimated that possibly fewer than 10 individual turtles nest annually on the islands of Saipan, Tinian and Rota (NMFS and USFWS 1998). Surveys of the northern islands, Alamagan, Pagan, Agrigan, and Asuncion, were sponsored by the Department of Defense and organized by the USFWS from May – June 2010. Turtle nesting activity was only observed on Agrigan, with seven nests documented (C. Eggleston and F. Amidon pers. com.). There were no recorded nesting observations during a survey of Anatahan in 2002 (Ilo and Manglona 2002). The CNMI Division of Fish and Wildlife (DFW) has monitored nesting activity on Saipan since 1999 and has documented four to eighteen nests laid per year (DFW unpublished annual reports to PIRO). At least five beaches on Saipan have been monitored somewhat consistently over the past five years: Bird Island, Wing, Tank, Lao Lao Bay, and Obyan beaches (Ilo et al. 2005; Kolinski et al. 2001; DFW 2009). Nesting likely occurs on all or most of the accessible beaches on Tinian (Pultz et al. 1999), with six beaches occurring on Navy lands monitored for turtle nesting activity by Navy personnel: Chulu, Lamlam, Babui, Chiget, Dangkulo (Long Beach), and Masalok (Vogt 2009). Eleven beaches on Rota are known to support nesting: Songton, Teteto, Mochong, Sagua (Kokomo), Coral Garden, Okgok, Apanon, and Gaonan (the Cave Beaches), Uyulan, Tatgua, and Latte Stone (Lalayak or I Batko) (Ilo et al. 2005), of which two beaches had confirmed nesting activity in 2009 (Okgok and Tagua).

Intensive monitoring occurred on Saipan at seven beaches from March 4 to August 31, 2009 resulting in 16 green turtle nests documented (DFW 2009). Of major concern, however, is that three of potentially five nesting turtles and three nests were illegally harvested which suggests that poaching remains a significant threat to turtles on Saipan. Rapid assessments at Rota beaches Okgok and Tatgua on July 12, 2009 yielded 13 nests. On Tinian, from July 22-31, 2009, 36 nests at five beaches were documented with evidence of one nesting female illegally harvested (DFW 2009). Additional nesting assessments and dedicated monitoring efforts at Tinian and Rota are needed as these islands may provide viable nesting beaches in CNMI and are likely good candidate index sites for long-term monitoring to assess nesting trends over time. Genetic samples analyzed to date indicate that nesting females in CNMI and Guam are indistinguishable and should be treated as a single management unit (Dutton 2009 unpublished). However, sample sizes are small and additional sampling may reveal other haplotypes. Sufficient information on nesting trend is not available for green turtles in CNMI although anecdotal information from residents suggests that nesting activity has decreased over time, likely as a result of direct harvest, coastal development, and WWII impacts to nesting turtles and their habitats.

In addition to protection under the federal ESA, sea turtles in CNMI are protected by the Fish, Game and Endangered Species Act (PL 2-51). CNMI PL 2-51 establishes a Fish and Wildlife Division and states that the Director of Natural Resources shall determine whether any species shall be designated as threatened or endangered. Green and hawksbill turtles are listed as protected species in the CNMI Hunting Regulations (CNMI DFWb, accessed 2010) prohibiting hunting for these species. The CNMI Department of Land and Natural Resources, Division of Fish and Wildlife is the agency with vested authority and responsibility for the conservation of protected species and enforcement of protected species regulations in CNMI.

— Guam

Guam is the southernmost island in the Marianas archipelago located in the western Pacific, south of Japan and north of Papua New Guinea. There is regular, low density green turtle nesting on Guam at a number of sites. Nesting activity appears to occur at low levels year round with a more concentrated nesting season apparent from May through August (Pritchard 1995b; NMFS and USFWS 1998a). Documented nesting beaches include: Ritidian National Wildlife Refuge, Haputo, Urunao, Tumon Bay, Cabras Island, the waterfront annex of Naval Base Guam, Spanish Steps, Cocos Island, Acho Bay, Nomña Bay, Jinapsan, and Tarague Beach (DAWR 2004; Grimm and Farley 2008). The nearshore marine environment around Guam has been degraded by impacts from intense combat during WWII, shoreline development, sediment-laden runoff, pollution, and years of poorly treated wastewater effluent. Spanish Steps is at the mouth of Apra Harbor which has been heavily modified, particularly since World War II (USN 2010).

The Guam Department of Agriculture Division of Aquatic and Wildlife Resources (DAWR) initiated a sea turtle program in 1999 with primary objectives to monitor nesting activity and collect population data. From October 1, 2006 through July 31, 2008, 55 green turtle nests were counted at various beaches during opportunistic surveys throughout Guam (DAWR 2009). Spanish Steps, or Orote point, on U.S. Navy land is considered one of the primary nesting locations on Guam (Grimm and Farley, 2008). Naval Facilities Engineering Command Marianas (NAVFACMAR) monitored nesting beaches at Spanish Steps three times per week from May to July during 2007 and 2008 that resulted in five and 18 green turtle nests, respectively (Grimm and Farley, 2008). Based on this limited information, one to four adult green turtles may nest per season at Spanish Steps; however, sufficient long-term and standardized monitoring information is not available to quantitatively describe the abundance or trend of nesting green turtles at

Spanish Steps or for Guam overall. In 2000 and 2007, two post-nesting green turtles were satellite tagged on Guam and traveled to the Philippines and Japan, respectively (DAWR unpublished). Currently, nesting activity is documented opportunistically by Haggan-watch, a community-based volunteer network administered by DAWR.

In addition to protection under the federal ESA, sea turtles are protected by the Endangered Species Act of Guam which adopts the same definitions and status designations as the federal ESA and carries additional penalties for violations at the local government level. DAWR is the agency with vested authority and responsibility for the conservation of protected species and enforcement of the ESA of Guam. Other Guam resource agencies, such as the Bureau of Statistics and Plans (BSP), also have specific mandates in relation to sea turtle conservation. The BSP administers the Guam Coastal Management Plan (GCMP) through the Coastal Zone Management Act of 1972 (Guam Public Law 92-583 and Public Law 94-370). The GCMP guides the use, protection, and development of land and ocean resources within Guam's coastal zone, which includes all non-Federal property and all submerged lands and waters out to 3 nm (5.6 km) from the shoreline.

— Hawaii

The State of Hawaii is an archipelago in the central Pacific Ocean containing hundreds of volcanic islands, separated into two groups: eight large southeastern Main Hawaiian Islands (MHI; seven of which are inhabited), and numerous uninhabited Northwestern Hawaiian Islands (NWHI; designated the Papahanaumokuakea Marine National Monument by Presidential proclamation in June 2006). Green turtles nesting and foraging within the Hawaiian Archipelago are likely comprised of one genetic stock, and may be considered a discreet management unit separate from other Pacific stocks (Dutton et al. 2008). Nesting occurs between May and August, and the primary nesting location at French Frigate Shoals (FFS) in the NWHI supports over 90% of documented green turtle nesting in Hawaii (Balazs 1976, 1980). Minor nesting also occurs at other atolls and islands in the NWHI and on Kauai, Oahu, Molokai, Lanai, and Maui within the MHI (PIFSC unpublished). Within FFS, over 50% of all nesting occurs on East Island (Balazs 1976; Niethammer et al. 1997, Balazs and Chaloupka 2004), where nesting surveys have been conducted annually at this index site since 1973 via a collaborative arrangement between NMFS Pacific Islands Fisheries Science Center (PIFSC) and USFWS.

The Hawaiian green turtle population was subjected to extensive human exploitation in the form of turtle and egg harvest at foraging and nesting grounds from the mid-1800s until the early 1960s, and nesting habitat destruction as a result of development (Balazs 1975a, 1976; Niethammer et al. 1997; Balazs and Chaloupka 2004). Since enactment of State and federal ESA protections in 1974 and 1978, respectively, the nesting population at FFS has exhibited high annual variability in nesting female abundance, and a consistent upward trend over the past thirty years with an estimated annual growth rate of 5.7% (Chaloupka et al. 2008). In Hawaii, green turtles lay up to six clutches of eggs per year (mean of 3.7) and clutches consist of about 100 eggs each. Females migrate to breed only once every two or possibly many more years. On the Hawaiian Archipelago, females nest every 3 to 4 years (Balazs and Chaloupka 2004).
The largest number of nesting females observed during a field season at East Island occurred in 2008 with 580 females identified during the six week sampling period (PIFSC and FWS unpublished).

In addition to protection under the federal ESA and international agreements and conventions, sea turtles in Hawaii are protected by the Hawaii Revised Statutes, Chapter 195D (Hawaii State Legislature, accessed 9/10/2010) and Hawaii Administrative Rules, 13-124 (Hawaii Administrative Rules, accessed 9/10/2010) which adopt the same definitions, status designations, and prohibitions as the federal ESA and carry additional penalties for violations at the State government level. The Hawaii Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) is the state agency responsible for the conservation and management of protected species in Hawaii. The Division of Conservation and Resources Enforcement (DOCARE) is the agency with enforcement authority at the state level in matters involving violations of Hawaii's protected species regulations.

— Pacific Remote Island Areas

The Pacific Remote Island Areas (PRIAs) are U.S. areas that are widely spread throughout the Pacific and include Wake, Johnston and Palmyra Atolls, Kingman Reef, and Jarvis, Howland, and Baker Islands. Following a 28 day assessment in 1983 it was concluded that green turtles do not nest at Johnston Atoll, but occur foraging within the atoll (Balazs and Forsyth 1986). Low-level nesting was observed at Palmyra in 1987 and along the west coast of Jarvis Island in the 1930s (NMFS & FWS 1998) but no recent surveys have been conducted. Both Jarvis and Palmyra are geographically part of the Line Islands chain of coral atolls and islands in the central Pacific and are uninhabited remote National Wildlife Refuges administered by the USFWS. Jarvis is visited infrequently by refuge staff for one to two days at a time every two years. There is a research station on Cooper Island at Palmyra Atoll operated by The Nature Conservancy (TNC) that houses a small maintenance staff year-round and various research groups for shorter time periods. Anecdotally, no evidence of sea turtle nesting has been observed at Palmyra in recent years (USFWS, pers. comm.). In 2007, an in-water sea turtle research project was initiated at Palmyra by the American Museum of Natural History and Columbia University. While nesting beach monitoring is not a focus of the project, any nesting activities will be documented by either the project or by TNC staff that currently reside at the Atoll.

The PRIAs do not support resident human populations and do not have local governments. Therefore, all sea turtle species that occur in the PRIAs are protected by the federal ESA as described previously.

Threats

Threats to green sea turtles include present and threatened destruction, modification or curtailment of habitat. There are increasing impacts to the nesting (e.g., beach construction) and marine habitat (e.g., contamination, structural degradation) (NMFS and USFWS 2007a).

Green sea turtles are also subject to overutilization and vulnerable to anthropogenic impacts during all life-stages. Poaching of eggs and killing of turtles continues to threaten subpopulations in many areas (NMFS and USFWS 2007a). This species is also vulnerable to being captured as bycatch in fisheries or affected incidentally by other human activities. Also, while the effects of climate change may be difficult to predict, its potential effects to the sea turtle environment (e.g., nesting habitat) or food sources is of concern (NMFS and USFWS 2007a).

Diseases also threaten a large number of existing subpopulations. The most commonly identified disease in green turtles is fibropapillomatosis (FP) (NMFS and USFWS 2007a).

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Listing Status and Critical Habitat

The hawksbill sea turtle was listed as endangered under the ESA in 1970, and is considered "Critically Endangered" by the International Union for the Conservation of Nature (IUCN) based on global population declines of over 80 percent during the past three 3 generations (105 years) (Meylan and Donnelly 1999). Anecdotal reports throughout the Pacific indicate that the current population is well below historical levels. In the Pacific, this species is rapidly approaching extinction primarily due to the harvesting of the species for its meat, eggs, and shell, as well as the modification and destruction of nesting habitat by humans (NMFS and USFWS, 2007b).

Critical habitat for the hawksbill sea turtle includes the waters surrounding the islands of Mona and Monito, Puerto Rico from the mean high water line seaward to 3 nautical miles (5.6 km). Key physical or biological features essential for the conservation of the hawksbill sea turtle found in this designated critical habitat include important foraging habitat, water quality, and shelter.

Physical Description

The hawksbill sea turtle has two pairs of prefrontal scales; thick, posteriorly overlapping scutes on the carapace; four pairs of costal scutes (the anterior- most not in contact with the nuchal scute); two claws on each flipper; and a beak-like mouth. In addition, when on land the hawksbill has an alternating gait, unlike the leatherback and green sea turtles. The carapace is heart-shaped in very young turtles and becomes more elongate or subovate with maturity. The lateral and posterior carapace margins are sharply serrated in all but very old individuals. The scutes are unusually thick and overlap posteriorly on the carapace in all but hatchlings and very old individuals. Carapacial scutes are often richly patterned with irregularly radiating streaks of brown and black on an amber background. The soft skin on the hawksbill's' venter is cream or yellow and may be pinkish-orange in mature individuals. The scales of the head and forelimbs are dark brown or black and have sharply defined yellow borders. There are typically four pairs of inframarginal scales. The head is elongate and tapers sharply to a point. The hawksbill is a small to medium-sized marine turtle. Nesting females average about 87 cm in curved carapace length (Eckert 1992) and weight may be to 80 kg in the Caribbean (Pritchard et al. 1983), with a record weight of 127 kg (Carr 1952). Hatchlings in the U.S. Caribbean average about 42 mm in straight carapace length and range in weight from 13.5 to 19.5 g (Hillis and Mackay 1989; van Dam and Sarti 1989; Eckert 1992).

Diet

Data on the diet of oceanic stage hawksbills are limited, but indicate a combination of plant and animal material (Bjorndal 1997). Studies have shown post-oceanic hawksbills to feed on sponges throughout their range, but to be especially spongivorous in the Caribbean (Meylan 1988, van Dam and Diez 1997b, Leon and Bjorndal 2002), and rather more omnivorous in the Indo-Pacific. They also are known to eat small crustaceans.

General Distribution

Hawksbills are found in all tropical seas between about 30EN and 30ES latitudes (NMFS and USFWS, 1998b). They occur in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf of Mexico (especially Texas); in the Greater and Lesser Antilles; and along the Central American mainland south to Brazil.

Within the United States, hawksbills are most common in Puerto Rico and its associated islands, and in the U.S. Virgin Islands. In the continental U.S., the species is recorded from all the gulf states and from along the eastern seaboard as far north as Massachusetts, with the exception of Connecticut, but sightings north of Florida are rare (Meylan and Donnelly 1999).

Hawksbills are observed in Florida with some regularity on the reefs off Palm Beach County, where the warm Gulf Stream current passes close to shore, and in the Florida Keys. Texas is the only other state where hawksbills are sighted with any regularity. Most sightings involve post-hatchlings and juveniles. They are closely associated with coral reefs and other hard-bottom habitats, but they are also found in other habitats including inlets, bays, and coastal lagoons. These small turtles are believed to originate from nesting beaches in Mexico.

Nesting within the Caribbean dependent areas of the United States occurs principally in Puerto Rico and the U.S. Virgin Islands, the most important sites being Mona Island and Buck Island. Nesting also occurs on other beaches of St. Croix, and on Culebra Island, Vieques Island, mainland Puerto Rico, St. John and St. Thomas. Within the continental United States, nesting is restricted to the southeast coast of Florida and Florida Keys.

In the U.S. Pacific Ocean, there have been no hawksbill sightings off the west coast. Hawksbills have been observed in the Gulf of California as far north as 29 degrees N, throughout the northwestern states of Mexico, and south along the Central and South American coasts to Columbia and Ecuador. In the Hawaiian Islands, nesting occurs in the main islands, primarily on several small sand beaches on the Islands of Hawaii and Molokai. Two of these sites are at a remote location in the Hawaii Volcanos National Park.

Within the Central Pacific, nesting is widely distributed but scattered and in very low numbers. Foraging hawksbills have been reported from virtually all of the island groups of Oceania, from the Galapagos Islands in the eastern Pacific to the Republic of Palau in the western Pacific (Witzell 1983; Pritchard 1982a,b in NMFS and USFWS 1998b). Along the far western and southwestern Pacific, hawksbills nest on the islands and mainland of southeast Asia, from China and Japan, throughout the Philippines, Malaysia, and Indonesia, to Papua New Guinea (PNG), the Solomon Islands (McKeown 1977) and Australia (Limpus 1982). Along the eastern Pacific rim, hawksbill turtles were common to abundant in the 1930s (Cliffton *et al.*, 1982). By the 1990s, the hawksbill turtle was rare to absent in most localities where it was once abundant (Cliffton *et al.*, 1982; Cornelius, 1982).

Life Hystory

The life history of hawksbills consists of a pelagic stage that lasts from the time they leave the nesting beach as hatchlings until they are approximately 22–25 cm in straight carapace length

(Meylan 1988), data suggest that the turtle switches foraging behaviors from pelagic surface feeding to benthic reef feeding (Limpus, 1992), followed by residency in developmental habitats (foraging areas where immatures reside and grow) in coastal waters. Within the Great Barrier Reef of Australia, hawksbills move from a pelagic existence to a "neritic" life on the reef at minimum CCL of 35 cm. The best estimate of age at sexual maturity for hawksbill turtles is about 20 to 40 years (Chaloupka and Limpus, 1997; Crouse, 1999a). Boulon (1994) estimated that juvenile hawksbills from the U.S. Virgin Islands would require between 16.5 and 19.3 additional years to reach maturity after entering nearshore habitats at several years of age at 21.4 cm straight carapace length. Australian hawksbill turtles are sex dependent with the female growing faster. Maximal growth rates for both males and females occurred at 60 cm curved carapace length (CCL) and then declined to minimal rates of growth as the turtles neared maturity at 80 cm CCL (Chaloupka and Limpus, 1997). The growth rates of Australian hawksbills appear to be less than those of Caribbean turtles, indicating geographic variation in growth. The maturing turtle establishes foraging territory and will remain in this territory until it is displaced (Limpus, 1992). As with other sea turtles, hawksbills will make long reproductive migrations between foraging and nesting areas (Meylan, 1999), but otherwise they remain within coastal reef habitats. In Australia, juvenile turtles outnumber adults 100:1. These populations are also sex biased with females outnumbering males 2.57:1 (Limpus, 1992).

Adult foraging habitat, which may or may not overlap with developmental habitat, is typically coral reefs, although other hard-bottom communities and occasionally mangrove-fringed bays may be occupied. Hawksbills show fidelity to their foraging areas over periods of time as great long as several years (van Dam and Diez 1998). Females nest an average of 3 to 5 times per season, with some geographic variation in this parameter (see references on pp. 204-205 of in Meylan and Donnelly 1999; Richardson et al. 1999). Clutch size is higher on average (up to 250 eggs) than that of green turtles (Hirth 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites. This, plus the tendency of hawksbills to nest at regular intervals within a season, makes them vulnerable to capture on the nesting beach.

Hawksbills utilize different habitats at different stages of their life cycle. Posthatchling hawksbills occupy the pelagic environment, taking shelter in weed lines that accumulate at convergence points. Hawksbills reenter coastal waters when they reach approximately 20-25 cm carapace length. Coral reefs are widely recognized as the resident foraging habitat of juveniles, subadults and adults. This habitat association is undoubtedly related to their diet of sponges, which need solid substrate for attachment. The ledges and caves of the reef provide shelter for resting both during the day and night. Hawksbills are also found around rocky outcrops and high energy shoals, which are also optimum sites for sponge growth. Hawksbills are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent. Tag return data (Pritchard and Trebbau 1984) and recent genetic studies (Bowen *et al*., 1995) suggest that individual foraging areas support hawksbills from distant breeding populations rather than just from nearby rookeries.

Although hawksbill nesting is broadly distributed, at no one place do hawksbills nest in large numbers, and many areas have experienced notable declines. Until recently, hawksbills were considered to be naturally rare and to have a more dispersed nesting pattern than other sea turtle species (Groombridge and Luxmoore 1989). However, it is now believed that the dispersed nesting observed today is the result of overexploitation of previously large colonies (Limpus 1995, Meylan and Donnelly 1999). Hawksbills utilize both low- and high-energy nesting beaches in tropical oceans of the world. Both insular and mainland nesting sites are known. Hawksbills will nest on small pocket beaches, and, because of their small body size and great agility, can traverse fringing reefs that limit access by other species. They exhibit a wide tolerance for nesting substrate type. Nests are typically placed under vegetation.

There is much variation in clutch size from site to site and among sizes of turtles, with the larger turtles laying the largest clutches. Known clutch size in the Pacific averages 130 eggs per clutch, around 3 clutches per year, and anecdotal reports indicate that hawksbill remigration intervals average around two years (Eckert, 1993; NMFS and USFWS, 1998b). Hawksbills nest throughout the insular tropical Pacific, though only in low density colonies. In the Campbell Island colony of northeastern Australia, nesting females average 83.2 cm CCL, weigh 51.6 kg and lay three clutches of eggs 14 days apart. Average clutch size was 132 eggs (Limpus *et al*., 1983). In Samoa, hawksbill nests averaged 149.5 eggs.

Mrosovsky *et al*. (1995) evaluated the effect of incubation temperature on sex determination in hawksbill hatchlings. Incubation temperatures warmer than approximately 29.2^{o}C produced females, while cooler temperatures produced males.

Migration

Like other sea turtles, hawksbills may undertake developmental migrations (migrations as immatures) and reproductive migrations that involve travel over hundreds or thousands of kilometers (Meylan 1999a). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. An adult female tagged in its foraging ground in the Torres Strait was observed nesting 322 days later in the Solomon Islands, a distance of over 1,650 km (Pritchard and Trebbau 1984). Another female traveled 1,400 km from the Solomon Islands to its foraging grounds in Papua New Guinea (Parmenter 1983). Movements of reproductive males are less well known, but are presumed to involve migrations to the nesting beach or to courtship stations along the migratory corridor.

Population Status and Trends

Since the hawksbill has become a solitary nester, population trends or estimates are difficult to determine. There are no world population estimates for hawksbill turtles, but a minimum of 15,000 to 25,000 females are thought to nest annually in more than 60 geopolitical entities (Groombridge and Luxmoore 1989). Moderate population levels appear to persist around the Solomons, northern Australia, Palau, Persian Gule islands, Oman, and parts of the Seychelles (Groombridge 1982). In a more recent review, Groombridge and Luxmoore (1989) list Papua New Guinea, Queensland, and Western Australia as likely to host 500-1,000 nesting females per year, while Indonesia and the Seychelles may support >1,000 nesting females. The largest known nesting colony in the world is located on Milman Island, Queensland, Australia where Loop (1995) tagged 365 hawksbills nesting within an 11 week period. With the exception of Mexico, and possibly Cuba, nearly all Wider Caribbean countries are estimated to receive <100 nesting females per year (Meylan 1989).

Hawksbills appear to be declining throughout their range**.** By far the most serious problem hawksbill turtles face is the harvest by humans, while a less significant threat, but no less important, is loss of habitat due to expansion of resident human populations and/or increased tourism development. Dramatic reductions in the numbers of nesting and foraging hawksbills have occurred in Micronesia and the Mexican Pacific coast, probably due largely to technological advances in fishing gear, which facilitate legal and illegal harvest. In addition, the hawksbill tortoiseshell trade probably remains an important contributing factor in the decline of the hawksbill. Although the Japanese market was closed in 1994, southeast Asia and Indonesia markets remain lucrative (NMFS and USFWS, 1998b). In addition to the demand for the hawksbill's shell, there is a demand for other products including leather, oil, perfume, and cosmetics. Prior to being certified under the Pelly Amendment, Japan had been importing about 20 metric tons of hawksbill shell per year, representing approximately 19,000 turtles. A negotiated settlement was reached regarding this trade on June 19, 1992. The hawksbill shell commands high prices, a major factor preventing effective protection.

Distribution and Abundance of Nesting Females in the Pacific Ocean
Generally, in the Pacific, the largest nesting concentrations of hawksbills occur on remote oceanic islands off Australia (Torres Strait), while remote beaches in the Solomon Islands, Papua New Guinea, Indonesia, and Malaysia serve as less significant sites. Otherwise, hawksbill nesting does not occur in abundance in the Pacific. Throughout Micronesia, hawksbill nesting is in decline, with Palau representing the highest activity, with conceivably as few as 20 nesting females per year (NMFS and USFWS, 1998b). In Japan, nesting is very rare and is confined to the southern islands. Hawksbill nesting also occurs in Vietnam and China, although the status in these areas is unknown. Nesting is widespread throughout the Philippines, although the sites are relatively poorly known, and population abundance has not been quantified (Eckert, 1993).

— American Samoa
For American Samoa, based on interviews, Tuato'o-Bartley *et al.* (1993) estimated 50 nesting female hawksbills per year on Tutuila and 30 nesting females per year on the Manu'a island group of Ofu, Olosega and Ta'u, using an average 2.8 nesting turtles per active beach. A total of 120 nesting females were estimated throughout American Samoa. However, since local people almost always seem to underestimate individual fecundity (numbers of clutches per female), the actual number of turtles nesting at Tutuila and Manu'a could be significantly lower than Tuato'o-Bartley's estimates. Given an estimate of 120 nesting females, recent records indicate that there is a decline in the number of females nesting annually, based on confirmed nests and clutches of hatchlings (Utzurrum, 2002).

— CNMI
There are no reports of hawksbills nesting in the Commonwealth of the Northern Mariana Islands (CNMI) (Pritchard, 1982a). This is partly because there is a long history of occupation on the more southern islands of Saipan, Rota, and Tinian, and partly because almost no hawksbill nesting surveys of small pocket beaches have ever been done in remote areas of the CNMI. However, lack of evidences does not rule out the possibility of hawksbills nesting at low levels at unknown locations.

— Hawaii

Within the State of Hawaii, hawksbill turtles are known to nest on the Hawaiian Islands of Maui, Molokai, and Hawaii. Two nesting sites are located in the Hawaii Volcanoes National Park (Balazs *et al*., 1992; Katahira *et al*., 1994). In surveys conducted between 1989 and 1993, 18 hawksbill turtles were tagged and 98 nests documented (NMFS and USFWS, 1998b), although total population numbers and trends in abundance are not known for the Hawaiian population of hawksbill turtles. The peak nesting occurs from late July to early September (Katahira *et al*., 1994). Although hawksbill nesting habitat on the Big Island at Halape and Apua are within Hawaii Volcanoes National Park, nesting on the island of Hawaii is also known to occur at Kamehame, Punaluu, Horseshoe, Ninole, Kawa, and Pohue; on Maui, nesting occurs at Kealia, Makena, Kihei, Lahaina, and Hana; on Molokai, nesting occurs at Halawa Valley (E. Sharpe, pers. comm., 2005). However, because many of the shoreline areas on all the islands have not been monitored for nesting turtles, hawksbill turtles probably nest on additional beaches (E. Sharpe, pers. comm., 2005). Hawksbill turtles appear to prefer nesting sites with steep beaches and coarse sand, and this may explain, in part, their presence in the main Hawaiian Islands.

Only the ETP purse seine fishery has observed the take of hawksbills. Unfortunately, turtles in this fishery are not sampled to determine nesting origin. Nonetheless, because of the location of fishing effort, hawksbills taken in this fishery likely originate from eastern Pacific nesting beaches.

Threats

Threats to hawksbill sea turtles include present and threatened destruction, modification or curtailment of habitat. There are increasing impacts to the nesting (e.g., beach construction) and marine habitat (e.g., contamination, structural degradation) (NMFS and USFWS 2007b). Hawksbill sea turtles are also subject to overutilization and vulnerable to anthropogenic impacts during all life-stages. Although hawksbills are subject to the suite of threats on both nesting beaches and in the marine environment that affect other sea turtles, the decline of the species is primarily attributed to centuries of exploitation for tortoise shell, the beautifully patterned scales that cover the hawksbill’s shell (Parsons 1972). Poaching of eggs and killing of turtles continues to threaten populations in many areas (NMFS and USFWS 2007b). The current primary global threat to hawksbills is habitat loss of coral reef communities. Hawksbill turtles rely on coral reefs and sea grass beds for food resources and habitat. As these communities continue to decline in quantity and quality, hawksbills will have reduced foraging opportunities and limited habitat options. Hawksbills are also vulnerable to being captured as bycatch in fisheries or affected incidentally by other human activities.

Coral reefs are vulnerable to destruction and degradation caused by human activities. Humans can alter coral reefs either gradually (i.e., pollution can degrade habitat quality) or catastrophically (e.g., toxic spills and vessel groundings). These habitats can be affected by eutrophication, sedimentation, chemical poisoning, collecting-gleaning, trampling (by fishermen and divers), anchoring, etc. (NMFS and USFWS 1998). Chemical pollutants, such as petroleum, sewage, pesticides, solvents, industrial discharges, and agricultural runoff are responsible for an unquantifiable level of sea turtle mortality each year (NMFS and USFWS 1998). The entanglement in and ingestion of marine debris threatens the survival of hawksbill sea turtles. Such debris includes not only discarded or abandoned fishing gear (lines, ropes, nets), but also plastic bags, plastic sheets, “6-pack” rings, and other discarded debris. Turtles can die from ingested garbage, such as plastic or tar (NMFS and USFWS 1998). Recent evidence also suggests that global climate change is negatively impacting coral reefs by causing higher incidences of coral diseases, which can ultimately kill entire coral reef communities (Crabbe 2008), as well as other potential effects to the sea turtle environment (e.g., nesting habitat) (NMFS and USFWS 2007b).

Throughout the Atlantic and Gulf of Mexico, problems at nesting beaches such as domestic animals, beach driving, litter, beach erosion, beach mining, beach replenishment, and recreational use of beaches have presented problems for nesting hawksbill turtles. In addition, beach front lights appear to pose a serious problem for hatchling hawksbill turtles in U.S. coastal areas (USFWS 1999).

The continuing demand for the hawksbill's shell as well as other products (leather, oil, perfume, and cosmetics), constitutes an important threat to this species. The British Virgin Islands, Cayman Islands, Cuba, Haiti, and the Turks and Caicos Islands (U.K.) all permit some form of legal take of hawksbill turtles. In the northern Caribbean, hawksbills are directly harvested primarily for their commercially valuable carapace, which is often carved into hair clips, combs, jewelry, and other trinkets (Marquez 1990; Stapleton and Stapleton 2006). Additionally, hawksbills are harvested for their eggs and meat while whole stuffed turtles are sold as curios in the tourist trade. Hawksbill products are openly available in the Dominican Republic and Jamaica despite a prohibition on harvesting hawksbills and eggs (Fleming 2001). While the international trade in the shell of this species is prohibited between those countries that have signed the Convention on International Trade in Endangered Species (CITES), illegal trade remains a problem.

In addition to anthropogenic threats, hawksbill turtles are also threatened by natural causes including hurricanes (NMFS and USFWS 2007d) and predation by exotic species (fire ants, raccoons (*Procyon lotor*) and opossums (*Didelphus virginiana*))(USFWS 1999).

Hawksbill sea turtles are the focus of research activities worldwide. Research on sea turtles in the U.S. is carefully controlled and managed so that it does not operate to the disadvantage of the species. A very small percentage of the takes related to these activities results in injury or mortality.

Environmental Baseline

Environmental baselines for Biological Opinions include the past and present impacts of all state, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process. The environmental baseline for this Biological Opinion includes the effects of several activities that affect the survival and recovery of threatened and endangered species in the action area. The following describes the fisheries and non-fisheries-related activities that impact the sea turtle discussed in this opinion. A number of these activities are operating outside of the action area, but due to the great distances these sea turtle species travel other activities may impact them when they migrate out of the action area. To provide the reader with a more comprehensive discussion of other the activities affecting the species found in the action area, we have included some activities occurring in areas to which these species could migrate during the course of their life cycle.

Fisheries Impacts

Few fisheries in the Pacific Ocean are well observed or monitored for bycatch. Rough estimates can be made of the impacts of coastal, offshore, and distant water fisheries on sea turtle populations in the Pacific Ocean by extrapolating data collected on fisheries with known effort that have been observed to incidentally take sea turtles. Such estimates are hampered by a lack of data on pelagic distribution of sea turtles.

This section will summarize some of the fisheries that have been observed or reported to incidentally or intentionally take sea turtles. Estimates of total fishing effort are complicated by the fact that not all active vessels fish equivalent number of days per trip or annually, or use the same number of hooks, length of net, or mesh size, or have the same carrying capacity. However, even with minimum effort estimates, it is apparent that there is significant fishing effort in the Pacific Ocean for which NMFS has minimal or no bycatch information for sea turtles.

North Pacific Driftnet Fisheries (before December 1992)
Because the effects of high seas driftnet fisheries operating prior to 1992 may still be evident in sea turtle population trends, it is important to summarize what little is known about the impact of the fisheries on sea turtles in the North Pacific Ocean. Foreign high-seas driftnet fishing in the North Pacific Ocean for squid, tuna and billfish ended with a United Nations moratorium in December, 1992. Except for observer data collected in 1990-1991, there is virtually no information on the incidental take of sea turtle species by the driftnet fisheries prior to the moratorium. The high seas squid driftnet fishery in the North Pacific was observed in Japan, Korea, and Taiwan, while the large-mesh fisheries targeting tuna and billfish were observed in the Japanese fleet (1990-91) and the Taiwanese fleet (1990). A combination of observer data and fleet effort statistics indicate that 4,373 turtles, mostly loggerheads and leatherbacks, were entangled by the combined fleets of Japan, Korea and Taiwan during June, 1990 through May, 1991, when all fleets were monitored (Wetherall 1997). Of these incidental entanglements, an estimated 1,011 turtles were killed (77 percent survival rate).

Green turtles and the majority of loggerheads measured by observers were immature, and most of the actual measured leatherbacks were immature, although the size of leatherbacks that were too large to bring on board were only estimated, and are therefore unreliable (Wetherall 1997).

These rough mortality estimates for a single fishing season provide only a narrow glimpse of the past impacts of the driftnet fishery on sea turtles. A full assessment of impacts would consider the turtle mortality generated by the driftnet fleets over their entire history and geographical range. Unfortunately, comprehensive data are lacking, but the observer data does indicate the possible magnitude of past turtle mortality, given the best information available. Wetherall *et al.* (1993) speculate that “the minimum total turtle mortality in the North Pacific high-seas driftnet fisheries may have been on the order of 2,500 turtles per year during the late 1980s. The actual mortality was probably greater than this, but less than the estimated total driftnet bycatch of perhaps 9,000 turtles per year. Based on 1990 observer data, most of the mortalities would have been loggerheads taken in the Japanese and Taiwanese large-mesh fisheries."

While a comprehensive, quantitative assessment of the impacts of the North Pacific driftnet fishery on turtles is impossible without a better understanding of turtle population abundance, stock origins, exploitation history and population dynamics, it is likely that the mortality inflicted by the driftnet fisheries in 1990 and in prior years was significant (Wetherall *et al.* 1993), and the effects may still be evident in sea turtle populations today. The high mortality of juvenile, pre-reproductive adults, and reproductive adults in the high-seas driftnet fishery has potentially altered the current age structure (especially if certain age groups were more vulnerable to driftnet fisheries) and therefore diminished or limited the reproductive potential of affected sea turtle populations.

Japanese tuna longliners in the Pacific Ocean and South China Sea - historical perspective
Based on turtle sightings and capture rates reported in a survey of fisheries research and training vessels and extrapolated to total longline fleet effort by the Japanese fleet in 1978, Nishimura and Nakahigashi (1990) estimated that 21,200 turtles, including greens, leatherback turtles, loggerheads, olive ridleys and hawksbills, were captured annually by Japanese tuna longliners in the Western Pacific and South China Sea, with a reported mortality of approximately 12,300 turtles per year. Using commercial tuna longline logbooks, research vessel data and questionnaires, Nishimura and Nakahigashi (1990) estimated that for every 10,000 hooks in the Western Pacific and South China Sea, one turtle is captured, with a mortality rate of 42 percent. Although species-specific information is not available, vessels reported sightings of turtles in locations which overlap with commercial fishing grounds in the following proportions: loggerhead - 36 percent; green turtle - 19 percent; leatherback - 13.7 percent; hawksbill - 10.3 percent; olive ridley - 1.7 percent; and unknown - 19 percent. Caution should be used in interpreting the results of Nishimura and Nakahigashi (1990), including estimates of sea turtle take rate (per number of hooks) and resultant mortality rate, and estimates of annual take by the fishery, for the following reasons: (1) the data collected was based on observations by training and research vessels, logbooks and a questionnaire (i.e. hypothetical), and do not represent actual, substantiated logged or observed catch of sea turtles by the fishery; (2) the authors assumed that turtles were distributed homogeneously; and (3) the authors used only one year (1978) to estimate total effort and distribution of the Japanese tuna longline fleet. Although the data and analyses provided by Nishimura and Nakahigashi (1990) are conjectural, longliners fishing in the Pacific have had, and probably continue to have significant impacts on sea turtle populations.

Japanese Pacific Ocean tuna longliners - recent
Bycatch information for Japanese tuna longliners is based on data collected during 2000. At a bycatch working group meeting of the IATTC, held in Kobe, Japan in 2004, a member of the Japanese delegation stated that based on preliminary data from 2000, the Japanese tuna longline fleet was estimated to take approximately 6,000 turtles, with 50 percent mortality. Little information on species composition was given; however, all species of Pacific sea turtles were taken (NMFS 2005).

Japanese coastal fisheries
Off the coast of Japan, gillnets and pound nets are very common. In addition, there is an intense trawl fishery for anchovy operated off-shore.

Taiwan Coastal setnet and gillnet fishery
Taiwanese have harvested sea turtles for many years for their meat, their bones for use in Chinese medicine, and eggs for profit. In Taiwan, sea turtle bycatch in fisheries occurs, although little quantitative information is available for fisheries operating in the Pacific Ocean (Cheng 2002).

Researchers investigated the incidental capture of sea turtles by the coastal setnet and gillnet fisheries in the eastern waters of Taiwan from 1991 through 1995. Setnets used in the coastal waters off Taiwan are near-shore sedentary trap nets, and rarely extend below 20 meters. During the time of the study, there were 107 setnets in Taiwan, and they provided the second largest total fish yields, after gillnets. According to interviews with fishermen, incidentally caught sea turtles are either sold to dealers in the market or are butchered for meat (subsistence). Fishing grounds including set nets and gillnets were observed from 1991 through 1992, and the fish market was visited once or twice per month from 1991 through 1995 to corroborate bycatch data (Cheng and Chen 1997).

Of the sea turtles caught, 82% were caught in setnets, and of these, all were alive. Green turtles accounted for 70% of the sea turtles taken, and captured turtles represented all age classes (large juvenile, subadult and adults)(Cheng and Chen 1997). Most captured loggerheads were either sub adults or adult females (only one male was unidentified), and most of the captured olive ridleys were sub adults. The one captured leatherback was released alive. Not surprisingly, bycatch rate also increased with fishing effort, and most of the turtles taken were sold to temples for “religious release” later. Of all captured turtles, 88% were sold to temples for Chinese religious ceremonies, 8% were stuffed or butchered, and 3% were released at the site (Cheng and Chen 1997).

Philippines
Near the Turtle Islands, a variety of fisheries interact with sea turtles, and Cruz (2002) reported an increasing number of floating dead turtles observed in this area since 1999, most likely attributable to an increasing number of fishing vessels operating in the area, including purse seiners, shrimp trawlers, and hulbot-hulbot (demersal drive-in net). These vessels originate primarily from Sabah, Malaysia, and Manila, Philippines. There was also an increasing number of fishing vessels operating in Philippine waters originated from China. Aside from fishing illegally, the Chinese vessels are also catching sea turtles. In January, 2002, more than 58 sea turtles, primarily green turtles were discovered on four Chinese vessels in Tabbataha Marine Park, a UNESCO Natural Heritage Park, located in the Sulu Sea (Cruz 2002).

Malaysia
Sea turtles are caught an a variety of fisheries in Malaysia, ranging from driftnets, lift nets, ray nets (similar to sunken driftnets with a large mesh to target rays and sharks), trawl nets, and purse seines.

Distant Water Fishing Nations Longline Fishing in the EEZ around the Federated States of Micronesia

Heberer (1997) summarized the results of 51 distant-water fishing nation (DWFN) longline trips observed by Micronesian Maritime Authority fisheries observers from 1993 through 1995. Vessels from China, Taiwan, and Japan captured a total of 34 sea turtles. These turtles were reported as 15 olive ridleys, 8 green turtles, and 11 unidentified sea turtles. Thirty of the 34 turtles were released alive and the remainder were dead when landed (11.8% mortality rate). Data on hooking location or entanglement was not reported, nor was the condition of each turtle by species. Observer coverage is historically low in this area and the overall magnitude of impact to sea turtles unclear, however it is likely sea turtles are taken in the longline fishery when it occurs in this area.

Foreign tuna fisheries in the western and central Pacific Ocean

The western and central Pacific Ocean (area west of 150 degrees W longitude, and between 10 degrees N and 45 degrees S) contains the largest industrial tuna fishery in the world. Much of the effort takes place in the EEZs of Pacific-Island counties, in the western tropical Pacific area. Observers have been placed on both purse seiners and longliners in this area, and have operated and reported to the Oceanic Fisheries Programme of the Secretariat of the Pacific Community. While observers have covered most of the fleets, three fleets have not been observed: the Japanese and Korean distant-water longline fleets operating in the eastern areas and the Australian swordfish fishery operating off eastern Australia.

There is low observer coverage (<1%) for the longline fishery, but patterns of sea turtle observed interactions have show that sea turtles are more likely to encounter gear in tropical waters and that they are much more likely to encounter gear that is shallow-set (by an order of magnitude) verses deep-set (for longline fishery). When encountered on deep-set gear, sea turtles were likely to be taken on the shallowest hooks. From available observer data, the longline fishery operating in the western and central Pacific has previously been estimated to take 2,182 sea turtles per year, with 500-600 expected to die as a result of the encounter. From observer data, 1,490 are estimated taken by offshore/fresh tuna vessels using shallow-night sets, 129 are estimated taken by offshore/fresh tuna vessels on deep-day sets, and 564 are estimated taken by distant water freezer vessels on deep-day sets. The composition of species observed taken include (ranked by highest occurrence first): olive ridley, green, leatherback, loggerhead and hawksbill. Given the low observer coverage, this estimate has very wide confidence intervals.

Chile

Although data on the incidental take of sea turtles in the Chilean swordfish fisheries are sparse, both green and leatherback turtles have been confirmed taken and killed, and olive ridleys and loggerheads may also be taken incidentally by the fishery (Weidner and Serrano 1997). The Chilean swordfish fishery was comprised primarily of artisanal fishermen, averaging 500 boats (mainly driftnetters) from 1989 to 1991, and decreasing in numbers after 1991. Large industrial (i.e. commercial) boats have fished swordfish in Chile, the effort is comprised of gillnets, pelagic longliners and boats that switch gear.

Effort by the artisanal driftnet fishery for swordfish appears to have been relatively constant through 1996, as shown in Table 9. Given the total sea turtle take estimate from the 1988-89 season, and combining it with the total effort (days-at-sea) data from 1988-1996, and assuming effort was constant and in the same general area during all years, a simple calculation can be made to estimate the incidental take of turtles by the Chilean artisanal driftnet fishery for swordfish during subsequent years. Turtles reportedly began appearing in Chilean markets in 1987, just as the swordfish driftnet fishery was expanding, and Chilean observers have reported occasional individual sets with leatherback mortalities (*in* Weidner and Serrano 1997). Assuming an artisanal driftnet fishing effort equivalent to 1996 and assuming the proportion of species taken is equivalent to data collected from the 1988-89 fishing season, this fishery would have taken an estimated 39 greens, 76 leatherback turtles, 4 loggerheads, and 29 olive ridleys annually through 2002. However, this was an approximation, as the artisanal fleet had declined to maybe a third of its size sometime after 1996.

During 1996, there was a substantial expansion of Chilean longline fishing in offshore areas, but as there was no collection of data on this fishery at that time (Weidner and Serrano 1997), the effects on sea turtle stocks as a result in this change in fishing strategy are not known. In addition to the swordfish fishery, Chile also has had a substantial purse seine fleet (Weidner and Serrano 1997).

Peru

Since 1995, Peruvian law has prohibited the capture, trade, and consumption of sea turtles. Despite the law, sea turtles continue to be caught alive in artisanal fisheries as bycatch and are nearly always killed for “bushmeat.”

Peruvian commercial longline fleets have had limited success in fishing for swordfish, so there is probably very little incidental catch of sea turtles in this fishery. Peruvian artisanal fishermen, however, also target fish species normally taken in commercial longline fisheries (especially shark) and have been more successful than the commercial longline fleet, so more turtles may be caught incidental to these artisanal fisheries (Weidner and Serrano 1997).

From 1997-1999, the government agency IMARPE estimated that 8.02 tons of turtles were captured (Alfaro-Shigueto, in press). Kelez et al. (2003) report that sea turtles are commonly caught incidentally by artisanal fisherman, entangled by gillnets and hook-and-line. In general, fishermen from the smaller villages may release a turtle that is alive; however, if it is dying they will kill it. In the larger towns, fishermen will nearly always kill an incidentally caught turtle because of the demand for its meat. The carapaces of sea turtles are also sold in the department of Tumbes and in the northern part of the department of Piura, due to the tourist industry (Kelez et al. 2003). From January, 2001 through February, 2003, observers sampled eight ports in Peru to document sea turtle bycatch. During this time, observed turtle bycatch was 1,630 individuals, with total estimated bycatch to be 2,025 turtles (after extrapolation for days not observed).

Foreign longline fleets are also active and extensive off Peru and the bycatch of sea turtles in these foreign fisheries has been considered significant (Weidner and Serrano 1997). From September, 2003 to November, 2004, observers were placed on artisanal longline vessels operating out of the port of Ilo, home to one of the largest year-round artisanal longline fleets. The fleet used surface longlines. During the observation period, 588 sets were observed during 60 trips, and 154 sea turtles were taken as bycatch. Loggerheads were the species most often caught (73.4%), followed by green turtles (18.2%), olive ridleys (3.8%), and leatherbacks (2.6%). Species were most often entangled (74%); the rest were hooked. Of the loggerheads taken, 68% were entangled, 32% were hooked. Of the two fisheries, sea turtle bycatch was highest during the mahi mahi season, with 0.597 turtles/1,000 hooks, while the shark fishery caught 0.356 turtles/1,000 hooks (Alfaro-Shigueto et al. 2005). Sea turtles are rarely released into the sea after being caught as bycatch in this fishery; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale.

Central American Shrimp Fishery
Shrimp fishery operations were initiated throughout Central America during the mid 1950s. Arauz (1996) estimated that over 60,000 sea turtles were taken by shrimp trawlers on the Pacific coast of Central America. Mortality rates were not estimated. Olive ridleys were the species most commonly taken, and foraging grounds for these turtles overlap with shrimp trawling grounds. Table 1 shows the estimated turtle catch by shrimp trawlers in Central America, by country, for 1993.

Table 1. Estimated turtle catch by shrimp trawlers for the Pacific coast of central America, 1993

Country	# Vessels	Total CPUE turtles/hr	Turtles/year
Guatemala	58	?	(10,000)
El Salvador	70	0.0511	21,280
Nicaragua	21	?	(8,000)
Costa Rica	55	0.0899	20,762
Total	204		60,042

Note: figures in parenthesis are estimated. Source: Arauz, 1996.

Costa Rica
Sea turtles are impacted by Costa Rican fisheries and by interaction with human activities. Several studies have been undertaken in recent years in order to document the incidental capture of sea turtles in Costa Rican longline fisheries. Two studies in 1997 and 1998 on two longline fishing cruises (one experimental) documented a high incidental take of sea turtles. On one cruise, a total of 34 turtles (55% olive ridleys and 45% east Pacific green turtles) were taken on two sets containing 1,750 hooks (1.42 turtles per 100 hooks). One additional set caught two leatherbacks. The second cruise documented the incidental take of 26 olive ridleys, with 1,804 hooks deployed (Arauz et al. 2000). An observer program was put in place from August, 1999 through February, 2000. Seventy seven longline sets were observed on 9 cruises. Of the nearly 40,000 hooks deployed, turtles represented 7.6% of the total catch, with a catch per unit effort of 6.364 turtles/1,000 hooks.

Mexican (Baja California) fisheries
Sea turtles have been protected in Mexico since 1990, when a federal law decreed the prohibition of the "extraction, capture and pursuit of all species of sea turtle in federal waters or from beaches within national territory ... [and a requirement that] ... any species of sea turtle incidentally captured during the operations of any commercial fishery shall be returned to the sea, independently of its physical state, dead or alive" (in Garcia-Martinez and Nichols 2000).

Although there are no solid estimates of fisheries-related sea turtle mortality rates for the region, sea turtles are known to interact with (and be killed by) several fisheries in the area. As in other parts of the world, shrimp trawling off Baja California is a source of sea turtle mortality, although since 1996, shrimp fishermen are required to use turtle excluder devices.

Tuna Purse Seine Fishery in the Eastern Tropical Pacific
The international fleet represents the majority of the fishing effort and carrying capacity in the ETP tuna fishery, with much of the total capacity consisting of purse seiners greater than 400 short tons (st). These large vessels comprised nearly 70 percent of the total fishing capacity operating in the ETP in 1996 (IATTC 2002). An average of 122 foreign vessels with a carrying capacity greater than 400 st fished each year in the ETP during 1996 to 2001. In addition to these larger vessels, the foreign fleet contains smaller vessels less than 400 st that target tuna in the ETP. From 1996 to 2001, an average of 59 foreign vessels ranging from 45 to 400 st carrying capacity fished in the ETP each year (IATTC 1999, 2001).

Recent information from the Inter-American Tropical Tuna Commission (IATTC) shows that the number of active purse seiners of all sizes is 236 vessels, with Mexico and Ecuador comprising the majority of the fleet (65 and 85 vessels, respectively) (Source: IATTC 2007 (www.iattc.org)).

Data from the IATTC indicate that between approximately 17 and 172 total sea turtles per year were killed by vessels over 400 st (364 mt) in the ETP purse seine fishery from 1993-2004. The primary species taken were olive ridleys (M. Hall, IATTC 2006), likely because they are proportionately more abundant than any other sea turtle species in the ETP and they have been observed to have an affinity for floating objects (Arenas and Hall 1992). The numbers of sea turtles killed by the fishery dropped significantly in 2002, and the years following, likely as a result of increased awareness by fishermen through educational seminars given by the IATTC and conservation measures implemented through Resolutions adopted by the IATTC. Given the passing of a recent IATTC Resolution on Bycatch, sea turtle mortalities should continue to decrease.

As mentioned, the U.S. fleet (large vessels only) has 100 percent observer coverage; therefore, the fate of every sea turtle taken is documented. Because the U.S. fleet does not set on dolphins, sea turtles are taken in school sets and log/FAD sets. The fate of sea turtles that interact with the U.S. purse seine fleet during such sets may only be comparable to the non-U.S. fleet that sets on logs/FADs and tuna schools. Similar to the entire purse seine fleet, the majority of the sea turtles taken by the fishery are olive ridleys, and most sea turtles are released unharmed (M. Hall, IATTC 2005).

Since 1999, seminars have been given by the IATTC to skippers and their crews to educate them on, among other issues, status of sea turtles, and handling and recovery of turtles taken by purse seiners in the ETP. Purse seine fishermen are required to promptly release unharmed, to the extent practicable, all sea turtles and crews are required to be trained in techniques for handling turtles to improve survival after release.

Purse seine fisheries in the western tropical Pacific Ocean (WTP)
There are nearly 400 active purse seine vessels originating from a variety of countries and operating nearly exclusively in tropical waters of the central and western Pacific Ocean. The purse seine fishery in the WTP is observed, and observer effort generally covers the extent of the fleet's activity. Although there has been less than 5% observer coverage for the entire fishery, the U.S. fleet has maintained up to 20% coverage since the mid-1990s. For the purse seine fisheries operating in the WTP, an estimated 105 sea turtles are taken per year, with approximately 17% mortality rate. The species included green turtles, hawksbills and most often olive ridleys. Encounters with sea turtles appeared to be more prevalent in the western areas of the WTP, where log sets are more prevalent. However, observer data for both the Philippines and Indonesia, which both fish in the east, were unavailable. These countries have purse seiners and ring-net fleets that fish predominantly on a variety of anchored FADs in this area (Oceanic Fisheries Programme 2001); therefore, the sea turtle take estimate in this fishery is likely underestimated and incomplete.

NMFS expects that 14 green, and 14 hawksbill turtles per year may be incidentally taken as a result of the U.S. western and central Pacific (WCPO) purse seine fishery. The nature of the take from encirclement and/or capture in the fishery may result in harassment and temporary harm. The best available data do not indicate that take in the form of mortality is likely to result to any sea turtle species due to interactions with the U.S. WCPO purse seine fishery (NMFS 2006).

Hawaii-based and American Samoa-based longline fishery
The area fished ranges as close as 25 miles from Hawaii to thousands of miles from port. These Hawaii-based longline vessels compete with foreign distant water fishing fleets operating on the high seas. In 2001, 101 Hawaii–based longline vessels made 1,034 trips, almost all of which targeted tunas. Swordfish was a major target species of this fishery prior to 2001, but due to conservation measures to protect sea turtles this segment of the Hawaii-based longline fishery was phased out completely by the end of 2001.

The Western Pacific Pelagics Fishery Management Plan (Pelagics FMP) covers the Hawaii-based deep-set longline fishery, the Hawaii-based shallow-set longline fishery, the American Samoa longline fishery, and several non-longline pelagic fisheries (trolling, handline, etc.). Section 7 consultation was completed for all fisheries in the Pelagics FMP on February 23, 2004. Reinitiation of consultation on the HI-based deep-set fishery was completed on October 4, 2005. The current incidental take statements (ITS) for these fisheries are shown in Tables 15–17 below. The ITS for the American Samoa longline fishery was exceeded in 2006, thus reinitiation of consultation was completed 2010. Also, the proposed expansion of the HI-based shallow-set longline fishery required reinitiation of consultation, and was completed in 2009 (NMFS 2009).

Direct Harvest

Mexico
Sea turtles have been protected in Mexico since 1990, when a federal law decreed the prohibition of the "extraction, capture and pursuit of all species of sea turtle in federal waters or from beaches within national territory ... [and a requirement that] ... any species of sea turtle incidentally captured during the operations of any commercial fishery shall be returned to the

sea, independently of its physical state, dead or alive" (in Garcia-Martinez and Nichols 2000). Despite the ban, studies have shown that sea turtles continue to be caught or "harvested," both indirectly in fisheries and by a directed harvest of eggs, immatures, and adults.

Peru and Ecuador

The Ministerio de Pesqueria (MIPE), which is the Peruvian agency responsible for fisheries, prohibited the taking of all leatherback turtles and green turtles less than or equal to 80 cm in length through a resolution in January, 1977 (Weidner and Serrano 1997). In 1995, the Peruvian government prohibited the capture, trade, and consumption of green turtles, leatherbacks, olive ridleys, and hawksbills. However, in many ports of Peru, this decree was and is poorly enforced, and sea turtles were widely caught for human consumption. Noted Peruvian ports included Pisco, Chincha, Pucusana, Callao, and Chimbote (Alfaro-Shigueto et al. 2002).

Peru conducted directed commercial turtle harvests throughout the 1980s, and, as recently as 1990, over 100 metric tons of turtles were taken (FAO, Yearbook of Fishery Statistics, 1994, in Weidner and Serrano 1997). Species-specific information was not available. Researchers from the Peruvian Centre for Coastal Research also opportunistically collected data on sea turtle captures while collecting data on dolphin mortality. They present data on sea turtle mortality in two ports, Cerro Azul and Chimbote in 1993 and 1994, and compile data on leatherback capture along the Peruvian coast from 1984-1999. Sea turtles, particularly olive ridleys and green turtles, are commonly taken with "animaleros," which are large mesh drift gillnets targeting sharks and rays, but take dolphins and sea turtles as bycatch. Researchers provided a minimum estimate of 77 turtles taken in 11 months (1993) and 45 turtles taken in 8 months (1994) in Cerro Azul. In Chimbote, researchers estimated a minimum of 133 turtles taken in approximately 7 months (1993). Species composition of observed turtles taken included both olive ridleys and greens (83.2%) and leatherbacks (16.18%) (Alfaro-Shigueto et al. 2002).

Vietnam

In Vietnam, there has been a high demand for sea turtle products in the market, and as a result, green turtles and hawksbills have been harvested heavily to supply this demand. Direct harvest of sea turtles is common among the coastal communities, where turtles forage and breed. In addition, sea turtle eggs are collected for food. Poverty in the country and a lack of awareness of the conservation of resources are partially to blame for this exploitation; in addition, there are no regulations and little government support for sea turtle research and conservation efforts (Hien 2002). Unfortunately, no quantitative estimates are available on the level of sea turtle mortality or the number of eggs taken.

Australasia (Bali, Torres Strait)

Bali has a large trade in live green turtles. Reports from World Wildlife Fund/International Union for the Conservation of Nature (1984 in Dermawan 2002) indicate that green turtles have been collected from all over Indonesia in order to supply Bali with up to 30,000 turtles. Turtles have been used as a standard source of food and in religious festivities in southern Bali (within the Balinese-Hindu culture) for many years, and as of 2002 the demand was increasing (Dermawan 2002). While traditional religious ceremonies require the use of sea turtle meat, Hindu high priests have estimated that only 300 to 500 turtles annually should serve that purpose (in Dethmers and Broderick 2003). The average demand for sea turtles in Bali alone is approximately 17,000 per year, although the government only permitted the harvest and slaughter of up to 3,000 turtles per year. With green turtles foraging near and nesting on Bali decreasing, the sea turtle fishery out of Bali has had to expand to more distant foraging and nesting populations throughout the Indonesian archipelago. This has required larger vessels and a network of hunters, traders, and shippers (Dethmers and Broderick 2003).

In the Torres Strait, both a commercial fishery and a subsistence fishery has operated, taking substantially fewer turtles than the Balinese fishery. In the subsistence fishery, Islanders use small aluminum dinghies and deploy small nets or use traditional gear, typically within a day's journey from their village. Sea turtles are consumed for subsistence or used in traditional feasts. In the late 1980s, the commercial fishery was estimated to take 5,000 and 10,000 sea turtles annually and was marketed through Daru in Papua New Guinea (Limpus and Parmenter 1986 and Groombridge and Luxmoore 1989, both in Dethmers and Broderick 2003).

Based on analysis of genetic data collected from green turtles from the Bali and Torres Strait region as well as a feeding aggregation in Aru, researchers analyzed the extent of the fisheries' impact on genetic stocks. There are 17 genetic stocks throughout the Australasian region. Researchers found that the Bali fishery is impacting several green turtle stocks throughout the region, with few stocks unaffected, while the Torres Strait fishery, having a more local focus, affects the NGBR almost exclusively (Dethmers and Broderick 2003).

Fiji

Of the main threats to sea turtle populations around Fiji, mortalities due to the traditional harvesting of adults for ceremonial purposes, and subsistence and commercial harvesting of adults, eggs, and shells are significant. For example, approximately 30,000 hawksbill shells were exported during the 1980s, with approximately 2,000 kilograms of shells exported in just 1989. In addition, eggs have also been harvested for subsistence and commercial purposes. Hunting for sea turtles in Fiji has historically been relatively easy because it is generally unregulated and uncoordinated. Fijians have been prohibited from taking turtles and their eggs during the breeding season (December through March), and there was a moratorium on the killing of turtles and poaching of eggs (including trade of turtle meat and eggs) through December, 2000. As of 2002, the Department of Fisheries was hoping to extend this moratorium (Rupeni *et al*. 2002).

Australia

Green turtles are the primary species harvested by Aboriginal/Torres Strait Islander people in the Great Barrier Reef, and although we do not have accurate records of the total number of green turtles harvested, anecdotal information indicates that the number of traditionally harvested turtles per annum is probably in the low hundreds (Dobbs pers. comm. 2008).

Philippines

Despite a significant increase in conservation awareness, turtles are still killed and sold for their meat and eggs are also taken and sold.

Other Federal Activities

The U.S. Department of the Interior established a National Wildlife Refuge in and around Palmyra in 2001, thus placing the atoll under the jurisdiction of the U.S. Fish and Wildlife

Service (USFWS). Including most of Palmyra Atoll and its surrounding marine ecosystem out to 12 nautical miles, the PANWR was established to protect and preserve the natural character of fish, wildlife, plants, coral reef communities, and other resources associated with the emergent, tidal, and submerged lands and waters of the atoll. In recent years Palmyra has been uninhabited except for management or research personnel, including members of the multi-institutional Palmyra Atoll Research Consortium (PARC), which carries out integrative studies of biodiversity and environmental physics along the Atoll. However, when the U.S. Government and others occupied the Atoll during World War II, Palmyra was heavily altered to improve its utility as a military base. Extensive dredging and connection of the islets that made up the Atoll into causeways changed the hydrological and oceanographic features of the Atoll.

Vessel Activities. Potential sources of adverse effects from federal vessel operations in the action area and throughout the range of sea turtles include operations of the U.S. Navy (USN) and Coast Guard (USCG), which maintain the largest Federal vessel fleets, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and the Army Corps of Engineer (COE). NMFS has conducted formal consultations with the USCG, the USN, and NOAA on their vessel operations. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. At the present time, however, they present the potential for some level of interaction.

Since the USN consultation only covered operations out of Mayport, Florida, potential still remains for USN vessels to adversely affect sea turtles when they are operating in other areas within the range of these species. Similarly, operations of vessels by other Federal agencies within or near the action area (NOAA, EPA, COE) may adversely affect sea turtles. However, the in-water activities of those agencies are limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

Private and commercial vessel operations also have the potential to interact with sea turtles. For example, shipping traffic in Massachusetts Bay is estimated at 1,200 ship crossings per year with an average of three per day. Similar traffic may exist in many other areas where sea turtles occur. The invention and popularization of new technology resulting in high speed catamarans for ferry services and whale watch vessels operating in congested coastal areas contributes to the potential for impacts from privately-operated vessels. In addition to commercial traffic and recreational pursuits, private vessels participate in high speed marine events concentrated in the southeastern United States that are a particular threat to sea turtles. The magnitude of these marine events is not currently known. The sea turtle stranding network (STSSN) also reports many records of vessel interaction (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic.

Other Military Activities. Potential sources of adverse effects to sea turtles from Federal vessel operations in the action area include operations of the U.S. Navy (USN), U.S. Coast Guard (USCG), Environmental Protection Agency (EPA), Army Corps of Engineers (ACOE), and NOAA to name a few. NMFS has previously conducted formal consultations with the USN, USCG, and NOAA on their vessel-based operations. NMFS has also conducted section 7 consultations with the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), Federal Energy Regulatory Commission (FERC), and Maritime Administration (MARAD) on vessel traffic related to energy projects in the Northeast Region and has implemented conservation measures. Through the section 7 process, where applicable, NMFS has and will continue to identify conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. Several Opinions for the USN activities (NMFS 1996, 1997, 2006b, 2008c, 2009a,b) and USCG (NMFS 1995, 1998c) contain details on the scope of vessel operations for these agencies and the conservation measures that are being implemented as standard operating procedures.

NMFS has conducted section 7 consultations on USN explosive ordnance disposal, mine warfare, sonar testing (e.g., AFAST, SURTASS LFA), and other major training exercises (e.g., bombing, Naval gunfire, combat search and rescue, anti-submarine warfare, and torpedo and missile exercises) in the Pacific Ocean. These consultations have determined that the proposed USN activities may adversely affect but would not jeopardize the continued existence of ESA-listed sea turtles (NMFS 2008c, 2009a,b).

Similarly, operations of vessels by other Federal agencies within the action area (NOAA, EPA, and ACOE) may adversely affect ESA-listed sea turtles. However, vessel activities of those agencies are often limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

Navigation Channel Dredging and Maintenance. The construction and maintenance of federal navigation channels has also been identified as a source of sea turtle mortality. Entrainment is the most imminent danger for sea turtles during hopper dredging operations. The National Research Council's Committee on Sea Turtle Conservation (1990) estimated that dredging mortalities, along with boat strikes, were second only to fishery interactions as a source of probable lethal takes of sea turtles. Experience has shown that injuries sustained by sea turtles entrained in hopper dredge dragheads are usually fatal. Mortality in hopper dredging operations most often occurs when turtles are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

Oil and Gas Exploration. The COE and the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) authorize oil and gas exploration, well development, production, and abandonment/rig removal activities that may adversely affect sea turtles. Both of these agencies have consulted numerously with the NMFS on these types of activities. NMFS anticipates incidental takes of sea turtles from vessel strikes, noise, marine debris, and the use of explosives to remove oil and gas structures. The impacts of oil contamination on the environment are further discussed under *Environmental Contamination* to the *Baseline.*

Electrical Generating Plants. Another action with federal oversight (the Federal Energy Regulatory Commission and the Nuclear Regulatory Agency) impacting sea turtles is the operation of electrical generating plants. Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants, though it is important to note that almost all of the turtles are caught and released alive; NMFS estimates the survival rate at 98.5% or greater (NMFS 1997).

State or Private Actions

State Fisheries. Various fishing methods used in state fisheries, including trawling, pot fisheries, fly nets, and gillnets are known to incidentally take listed species, but information on these fisheries is sparse (NMFS SEFSC 2001). Although few of these state regulated fisheries are currently authorized to incidentally take listed species, several state agencies have approached NMFS to discuss applications for a section 10(a)(1)(B) incidental take permit. Since NMFS' issuance of a section 10(a)(1)(B) permit requires formal consultation under section 7 of the ESA, the effects of these activities are considered in section 7 consultation. Any fisheries that come under a section 10(a)(1)(B) permit in the future will likewise be subject to section 7 consultation. Although the past and current effects of these fisheries on listed species is currently not determinable, NMFS believes that ongoing state fishing activities may be responsible for seasonally high levels of observed strandings of sea turtles. Most of the state data are based on extremely low observer coverage or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem. In addition to the lack of interaction data, there is another issue that complicates the analysis of impacts to sea turtles from these fisheries. Certain gear types may have high levels of sea turtle takes, but very low rates of serious injury or mortality. For example, the hook and line takes rarely result in death, but trawls and gillnets frequently do. Leatherbacks seem to be susceptible to a more restricted list of fisheries, while the hard shelled turtles, particularly loggerheads, seem to appear in data on almost all of the state fisheries.

Recreational fishermen have reported hooking turtles when fishing from boats, piers, and beach, banks, and jetties. Commercial fishermen fishing for reef fish and for sharks with both single rigs and bottom longlines have also reported hooked turtles (NMFS 2001). A detailed summary of the known impacts of hook and line incidental captures to loggerhead sea turtles can be found in the TEWG reports (1998, 2000).

Vessel Traffic. Commercial traffic and recreational pursuits can adversely effect sea turtles through propeller and boat strikes. Turtles swimming or feeding at or just beneath the surface of the water are particularly vulnerable to boat and vessel strikes, which can result in serious propeller injuries and death (Hazel *et al.* 2007). Boat collisions may pose a threat to sea turtles in the action area although NMFS is unclear to what extent. The magnitude of these marine events is not currently known.

Other Potential Sources of Impacts in the Baseline

Significant anthropogenic impacts threaten nesting populations of all species in areas within as well as outside of the U.S. These impacts include poaching of eggs, immatures and adults as well as beach development problems. The impacts from these activities are difficult to measure.

Habitat Loss. Loss or degradation of nesting habitat resulting from erosion control through beach nourishment and armoring, beachfront development, artificial lighting, and non-native vegetation is a serious threat affecting nesting females and hatchlings. Although beach nourishment, or placing sand on beaches, may provide more sand, the quality of that sand, and hence the nesting beach, may be less suitable than pre-existing natural beaches. Sub-optimal nesting habitat may cause decreased nesting success, place an increased energy burden on nesting females, result in abnormal nest construction, and reduce the survivorship of eggs and hatchlings (Mann 1977; Ackerman 1980; Mortimer 1990).

Beach armoring (e.g., bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, and geotextile tubes) can impede a turtle's access to upper regions of the beach/dune system, thereby limiting the amount of available nesting habitat (Mazaris et al. 2009). Impacts also can occur if structures are installed during the nesting season. For example, unmarked nests can be crushed or uncovered by heavy equipment, nesting turtles and hatchlings can get caught in construction debris or excavations, and hatchlings can get trapped in holes or crevices of exposed riprap and geotextile tubes. In many areas of the world, sand mining (removal of beach sand for upland construction) seriously reduce or degrade/destroy sea turtle nesting habitats or interfere with hatchling movement to sea (NMFS 2003).

Artificial lighting on or near the beach adversely affects both nesting and hatchling sea turtles. Specifically, artificial lighting may deter adult female turtles from emerging from the ocean to nest and can disorient or misorient emerging hatchlings away from the ocean (Ehrhart 1983, Salmon and Witherington 1995). Hatchlings have a tendency to orient toward the brightest direction, which on natural, undeveloped beaches is commonly toward the broad open horizon of the sea. However, on developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Peters and Verhoeven 1994; Salmon et al. 1995). Hatchlings lured into lighted parking lots or toward streetlights can get crushed by passing vehicles. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

Marine Debris. Ingestion of marine debris can be a serious threat to sea turtles. Sea turtles living in the pelagic (open ocean) environment commonly ingest or become entangled in marine debris (e.g., tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear) as they feed along oceanographic fronts, where debris and their natural food items converge (Bugoni *et al.* 2001; Pichel *et al.* 2007; Mrosovsky *et al.* 2009). This is especially problematic for turtles that spend all or significant portions of their life cycle in the pelagic environment (e.g., leatherbacks, juvenile loggerheads, and juvenile green turtles). Some types of marine debris may be directly or indirectly toxic to sea turtles on their migration to (and potentially within) the action area, such as oil. Turtles can become entangled in derelict gillnets, pound nets, and the lines associated with longline and trap/pot fishing gear. Turtles entangled in these types of fishing gear may drown and often suffer serious injuries to their flippers from constriction by the lines or ropes.

Environmental Contamination. Coastal runoff and river discharges carry large volumes of petrochemical and other contaminants from agricultural activities, cities and industries into the oceans. Marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise and boat traffic can degrade marine habitats used by sea turtles (Colburn *et al*. 1996). The development of marinas and docks in inshore waters can negatively impact nearshore habitats. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations do not likely affect the more pelagic waters, the species of turtles analyzed in this Opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

Petrochemicals can impact wildlife directly through three primary pathways: ingestion – when animals swallow oil particles directly or consume prey items that have been exposed to oil, absorption – when animals come into direct contact with oil, and inhalation – when animals breath volatile organics released from oil or from “dispersants” applied by response teams (spill) in an effort to increase the rate of degradation of the oil in seawater. Several aspects of sea turtle biology and behavior place them at particular risk, including the lack of avoidance behavior, indiscriminate feeding in convergence zones, and large predive inhalations (Milton *et al.* 2003). When large quantities of oil enter a body of water, chronic effects such as cancer, and direct mortality of wildlife becomes more likely (Lutcavage *et al.* 1997). Oil spills in the vicinity of nesting beaches just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts and McGehee 1982; Lutcavage *et al*. 1997; Witherington 1999). Continuous low-level exposure to oil in the form of tarballs, slicks, or elevated background concentrations also challenge animals facing other natural and anthropogenic stresses. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease (Keller *et al.* 2004, 2006). Chronic exposure may not be lethal by itself, but it may impair a turtle’s overall fitness so that it is less able to withstand other stressors (Milton *et al.* 2003).

The earlier life stages of living marine resources are usually at greater risk from an oil spill than adults, especially true for hatchlings, since they spend a greater portion of their time at the sea surface than adults, their risk of exposure to floating oil slicks is increased (Lutcavage *et al*. 1995). One of the reasons might be the simple effects of scale: for example, a given amount of oil may overwhelm a smaller immature organism relative to the larger adult. The metabolic machinery an animal uses to detoxify or cleanse itself of a contaminant may not be fully developed in younger life stages. Also, in early life stages, animals may contain proportionally higher concentrations of lipids, to which many contaminants such as petroleum hydrocarbons bind. Most reports of oiled hatchlings originate from convergence zones, ocean areas where currents meet to form collection points for material at or near the surface of the water. Sixty-five of 103 post-hatchling loggerheads in convergence zones off Florida's east coast were found with tar in the mouth, esophagus or stomach (Loehefener *et al*. 1989). Thirty-four percent of post-hatchlings captured in Sargassum off the Florida coast had tar in the mouth or esophagus and more than 50% had tar caked in their jaws (Witherington 1994). These zones aggregate oil slicks, such as a Langmuir cell, where surface currents collide before pushing down and around, and represents a virtually closed system where a smaller weaker sea turtle can easily become trapped (Witherington 2002; Carr 1987). Lutz (1989) reported that hatchlings have been found apparently starved to death, their beaks and esophagi blocked with tarballs. Hatchlings sticky with oil residue may have a more difficult time crawling and swimming, rendering them more vulnerable to predation.

Frazier (1980) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell apparently plays an important role in navigation and orientation. A related problem is the possibility that an oil spill impacting nesting beaches may affect the locational imprinting of hatchlings, and thus impair their ability to return to their natal beaches to breed and nest (Milton *et al.* 2003). Whether hatchlings, juveniles, or adults, tarballs in a turtle's gut are likely to have a variety of effects – starvation from gut blockage, decreased absorption efficiency, absorption of toxins, effects of general intestinal blockage (such as local necrosis or ulceration), interference with fat metabolism, and buoyancy problems caused by the buildup of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats), among others. Also, trapped oil can kill the seagrass beds that turtles feed upon.

There are studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Aguirre *et al.* 1994; Caurant *et al.* 1999; Corsolini *et al.* 2000). Mckenzie *et al.* (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtles tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles (Storelli *et al.* 2008). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai et al (1995) found the presence of metal residues occurring in loggerhead turtle organs and eggs. Storelli et al (1998) analyzed tissues from twelve loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises (Law *et al.* 1991). No information on detrimental threshold concentrations are available, and little is known about the consequences of exposure of organochlorine compounds to sea turtles. Research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

Nutrient loading from land-based sources, such as coastal communities and agricultural operations, are known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. An example is the large area of the Louisiana continental shelf with seasonally-depleted oxygen levels (<2mg/i) is caused by eutrophication from both point and non-point sources. Most aquatic species cannot survive at such low oxygen levels and these areas are known as "dead zones." The oxygen depletion, referred to as hypoxia, begins in late spring, reaches a maximum in midsummer, and disappears in the fall. Since 1993, the average extent of mid-summer bottom-water hypoxia in the northern GOM has been approximately 16,000 km2, approximately twice the average size measured between 1985 and 1992. The hypoxic zone attained a maximum measured extent in 2002, when it was about 22,000 km^2 which is largest than the state of Massachusetts (U.S. Geological Service, 2005). The hypoxic zone has impacts on the animals found there, including sea turtles, and the ecosystem-level impacts continue to be investigated.

Disease. A disease known as fibropapilloma (FP), is a major threat to green turtles in some areas of the world. FP is characterized by tumorous growths, which can range in size from very small to extremely large, and are found both internally and externally. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley *et al.* 2005). FP was first described in green turtles in the Florida Keys in the 1930s. Since then it has been recorded in many green turtle populations around the world, most notably present in green turtles of Hawaii, Florida, and the Caribbean. In Florida, up to 50% of the immature green turtles captured in the Indian River Lagoon are infected, and there are similar reports from other sites in Florida, including Florida Bay, as well as from Puerto Rico and the U.S. Virgin Islands. In addition, scientists have documented FP in populations of loggerhead, olive ridley, and leatherback turtles (Huerta *et al.* 2002). The effects of FP at the population level are not well understood and could be a serious threat to their recovery. The cause of the disease remains unknown. Research to determine the cause of this disease is a high priority and is underway.

*Impacts from non-native species introductions***.** An increased human presence at some nesting beaches or close to nesting beaches has lead to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (e.g. raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Non-native vegetation has invaded many coastal areas and often outcompetes native species. Non-native vegetation is usually less-stabilizing and can lead to increased erosion and degradation of suitable nesting habitat. Non-native vegetation may also form impenetrable root mats that can prevent proper nest cavity excavation, invade and desiccate eggs, or trap hatchlings. In light of these issues, conservation and long-term protection of sea turtle nesting and foraging habitats is an urgent and high priority need.

Acoustic impacts. NMFS and the USN have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment. Acoustic impacts to sea turtles can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. There are other more indirect factors; for a complete list refer to NMFS SEFSC (2001).

International. For sea turtle species in the Pacific, international activities, particularly fisheries, are significant factors impacting populations. NMFS estimates that, each year, thousands of sea turtles of all species are incidentally caught and a proportion of them killed incidentally or intentionally by international activities. The impact of international fisheries is a significant

factor in the baseline inhibiting sea turtle recovery. Additional information on the impacts of international fisheries is found in NMFS SEFSC (2001) and Lewison *et al.* (2004).
Global climate change. There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities. Some of the likely effects commonly mentioned' are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The EPA's climate change webpage provides basic background information on these and other measured or anticipated effects (see www. epa.gov/climatechange/index.html). Activities in the action area that may have contributed to global warming include the combustion of fossil fuels by vessels.

The effects of global climate change on sea turtles is typically viewed as being detrimental to the species (NMFS and USFWS 2007a; 2007b; 2007c; 2007d). It is believed that increases in sea level, approximately 4.2 mm per year until 2080, have the potential to remove available nesting beaches, particularly on narrow low lying coastal and inland beaches and on beaches where coastal development has occurred (Church *et al.* 2001; IPCC 2007; Nicholls 1998; Fish *et al.* 2005; Baker *et al.* 2006; Jones *et al.* 2007; Mazaris *et al.* 2009). Additionally, global climate change may affect the severity of extreme weather (e.g., hurricanes), with more intense storms expected, which may result in the loss/erosion of or damage to shorelines, and therefore, the loss of potential sea turtle nests and/or nesting sites (Goldenburg *et al.* 2001; Webster *et al. 2005;* IPCC 2007). The cyclical loss of nesting beaches resulting from extreme storm events may then result in a decrease in hatching success and hatchling emergence (Martin 1996; Ross 2005; Pike and Stiner 2007; Prusty *et al.* 2007; Van Houton and Bass 2007). However, there is evidence that, depending on the species, sea turtles species with lower nest site fidelity (i.e., leatherbacks) would be less vulnerable to storm related threats than those with a higher site fidelity (i.e., loggerheads). In fact, it has been reported that sea turtles in Guiana are able to maintain successful nesting despite the fact that between nesting years some beaches they once nested on have disappeared, suggesting that sea turtle species may be able to behavioral adapt to such changes (Pike and Stiner 2007; Witt *et al.* 2008; Plaziat and Augustinius 2004; Girondot and Fretey 1996; Rivalan *et al.* 2005; Kelle *et al. 2007).*

Changes in water temperature are also expected as a result of global climate change. Changes in water temperature are expected affect water circulation patterns perhaps even to the extent that the Gulf Stream is disrupted, which would have profound effects on every aspect of sea turtle life history from hatching success, oceanic migrations at all life stages, foraging, and nesting. (Gagosian 2003; NMFS and USFWS 2007a; 2007b; 2007c; 2007d; Rahmstorf 1997, 1999; Stocker and Schmittner 1997). Thermocline circulation patterns are expected to change in intensity and direction with changes in temperature and freshwater input at the poles (Rahmstorf 1997; Stocker and Schmittner 1997), which will potentially affect not only hatchlings, which rely on passive transport in surface currents for migration and dispersal but also pelagic adults (i.e., leatherbacks) and juveniles, which depend on current patterns and major frontal zones in obtaining suitable prey, such as jellyfish (Hamann *et al.* 2007; Hawkes *et al. 2009).*

Changes in water temperature may also affect prey availability for species of sea turtles. Herbivorous species, such as the green sea turtle, depend primarily on seagrasses as their forage base. Seagrasses could ultimately be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Short and Neckles 1999; Bjork *et al.* 2008), as well as increased runoff due the expected increase in extreme storm events as a result of global climate change. These alterations of the marine environment due to global climate change could ultimately affect the distribution, physiology, and growth rates of seagrasses, potentially eliminating them from particular areas. However, the magnitude of these effects on seagrass beds, and therefore green sea turtles, are difficult to predict, although some populations of green sea turtles appear to specialize in the consumption of algae (Bjorndal 1997) and mangroves (Limpus and Limpus 2000) and as such, green sea turtles may be able to adapt their foraging behavior to the changing availability of seagrasses in the future. Omnivorous species, such as Kemp's ridley and loggerhead sea turtles, may face changes to benthic communities as a result of changes to water temperature; however, these species are probably less likely to suffer shortages of prey than species with more specific diets (i.e., green sea turtles) (Hawkes *et al. 2009).*

Several studies have also investigated the effects of changes in sea surface temperature and air temperatures on turtle reproductive behavior. For loggerhead sea turtles, warmer sea surface temperatures in the spring have been correlated to an earlier onset of nesting (Weishampel *et al.* 2004; Hawkes *et al.* 2007), shorter internesting intervals (Hays *et al.* 2002), and a decrease in the length of the nesting season (Pike *et al.* 2006). Green sea turtles also exhibited shorter internesting intervals in response to warming water temperatures (Hays *et al.* 2002*).*
Air temperatures also play a role in sea turtle reproduction. In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35° C (Ackerman 1997). Based on modeling done of loggerhead sea turtles, a 2° C increase in air temperature is expected to result in a sex ratio of over 80% female offspring for loggerhead nesting beaches in the vicinity of Southport, NC. Farther to the south at Cape Canaveral, Florida, a 2°C increase in air temperature would likely result in production of 100% females while a 3°C increase in air temperature would likely exceed the thermal threshold of turtle clutches (i.e., greater than 35° C) resulting in death (Hawkes *et al.* 2007). Glen et al. (2003) also reported that, for green sea turtles, incubation temperatures also appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures; however, it is unknown whether this effect is species specific and what impact it has on the survival of the offspring. Thus changes in air temperature as a result of global climate change may alter sex ratios and may reduce hatchling production in the most southern nesting areas of the U.S. (Hawkes et al. 2007; Hamann *et al.* 2007). Given that the south Florida nesting group is the largest loggerhead nesting group in the Atlantic (in terms of nests laid), a decline in the success of nesting as a result of global climate change could have profound effects on the abundance and distribution of the loggerhead species in the Atlantic, however; variation of sex ratios to incubation temperature between individuals and populations is not fully understood and as such, it is unclear whether sea turtles will (or can) adapt behaviorally to alter incubation conditions to counter potential feminization or death of clutches associated with water temperatures (e.g., choosing nest sites that are located in cooler areas, such as shaded areas of vegetation or higher latitudes; nesting earlier or later during cooler periods of the year) (Hawkes *et al. 2009*).

Ocean acidification related to global warming would also reasonably be expected to negatively affect sea turtles. The term "ocean acidification" describes the process of ocean water becoming corrosive as a result of carbon dioxide ($C0_2$) having been absorbed from the atmosphere. The absorption of atmospheric CO_2 into the ocean lowers the pH of the waters. Evidence of corrosive water caused by the ocean's absorption of $C0_2$ was found less than 20 miles off the West coast of North America during a field study from Canada to Mexico in the summer of 2007 (Feely *et al.* 2008). This was the first time "acidified" ocean water was found on the continental shelf of western North America. While the ocean's absorption of $C0_2$ provides a great service to humans by significantly reducing the amount of greenhouse gases in the atmosphere and decreasing the effects of global warming, the resulting change in ocean chemistry could adversely affect marine life, particularly organisms with calcium carbonate shells such as corals, mussels, mollusks, and small creatures in the early stages of the food chain (*e.g.,* plankton). A number of these organisms serve as important prey items for sea turtles.

Although potential effects of climate change on sea turtle species are currently being addressed, fully understanding the effects of climate change on listed species of sea turtles will require development of conceptual and predictive models of the effects of climate change on sea turtles, which to date are still being developed and will depend greatly on the continued acquisition and maintenance of long-term data sets on sea turtle life history and responses to environmental changes. Until such time, the type and extent of effects to sea turtles as a result of global climate change are will continue to be speculative and as such, the effects of these changes on sea turtles cannot, for the most part, be accurately predicted at this time.

Other ESA Section 10 Sea Turtle Permits.
Regulations developed under the ESA allow for the issuance of permits allowing take of certain ESA-listed species for the purposes of scientific research under Section 10(a)(1)(a) of the ESA. In addition, the ESA allows for the NMFS to enter into cooperative agreements with states developed under Section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with Section 7 of the ESA.

Sea turtles are the focus of research activities authorized by a Section 10 permit under the ESA. As of November 2011, there were 4 active scientific research permits (excluding the current permits the researchers hold 1556 &1581 that expire once the new permit is authorized) issued for the target sea turtle species in the central Pacific. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, blood sampling, tissue sampling (biopsy), lavage, and carapace marking/etching on intentionally captured turtles. The number of authorized takes varies widely depending on the research and species involved but may involve the taking of hundreds of turtles annually. Most of takes authorized under these permits are expected to be non-lethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations. However, it should be noted that while research permits may result in minor (relative to other activities such as fisheries) negative impacts to targeted individuals, these permits also yield positive impacts to these species by aiding the conservation, recovery and management of sea turtles.

In addition, since issuance of the permit is a federal activity, issuance of the permit by the NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species. However, despite these safeguards research activity may result in cumulative effects on sea turtle populations.

Conservation and Recovery Actions Shaping the Environmental Baseline

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Fishing Statistical Survey (MRFSS). The summaries below discuss all of these measures in more detail.

— Baja, Mexico halibut gillnet fishery:
Under this contract, Wildcoast would conduct mortality reduction workshops with fishermen and place observers on local boats to insure that all the live loggerheads that comprise the estimated 3,000 loggerhead juveniles per year caught in the halibut gillnets are returned to the ocean (TAC 2003, P. Dutton, NMFS SWFSC). Without observers, these loggerheads become part of the catch.

— Costa Rica
A contract has been developed with the Ostional National Wildlife Refuge in Costa Rica to help refuge managers to convene workshops to reduce sea turtle mortalities in longline fisheries based in Costa Rica.

NMFS has provided funding to support leatherback nesting beach work on the eastern Pacific coast of this country to evaluate nesting and to reduce the loss of nests due to poaching of eggs. These efforts are also benefitting green and olive ridley turtles that use these same beaches.

Sea Turtle Handling and Resuscitation Techniques
NMFS published a final rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear.

Outreach and Education, Sea Turtle Entanglements, and Rehabilitation
There is an extensive network of Sea Turtle Stranding and Salvage Network participants along the Atlantic and Gulf of Mexico coasts who not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the U.S. Coast Guard, or any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA [50 CFR 223.206(b)].

Other Actions
A recovery plan for the loggerhead sea turtle was published December 2008 (74 FR 2995). A draft revised recovery plan for the Kemp's ridley sea turtle was published March 2010 (75 FR 12496). Recovery teams comprised of sea turtle experts have been convened and are currently working towards revising these plans based upon the latest and best available information. Five-year status reviews have been completed for green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles. These reviews were conducted to comply with the ESA mandate for periodic status evaluation of listed species to ensure that their threatened or endangered listing status remains accurate. Each review determined that no delisting or reclassification of a species status (i.e., threatened or endangered) was warranted at this time. However, further review of species data for the green, hawksbill, and leatherback was recommended, to evaluate whether distinct population segments (DPS) should be established for these species (NMFS and USFWS 2007a-e). The final rule to list nine distinct population segments (DPSs) of Loggerhead sea turtles under the ESA was published September 22 2011(76 FR 58868).

Effects of the Proposed Action

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. Direct adverse effects of the permitted activities on listed species that are within the action area would include disruption of feeding, breeding, resting and other behaviors. Some displacement may result from these activities. The duration of the behavioral disruptions and displacements are expected to vary by species and type of disturbance.

In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed action, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent.

For this consultation, we are particularly concerned about behavioral disruptions that may result in listed sea turtles 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, harass is defined by USFWS 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 that are essential to sea turtles' life history or its contribution to the population the animal represents.

The purpose of this assessment is, then, to determine if it is reasonable to expect that the research, as conducted under the permits, can be expected to have direct or indirect effects on threatened and endangered sea turtle species that appreciably reduce their likelihood of surviving and recovering in the wild or result in destruction or adverse modification of critical habitat. Including assessing the direct and indirect effect of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). Jeopardy analyses compare reductions in a species' likelihood of surviving and recovering in the wild associated with a *specific* action with the species' likelihood of surviving and recovering in the wild that was established in the *Status of the Species* section of an Opinion. Jeopardy analyses also consider the importance of the action area to a listed species and the effects of other human actions and natural phenomena (that were summarized in the *Environmental Baseline)* on a species' likelihood of surviving and recovering in the wild. As a result, jeopardy analyses in biological opinions distinguish between the effects of a specific action on a species' likelihood of surviving and recovering in the wild and a species' background likelihood of surviving and recovering given the full set of human actions and natural phenomena that threaten a species.

This section will assess the types of effects that are expected from the proposed action, the extent of those effects, and the overall impact of those effects on sea turtle populations.

Standards Used in Effects Analysis

The analyses in this Opinion are based on an implicit understanding that the listed sea turtle species considered in this Opinion are threatened or endangered with local or global extinction by a wide array of human activities and natural phenomena. We have outlined many of those activities in the *Status of the Species* section of this Opinion. NMFS also recognizes that some of these other human activities and natural phenomena pose serious threats to the survival of these listed species (and other flora and fauna). Further, NMFS recognizes that such species will not recover without addressing the full range of human activities and natural phenomena such as patterns of beach erosion, predation on turtle eggs, and turtle captures, injuries, and deaths in other domestic and international fisheries and other State, federal, and private activities that could cause these animals to become extinct in the foreseeable future.

Nevertheless, this Opinion focuses solely on whether the direct and indirect effects of the proposed action can be expected to appreciably reduce the listed sea turtles' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution or would result in a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Jeopardy analyses in biological opinions distinguish between the effects of a specific action on a species' likelihood of surviving and recovering in the wild and a species' background likelihood of surviving and recovering given the full set of human actions and natural phenomena that threaten a species.

This Opinion treats sea turtle populations in the Atlantic Ocean as distinct from the Pacific Ocean populations for the purposes of this consultation. This approach is also consistent with traditional jeopardy analyses: the loss of sea turtle populations in the Atlantic basin would result in a significant gap in the distribution of each turtle species, which makes these populations biologically significant. Finally, the loss of these sea turtle populations in the Atlantic basin would dramatically reduce the distribution and abundance of these species and would, by itself, appreciably reduce the entire species' likelihood of surviving and recovering in the wild.

Conservative Decisions- Providing the Benefit of the Doubt to the Species
The analysis in this section is based upon the best available commercial and scientific data on sea turtle biology and the effects of the proposed action. However, there are instances where there is limited information upon which to make a determination. 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 will generally make determinations which provide the most conservative outcome for listed species.

Exposure Analyses

Exposure analyses identify the co-occurrence of ESA-listed species within the action's effects in space and time, and identify the nature of that co-occurrence. They identify as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the population(s) or subpopulation(s) those individuals represent. Individuals exposed may be of either sex or of any age.

The proposed action will expose listed sea turtle species to disturbance from boat, capture, sampling and collection activities. The applicants have requested authorization to annually sample green and hawksbill sea turtles within nearshore habitats off the Northern Mariana Islands (NMI), the Main Hawaiian Islands, and Palmyra Atoll. Animals will be measured, flipper and passive integrated transponder (PIT) tagged, sonic tagged, blood, skin and carapace sampled, lavaged, weighed, carapace marked (temporarily) and released. Since these species are highly mobile, and because the proposed activities are to take place at multiple times of year, individual listed species may suffer repeated exposures.

Response Analyses

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

The responses by animals to human disturbance are similar to their responses to potential predators (Beale and Monaghan, 2004; Frid, 2003; Frid and Dill, 2002; Gill and Sutherland, 2001; Harrington and Veitch, 1992; Lima, 1998; Romero, 2004). These responses include interruptions of essential behavior and physiological processes such as feeding, mating, resting, digestion etc. This can result in stress, injury and increased susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker et al., 2006).

Capture

Turtles may exhibit respiratory and metabolic stress, particularly if turtle is chased and /or forced to remain submerged (swimming or evasive behavior to avoid capture). Metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. While most voluntary dives appear to be aerobic, showing little if any increases in blood lactate and only minor changes in acid-base status, the effects are quite different in forcibly submerged turtles where oxygen stores are rapidly consumed, anaerobic glycolysis is activated, and acid-base balance is disturbed, sometimes to lethal levels (Lutcavage and Lutz 1997). Forced submergence of Kemp's ridley sea turtles in shrimp trawls resulted in an acid-base imbalance after just a few minutes (times that were within the normal dive times for the species) (Stabenau et al. 1991) and recovery times for acid-base levels to return to normal may be prolonged as long as 20 hours or more (Henwood and Stuntz 1987). This effect is expected to be worse for sea turtles that are recaptured before metabolic levels have returned to normal. Respiratory and metabolic stress due to forced submergence is also correlated with additional factors such as size and activity of the turtle, water temperatures, and biological and behavioral differences between species.

Capture by hand or scoop net can result in raised levels of stressor hormones. The harassment of individual turtles during capture and handling could disrupt their normal activities (e.g., foraging cycle). However, these capture methods are simple and not invasive. The turtles would be held in a manner to minimize the stress to them. If done correctly, with minimal pursuing of the animals in chase, the effects are of hand capture or scoop net would be expected to be minimal. NMFS expects that individual turtles would experience no more than short-term stresses during these types of capture activities and that these stresses would dissipate within a short period of time. Divers would capture one turtle at a time. SCUBA would be used in deeper waters and divers would not chase or wrestle the turtles to avoid prolonged submergence or stress on the animal. NMFS expects no mortalities or serious injuries from these capture activities.

Entanglement nets would be expected to result in some level of forced submergence. This could result in stresses due to interaction with the tangle net gear. Turtles can be affected by entanglement in the nets and/or drowning as a result of the forced submergence (Sasso and Epperly 2006). Sea turtles are particularly prone to entanglement as a result of their body configuration and behavior. Records of stranded or entangled sea turtles reveal that fishing debris can wrap around the neck or flipper, or body of a sea turtle and severely restrict swimming or feeding. Sea turtles may also experience constriction of appendages as a result of the entanglement. Constriction may cut off blood flow, causing deep gashes, some severe enough to remove an appendage. To minimize the potential for adverse impact on the turtles, when nets are in the water they would be constantly monitored, so that any turtle caught would be quickly retrieved. In addition, several field personnel would be in the water during all capture activities (hand capture and tangle netting) to ensure that stress to the animal is minimized during capture. A veterinarian would be on call during all capture activities in the event veterinary consultation is required. If a turtle is encountered in a comatose state, researchers would immediately commence resuscitation techniques. Since the nets will be manned at all times and turtles will be immediately removed, the risks to the turtles are expected to be greatly reduced and the effects of the entanglement and forced submergence are expected to dissipate within a day (Stabenau and Vietti 1999). No mortalities or injuries are expected as a result of the capture.

Measuring, Photographing, and Weighing

These procedures are simple and not invasive. Measuring will be done using a calipers and tape measure. Turtles will be weighed by placing them in a net and weighing them with a spring scale. The applicant will use non-toxic paints that do not contain zylene or toulene, and will be applied without crossing suture lines. Also, the applicant will not use paints with exothermic set-up reactions to avoid any effects from heat that could affect the turtle as the paint cures.

NOAA Fisheries does not expect that individual turtles will experience more than short-term stresses during the measuring, weighing, or photographing process. No injury is expected from these activities. As discussed above, turtles will be worked up as quickly as possible to minimize stresses resulting from their capture. The applicant will also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals.

Handling, measuring, photographing, and weighing can result in raised levels of stressor hormones in sea turtles. The additional on-board holding time imposes an additional stressor on these already acidotic turtles (Hoopes *et al.* 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler *et al.* 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate production. However, the handling, measuring, photographing, carapace painting and weighing procedures are simple, non-invasive, with a relatively short time period and NMFS does not expect that individual turtles would normally experience more than short-term stresses as a result of these activities. No injury is expected from these activities, and turtles will be worked up as quickly as possible to minimize stresses resulting from their capture.

Shell Etching and Painting

Because the keratin layer has no nerve endings or blood vessels, shallow shell etchings would not be expected to result in bleeding, discomfort or pain to the turtle. Etched areas would grow back within a year or so (Balazs 2004). Dozens of sea turtle researchers have used painting successfully for many years with no visible effects to turtles. In the case of paint, it would be non-toxic, would not contain xylene or toluene, and would not generate heat as it cures. Previous permit holders, such as Dr. Wyneken (Permit No. 1397), reported that paint marks wore off of the shell within weeks and showed no evidence of any problems associated with it. NMFS does not expect that individual turtles would normally experience more than short-term stresses as a result of these activities. No injury is expected from these activities, and turtles will be worked up as quickly as possible to minimize stresses resulting from their shell etching and painting.

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

PIT tags have been used with a wide variety of animal species that include fish (Clugston 1996; Skalski *et al.* 1998; Dare 2003), amphibians (Thompson 2004), reptiles (Cheatwood *et al.* 2003; Germano and Williams 2005), birds (Boisvert and Sherry 2000; Green *et al.* 2004), and mammals (Wright *et al.* 1998; Aguirre *et al.* 2002). PIT tags have the advantage of being encased in glass, which makes them inert, and are positioned inside the turtle where loss or damage due to abrasion, breakage, corrosion or age over time is virtually non-existent (Balazs 1999; Braun-McNeill et al. 2003). Also with PIT tagging, there is a lower rate of loss than with conventional methods, possibly leading to less retagging, and hence reduced interference as well as data of increased reliability and scientific value (Broderick and Godley 1999). When PIT tags are inserted into animals that have large body sizes relative to the size of the tag, empirical studies have generally demonstrated that the tags have no adverse effect on the growth, survival, reproductive success, or behavior of individual animals (Skalski *et al.* 1998, Hockersmith *et al.* 2003). However, over time PIT tags can migrate within body tissue (van Dam and Diez 1999; Wyneken et al. 2010) making it necessary to scan the entire surface of the implantation area.

NMFS expects the stresses to be minimal and short-term, and that the small wound resulting from the insertion of the tag would heal completely in a short period of time. NMFS does not expect that individual turtles would experience more than short term stresses during the application of the PIT tags. The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999). No problems with tagging have been reported by any of the NMFS permit holders. In the many years that the NMFS Southeast Fisheries Science Center has been PIT-tagging turtles, turtle discomfort was observed to be temporary, as the turtles exhibit normal behavior shortly after tagging and swim normally after release. The applicant will also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals.

Gastric Lavage

The feeding habits of wild turtles can be determined by a variety of methods, but the preferred technique is gastric lavage or stomach flushing. This comparatively simple and reliable technique has been used to successfully sample the gut contents of various vertebrate animals groups without harm to the animal (Forbes 1999). Lavage can provided information on diets and how they relate to seasonal foraging and habitat use (Witherington 2000; Mayor *et al.* 1998) and can provide useful information aiding to the designation of critical habitat. This technique has been successfully used on green, hawksbill, olive ridley and loggerhead turtles ranging in size from 25 to 115 curved carapace length (CCL). Forbes (1999) states that many individual turtles have been lavaged more than three times without any known detrimental effect. Individuals have been recaptured from the day after the procedure up to three years later and appear healthy and feeding normally. Laparoscopic examination of the intestines following the procedure has not detected any swelling or damage to the intestines. While individual turtles are likely to experience discomfort during this procedure, NMFS does not expect individual turtles to experience more than short-term distress. Injuries are not anticipated. The applicant will also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals, including having separate lavage equipment for the sampling of turtles with and without FP, as well as on the size of the turtles.

The gastric sampling modification (forceps grasper method) could be potentially less traumatic and reduce possible dangers to sea turtles associated with the variable amount of fluids introduced during the normal gastric lavage methodology, which can lead to over-filling or aspiration of fluids. This modification does not introduce fluids for sampling. It has also shown (with some degree of success) to be a better method in obtaining stomach samples. Past sampling using this grasper method (27 green turtles in Palmyra), with 3 sampling attempts per turtle, were successful without any undue stress, bleeding or other trauma (except once where a single esophageal papilla was obtained). Since then the protocol has been modified to eliminate the possibility of it occurring again (pers. comm. Dr. T. Work, 2011).

Given how this modification is being used and the organs into which it is being introduced (esophagus and crop that both have a thick mucosa designed to resist abrasion), and will only be performed on green turtles, NMFS does not expect that individual turtles will experience more than short-term stresses during this forceps grasper method. The applicant would be required to follow the same previously mentioned procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals.

Blood, Carapace and Tissue Sampling
The permit would contain conditions to mitigate adverse impacts to turtles. The applicant would be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen during handling and sampling. It is not expected that individual turtles would experience more than short-term stresses during tissue sampling. SEFSC researchers who examined turtles caught 2 to 3 weeks after sample collection noted the sample collection site was almost completely healed (NMFS SEFSC 2008). During more than 5 years of tissue biopsying

using sterile techniques, NMFS SEFSC researchers have encountered no infections or mortality resulting from this procedure (NMFS SEFSC 2008).

NMFS does not expect that individual turtles will experience more than short-term stresses during blood or tissue sampling. Taking a blood sample from the sinuses in the dorsal side of the neck is now a routine procedure (Owens 1999), is a non-lethal and is not expected to have any sub-lethal effects. According to Owens (1999), with practice, it is possible to obtain a blood sample 95% of the time and the sample collection time should be about 30 seconds in duration. During the more than 5 years of tissue biopsying using sterile techniques, NMFS Southeast Fisheries Science Center researchers have encountered no infections or mortality resulting from this procedure (NMFS 2006). Bjorndal *et al*. (2010) found that turtles exhibited rapid healing at the tissue sampling site with no infection or scarring, and that the sampling did not adversely impact turtle physiology or health. Sample collection sites are always sterilized with alcohol or other antiseptic, prior to sampling and attempts will be limited. The permit would be conditioned to limit volume of blood sampled to only a conservative amount. Once the blood is collected, direct pressure would be applied to the site to ensure clotting and prevent subsequent blood hemorrhaging (Stoskopf 1993). Additionally, all of the researchers responsible for obtaining these samples will have received extensive experience in the procedure.

As stated above, this procedure is non-lethal and we do not expect this method to have sub-lethal effects. We acknowledge that pain, handling discomfort, possible hemorrhage at the site or risk of infection could occur, but procedure mitigation efforts (such as pressure and disinfection) lessen those possibilities. We believe that drawing blood or tissue biopsy in the manner described appears to have little probability of harming or producing sub-lethal effects as long as the procedure is conducted by an experienced biologist.

NMFS expects that the collection of a blood or tissue sample would cause minimal additional stress or discomfort to the turtle beyond that experienced during capture, collection of measurements, tagging, etc.

Fecal Sampling

NMFS does not expect individual turtles to experience more than short-term stresses and possibly some minor discomfort as a result of this activity. No injury or lasting effects are expected from this procedure. NMFS' Beaufort Laboratory conducted fecal sampling, and turtles exhibited normal behavior as they were released (NMFS SEFSC 2008).

Transmitters and Epoxy Attachment

Carapace-mounted transmitters would be attached to the turtles' scutes. A low-heat-producing marine epoxy or fiberglass resin and cloth would be used to attach equipment in order to prevent harm to the animal. Attachment of satellite, sonic, or radio tags with epoxy is a commonly used and permitted technique by NMFS. The permit would also require that the researchers provide adequate ventilation around the turtle's head during the attachment of all transmitters. To prevent skin or eye injury due to the chemicals in the resin, transmitter attachment procedures would not take place in the water.

In previous studies with these types of techniques, the actual attachment of the sonic tags has shown that that turtles would likely experience some small additional stress from attaching the transmitters, but not significant increases in stress or discomfort to the turtle beyond what was experienced during other research activities. Recaptured turtles previously tagged show very minimal to no signs of injury from the attachments (Keinath et al. 1989). The energetic costs of swimming for an instrumented turtle may be increased, resulting in major effects on activity, behavior, metabolism, habitat selection, and other key aspects of the animals' life history. Transmitters, as well as biofouling of the tag, attached to the carapace of turtles increase hydrodynamic drag and affect lift and pitch. For example, Watson and Granger (1998) performed wind tunnel tests on a full-scale juvenile green turtle and found that, at small flow angles representative of straight-line swimming, a transmitter mounted on the carapace increased drag by 27 to 30 percent, reduced lift by less than 10 percent, and increased pitch moment by 11 to 42 percent. It is likely that this type of transmitter attachment would negatively affect the swimming energetics of the turtle. However, based on the results of hardshell sea turtles equipped with this tag setup, NMFS is unaware of transmitters resulting in any serious injury to these species. These tags are unlikely to become entangled due to their streamlined profile and will typically be shed after about 1 year, posing no long-term risks to the turtle. The permits, if issued, would require the researchers to streamline the attachment materials so that neither buoyancy nor drag would affect the turtle's swimming ability, in addition to reducing the risk of entanglement. There would be no gap allowed between the transmitter and the turtle. All transmitters would be attached in the most hydrodynamic manner possible, minimizing the epoxy footprint. Removal of the transmitters at the end of the experiment is a non-invasive procedure and is not expected to result in any significant stress above that which has occurred during recapture. The transmitter attachment (ties) will break away and release the sonic tag after its life is finished in case, for some unexpected reason, the researchers are unable to recapture an animal to remove it.

Sonic tags/transponders emit a moderate to high frequency sonic pulse detectable using an underwater directional hydrophone (Oden et al. 1983; Yano and Tanaka 1991). Triangulation of the acoustic signal allows researchers to determine turtle locations. The sonic transmitters would have a frequency of approximately 50 to 80 kHz. This frequency level is not expected to adversely affect turtles. Sea turtles have low-frequency hearing sensitivity and are potentially affected by sound energy in the band below 1,000 Hz (Lenhardt 2003). Bartol *et al.* (1999) found the effective bandpass of the loggerhead sea turtle to be between at least 250 and 1,000 Hz. Ridgeway *et al.* (1969) found the maximum sensitivity of green sea turtle hearing to fall within 300- 500 Hz with a sharp decline at 750 Hz. Since the sonic tags authorized for sea turtle tracking research would be well above this hearing threshold, these tags would not be heard by the turtles. NMFS would not expect the transmitters to interfere with turtles' normal activities after they are released.

Another important consideration is whether the sounds emitted by the sonic transmitters would attract potential predators, primarily sharks. Unfortunately, hearing data on sharks is limited. Casper and Mann (2004) examined the hearing abilities of the nurse shark (*Ginglymostoma cirratum*), and results showed that this species detects low-frequency sounds from 100 to 1,000 Hz, with best sensitivity from 100 to 400 Hz. Myrberg (2001) explained that audiograms have been published on elasmobranchs. Although we do not have hearing information for all the sharks that could potentially prey on sea turtles, estimates for hearing sensitivity in available studies provided ranges of 25 to 1,000 Hz. In general, these studies found that shark hearing is not as sensitive as in other tested fishes, and that sharks are most sensitive to low-frequency sounds (Nelson 1967; Casper *et al.* 2003). Thus, it appears that the sonic transmitters would not attract potential shark predators to the turtles, because the frequency of the sonic tags is well above the 1,000-Hz threshold.

Effects of Transport and Holding
Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to transport and holding, NMFS believes that any transport and holding of the animals would have minimal and insignificant effects on the animals. All animals would be transported and held under climate-controlled conditions and later returned to the sea.

Boat Strikes, Noise and Visual Disturbance
There is a potential for boat strikes, noise and visual disturbance to listed species resulting from the proposed activities. However, because of the trained research personnel, maneuverability and slow operating speeds of the research vessels, boat strikes are extremely unlikely and noise and visual disturbance would be discountable. As a result, any risk of boat related disturbances to listed species is highly unlikely and no reduction in the fitness of any individual listed sea turtle is expected.

Summary of Effects
The short-term stresses resulting from capture, handling, measuring, photographing, weighing, lavage, biological sampling (blood, tissue, carapace and fecal), flipper and PIT tagging, and transmitter attachment are expected to be minimal. The Permits would contain conditions to mitigate adverse impacts to turtles from these activities. As discussed above, turtles would be worked up as quickly as possible to minimize stresses resulting from the research and the applicant would also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals. The applicant would be required to exercise care when handling animals to minimize any possible injury. An experienced veterinarian or veterinarian technician would be named by the applicant for emergencies. During release, turtles would be lowered as close to the water's surface as possible, to prevent potential injuries.

Species' Response to Effects of the Proposed Action

Actions that result in mortality affect listed species through the impact of the loss of individual turtles and also through the loss of the reproductive potential of each turtle to its respective population. Similarly, serious injuries to listed species due to an action that result in an animal's inability to reproduce affects a listed species due to the loss of that animal's reproductive potential. These effects have the potential to reduce the likelihood of survival and recovery of species.

Mortality and serious injury under the research as described under the proposed actions are not expected. The effects of the proposed from capture, handling, measuring, photographing, weighing, lavage, biological sampling (blood, tissue, carapace and fecal), flipper and PIT tagging, and transmitter attachment have been determined to have the potential to elicit short-term changes in sea turtle behavior, but are not likely to result in long-term effects on these individuals or populations. Therefore, NMFS does not expect the research procedures that would be authorized under the proposed action to result in more than short-term effects on individual animals due to the conditions concerning research procedures and placed on the applicant. In addition, NMFS does not expect any delayed mortality of turtles following their release as a direct result of the research based on past research efforts by other researchers and adherence to certain protocols identified in the proposed action. The data generated by the applicant over the duration of this study will provide beneficial information that will be important to the management and recovery of threatened and endangered species. The information collected as a direct result of permit issuance will be available to implement the goals identified in the Recovery Plans for sea turtles.

Based on the above, NMFS believes it is reasonable to assume that issuance of the proposed permit will have beneficial effects for green sea turtles. Issuance of this permit is not likely to appreciably reduce the numbers, distribution, or reproduction of green sea turtles in the wild that would appreciably reduce the likelihood of survival and recovery of these species.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions, including research authorized under ESA Section 10(a)1(A), 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. 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.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, and natural mortality) will continue to influence listed sea turtles as described in the *Environmental Baseline*. We also expect current anthropogenic effects will also continue, including vessel traffic and scientific research. Potential future effects from climate change on sea turtles in the action area are not definitively known. However, climatic variability has the potential to affect these species in the future, including indirectly by affecting sex ratios.

As the size of human communities increase, there is an accompanying increase in habitat alterations resulting from an increase in housing, roads, commercial facilities and other infrastructure. This results in increased discharge of sediments and pollution into the marine environment. These activities are expected to continue to degrade the habitat of sea turtles as well as that of the food items on which they depend. However, it is the combination and extent to which these natural and human-induced phenomena will affect sea turtles that remains unknown.

Integration and Synthesis of Effects

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

The narrative that follows integrates and synthesizes the information contained in the Status of the Species, the Environmental Baseline, and the Effects of the Action sections of this Opinion to assess the risk the proposed activities pose to green sea turtles. There are known cumulative effects (i.e., from future state, local, tribal, or private actions) that fold into our risk assessment for this species. This section provides an integration and synthesis of the information presented in the Status of the Species, Environmental Baseline, Cumulative Effects, and Effects of the Action sections of this Opinion. The intent of the following discussion is to provide a basis for determining the additive effects of the take authorized in the permit on green and hawksbill sea turtles, in light of their present and anticipated future status.

While the loss of any turtle, including eggs, has likely adversely affected the ability of the green and hawksbill sea turtle populations considered in this Opinion to maintain or increase their numbers by limiting the number of individuals in these populations, the loss of reproductive adults results in reductions in future reproductive output. Species with delayed maturity such as sea turtles are demographically vulnerable to increases in mortality, particularly of juveniles and subadults, those stages with higher reproductive value. The potential for an egg to develop into a hatchling, into a juvenile, and finally into a sexually mature adult sea turtle varies among species, populations, and the degree of threats faced during each life stage. Each juvenile that does not survive to reproduce will be unable to contribute to the maintenance or improvement of the species' status. Reproducing females that are prematurely killed due the threats mentioned in the above sections, while possibly having contributed something before being removed from the population, will not be allowed to realize their reproductive potential. Similarly, reproductive males prematurely removed from the population will be unable to make their reproductive contribution to the species' population.

As described in the Effects of the Action section of this Opinion, the research activities that would take place under Permits 15661, 15685 and 10027-04 are not expected to result in mortality or injury to any green and hawksbill sea turtles. The capture, handling, measuring, photographing, weighing, lavage, biological sampling (blood, tissue, carapace and fecal), flipper and PIT tagging, and transmitter attachment sampling activities will only result in temporary stress to the animal and are not expected to have more than short-term effects on individual green sea turtles. These non-lethal interactions will not affect the turtle's ability to reproduce and contribute to the maintenance or recovery of the species. These effects are expected to be short-term because the take is non-lethal and previous experience with the type of proposed research activities has demonstrated that it is reasonable to expect that effects will be minimal. This research will affect the turtles by harassing individual turtles during the research thus raising levels of stressor hormones, and the turtle may experience some discomfort during from capture, handling, measuring, photographing, weighing, lavage, biological sampling (blood, tissue, carapace and fecal), flipper and PIT tagging, and transmitter attachment procedures. Based on past observations of similar research, these effects are expected to dissipate within approximately a day. Based on this prior information and experience, and conditions placed on the Permit Holders, NMFS does not expect the applicant's proposal to conduct the research as described above to result in more than short-term effects on the individual animals. NMFS also does not expect any delayed mortality of any turtles following their release as a direct result of the research based on past research efforts by other researchers and adherence to certain protocols identified in the proposed action.

Although some degree of stress or pain is likely for individual turtles from capture, handling, measuring, photographing, weighing, lavage, biological sampling (blood, tissue, carapace and fecal), transmitter attachment, and flipper and PIT tagging (which will result in tissue injuries), none of the research procedures are expected to result in mortality or reduced fitness of individuals. The proposed permit is not expected to affect the population's reproduction, distribution, or numbers. Because the proposed action is not likely to reduce the particular population's likelihood of surviving and recovering in the wild, it is not likely to reduce the species' likelihood of surviving and recovering in the wild.

NMFS does not expect the proposed research activities to appreciably reduce the green and hawksbill sea turtles likelihood of survival and recovery in the wild by adversely affecting their birth rates, death rates, or recruitment rates. In particular, NMFS does not expect the proposed research Permit to affect adult, female turtles in a way that appreciably reduces the number of animals born in a particular year; the reproductive success of adult female turtles; the survival of young turtles; or the number of young turtles that annually recruit into the adult, breeding populations of any population of green and hawksbill sea turtles.

The proposed actions are not expected to have more than short-term effects on either green or hawksbill sea turtle populations. The data generated by the applicant regarding these populations over the duration of these studies will provide beneficial information that will be important to the management and recovery of threatened and endangered species. The information collected as a direct result of the Permits issuance will be used to implement the goals identified in the Recovery Plans for the U.S. Pacific Ocean Populations of sea turtles. As discussed above, NMFS believes it is reasonable to assume that issuance of the proposed Permit will have beneficial effects for the Pacific Ocean populations of green and hawksbill sea turtles.

Conclusion

After reviewing the current status of the green and hawksbill sea turtles, the environmental baseline for the action area, the effects of the take authorized in this permit, and probable cumulative effects, it is NMFS' biological opinion that issuance of the permits, as proposed, will not reduce the likelihood of the survival and recovery of their populations in the wild by reducing their numbers, distribution, or reproduction, and therefore is not likely to jeopardize the continued existence of these species.

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 USFWS 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.

Amount or Extent of Take

The permit is for the directed take, for research purposes, of listed green and hawksbill sea turtles; no incidental take of other listed species is anticipated or authorized.

This Opinion does not authorize any take of other listed species or immunize any actions from the prohibitions of section 9(a) of the ESA. Take is authorized by section 10(a)(1)(a) as specified in the permits.

CONSERVATION RECOMMENDATIONS

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

The following conservation recommendations would provide information that would improve the level of protections afforded in future consultations involving proposals to issue permits for research on the listed sea turtle species:

> *Cumulative Impact Analysis.* The Permits and Conservation Division should encourage researchers (future permit holders) to consider the feasibility of performing a laparoscopic examination of the esophagus and crop for signs of internal injury upon recapture of animals that have been previously stomach sampled using forceps, to establish behavioral, clinical, and observational records for sea turtles in the wild. This will allow for analyses of cumulative effects (natural and anthropogenic) at individual and population levels over time.

RENITIATION NOTICE

This concludes formal consultation and conference on the proposal to issue scientific research permits 15661, 15685 and modification 10027-04. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of 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.

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Appendix 1: Maps of the Action Area for Permit No. 15661

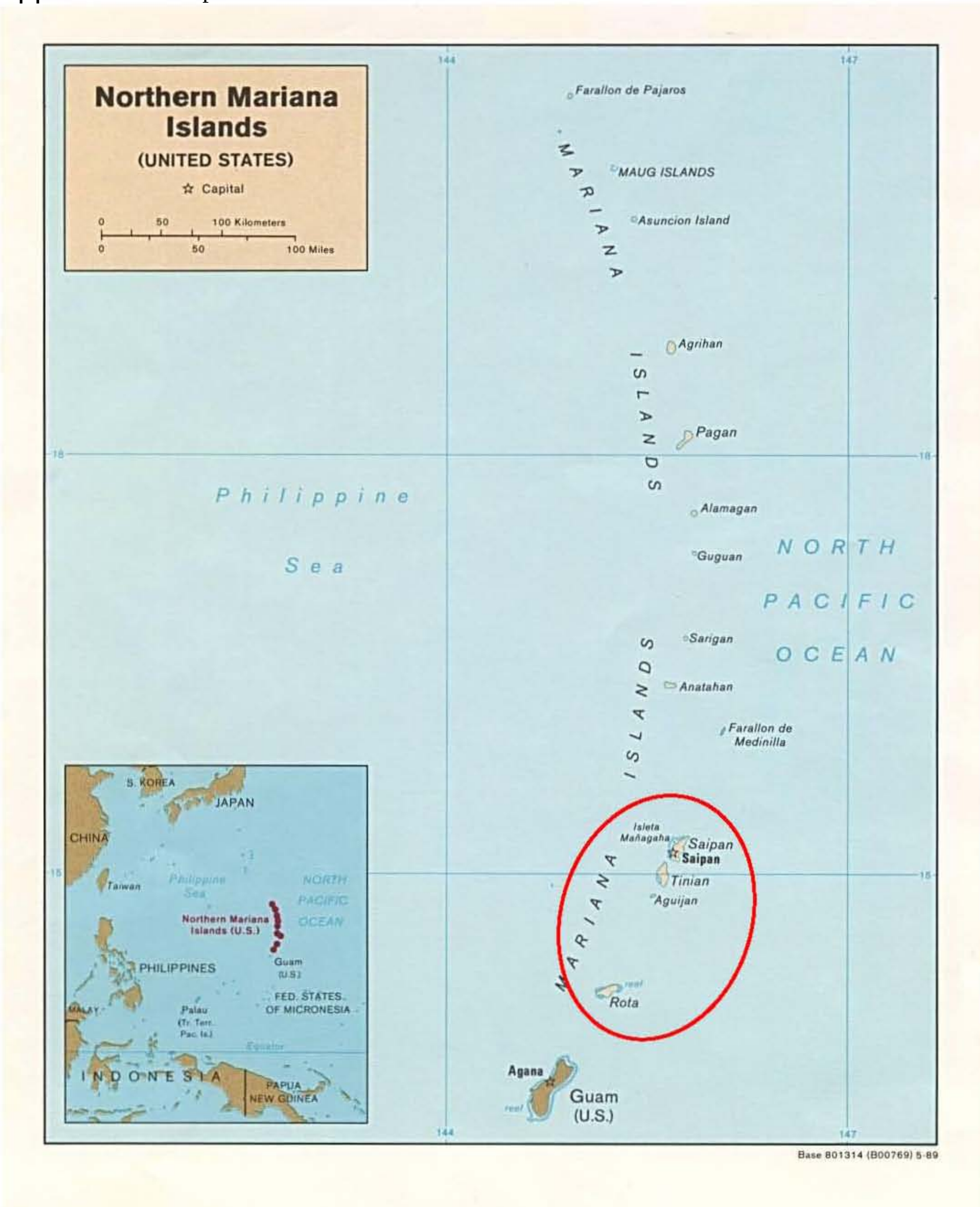

Figure 1: Location of the Northern Marina Islands. Main study areas are circled.

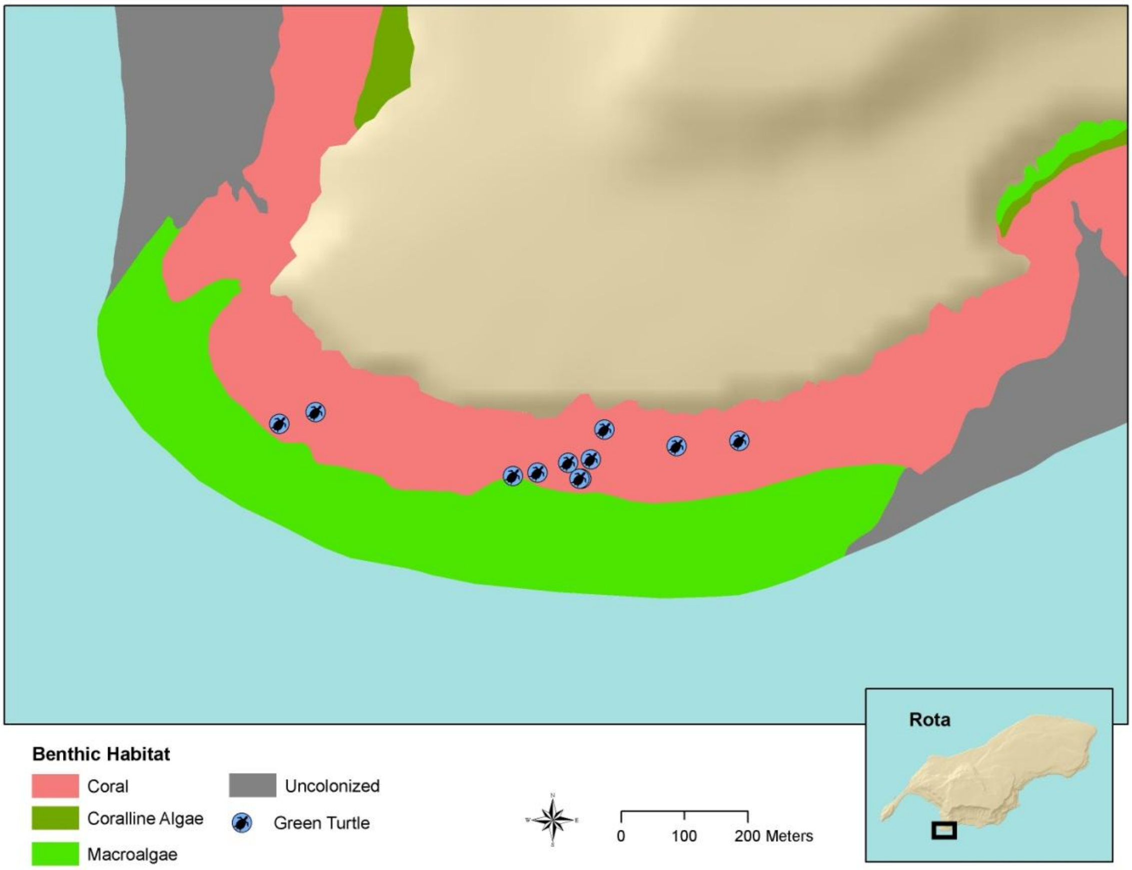

Figure 2: Rota Island. Turtle symbols identify past capture locations in relation to habitat type.

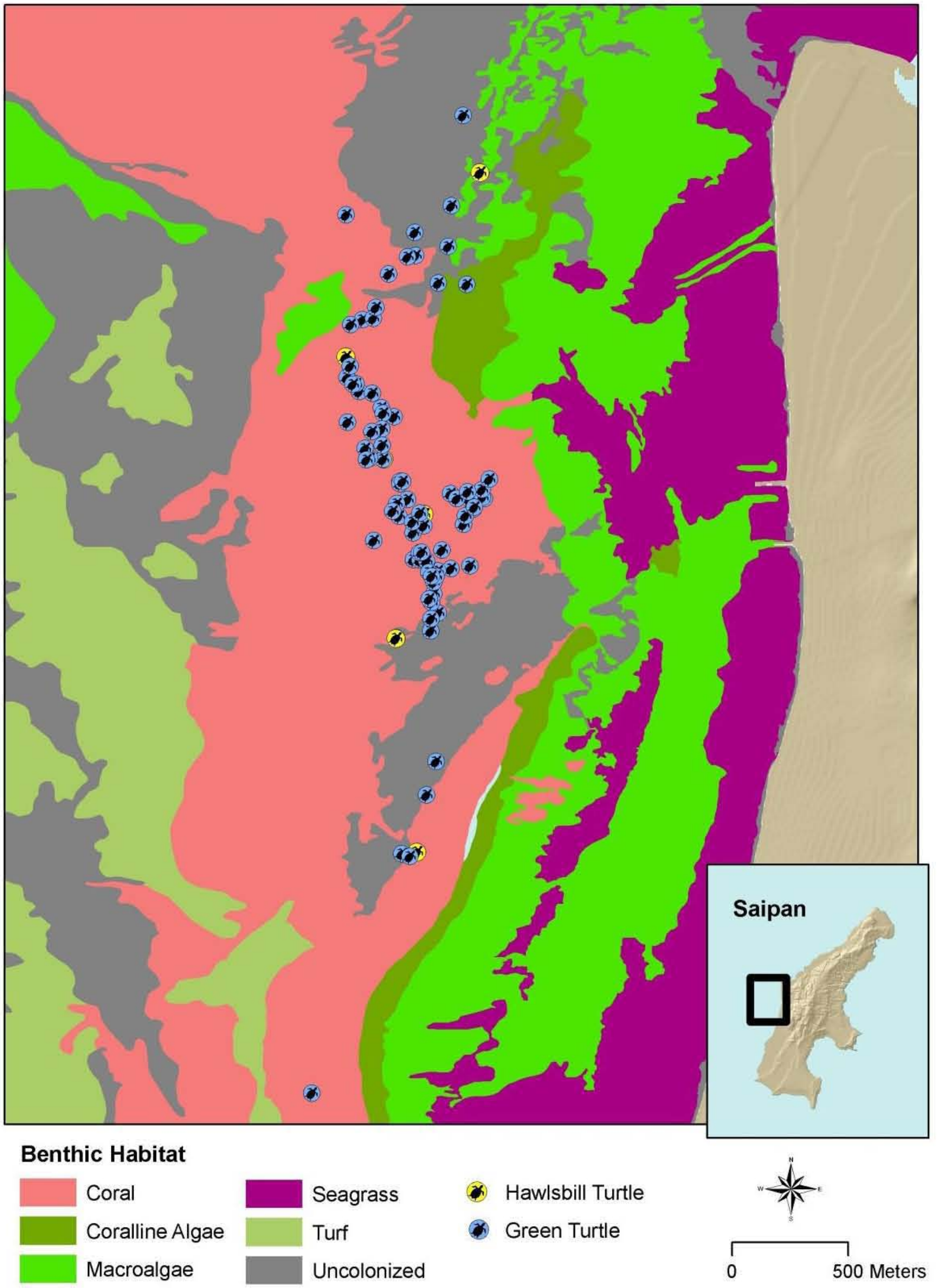

Figure 3: Saipan Island. Turtle symbols identify past capture locations in relation to habitat type.

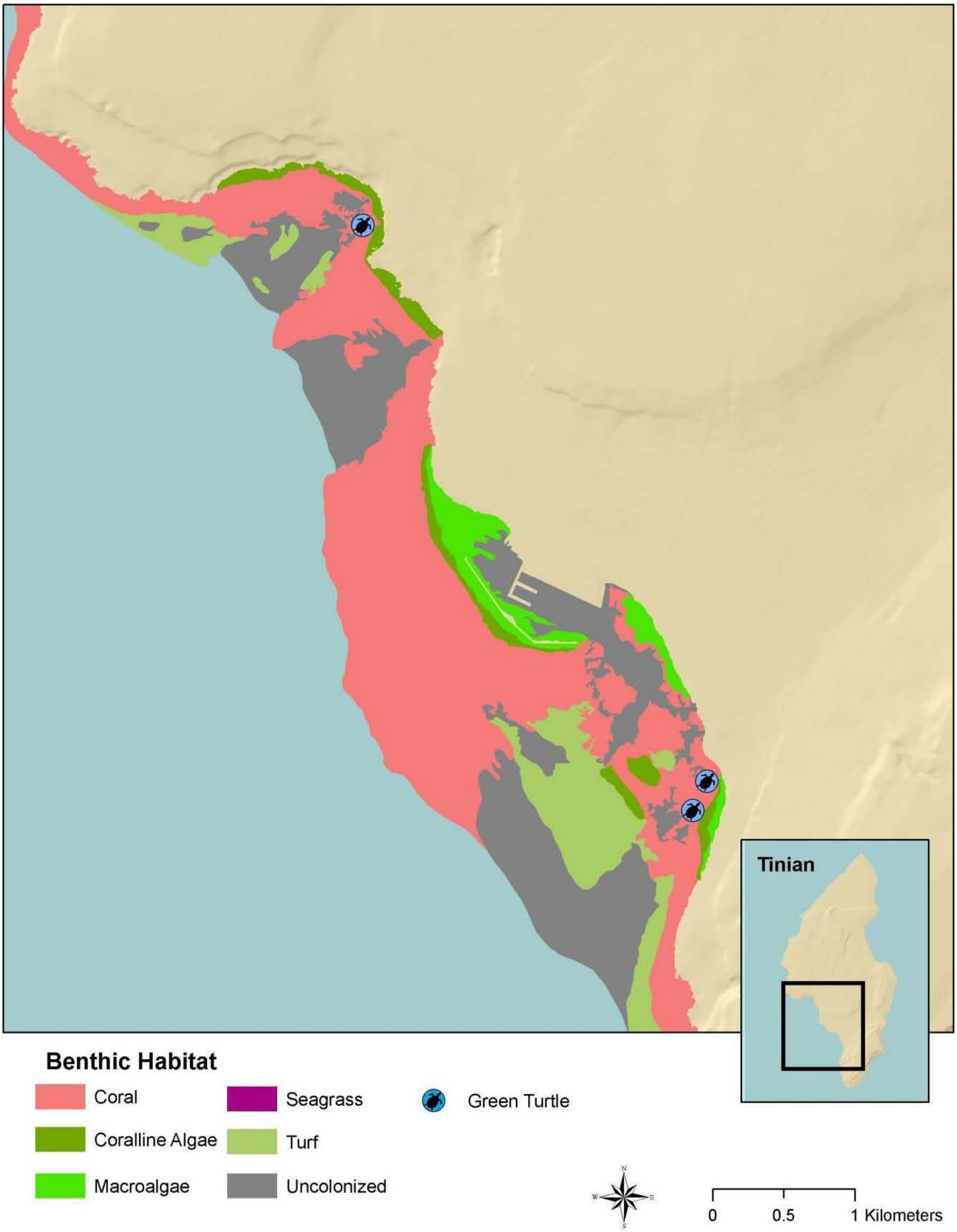

Figure 4: Tinian Island. Turtle symbols identify past capture locations in relation to habitat type.

Appendix 3: Maps of the Action Area for Permit Modification No. 10027-04

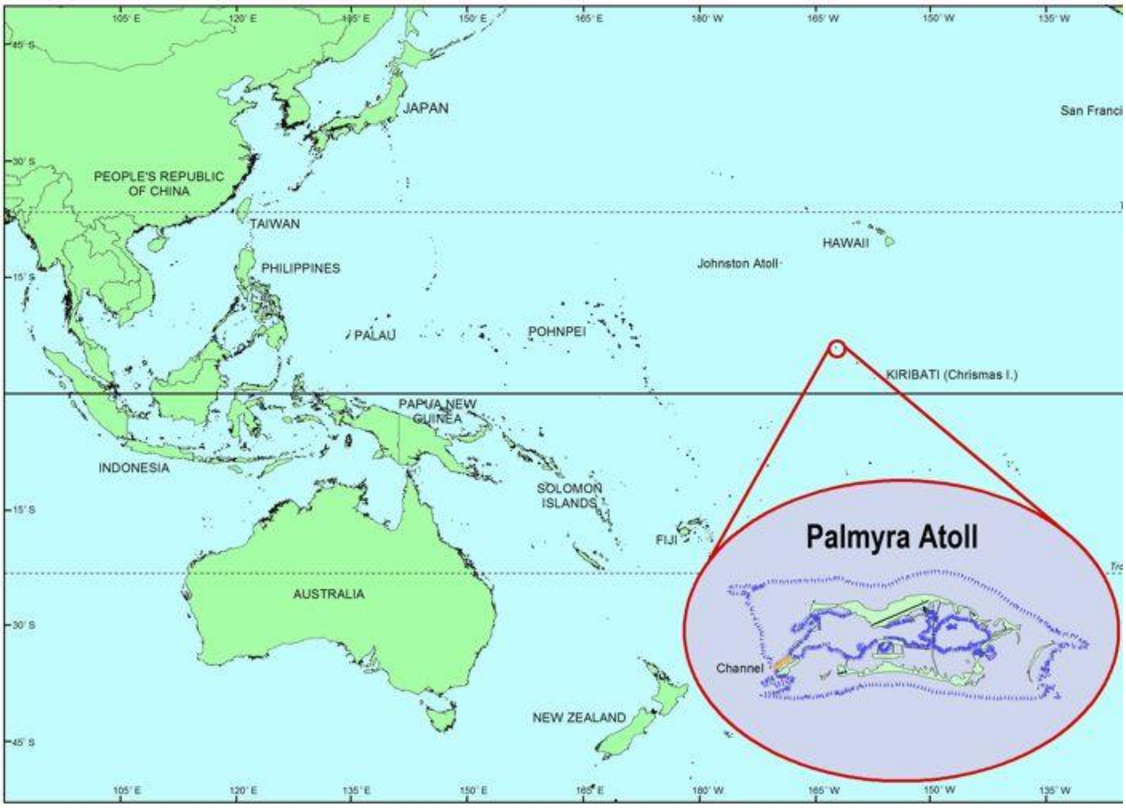

Figure 1. Map showing the location of Palmyra Atoll, Central Pacific.