Appendix VI

2008 NMFS Biological Opinion

on

Proposed Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific

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Endangered Species Act – Section 7 Consultation

Biological Opinion

Action Agency:	National Marine Fisheries Service, Pacific Islands Region, Sustainable Fisheries Division
Activity:	Management Modifications for the Hawaii-based Shallow-set Longline Swordfish Fishery – Implementation of Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region.
Consulting Agency:	National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division
Approved By:	William L. Robinson William L. Robinson Regional Administrator, Pacific Islands Region
Date Issued:	October 15, 2008

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Figures and Tables

Acronyms

AFM	Adult female mortalities
BA	Biological Assessment
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
DPS	Distinct population segment
DSEIS	Draft Supplement Environmental Impact Statement
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FAO	Food and Agriculture Organization of the United Nations
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
FR	Federal Register
HLA	Hawaii Longline Association
IAC	Inter-American Convention for the Protection and Conservation of Sea Turtles
ITS	Incidental Take Statement
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service (also NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
PIFSC	Pacific Islands Fisheries Science Center
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PMUS	Pelagic Management Unit Species
PNG	Papua New Guinea
PRD	Protected Species Division, NMFS Pacific Islands Regional Office
PSW	Protected Species Workshop
QET	Quasi-extinction threshold
SCL	Standard carapace length
SFD	Sustainable Fisheries Division, NMFS Pacific Islands Regional Office
SQE	Susceptibility to Quasi-Extinction
SSC	Scientific and Statistical Committee of the WPFMC
SSLL	Shallow-set longline
STAJ	Sea Turtle Association of Japan
TEWG	Turtle Expert Working Group
USFWS	U.S. Fish and Wildlife Service
WCP	Western Central Pacific
WCPFC	Western and Central Pacific Fisheries Commission
WPFMC	Western Pacific Fishery Management Council

1 Introduction

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" an ESA-listed species, that agency is required to consult formally with the National Marine Fisheries Service (for marine species or their designated critical habitat) or the U.S. Fish and Wildlife Service (for terrestrial and freshwater species or their designated critical habitat). Federal agencies are exempt from this formal consultation requirement if they have concluded that an action "may affect, but is not likely to adversely affect" ESA-listed species or their designated critical habitat, and the National Marine Fisheries Service (NMFS, or NOAA Fisheries) or the U.S. Fish and Wildlife Service (USFWS) concur with that conclusion (see ESA Section 7 Implementing Regulations; 50 CFR 402).

The proposed federal action addressed by this biological opinion is modification of the management program for the Hawaii-based shallow-set longline fishery, as recommended in Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (Pelagics FMP). Amendment 18 was developed by the Western Pacific Fishery Management Council (Council or WPFMC), and is described in the Amendment 18, including a Draft Supplemental Environmental Impact Statement (WPFMC 2008). NMFS has responsibility under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) for approving FMPs and their amendments, and NMFS also has responsibility under the ESA for conducting Section 7 consultations on federal actions affecting ESA-listed marine species. Therefore, this biological opinion is an intra-service Section 7 consultation, as described in the Endangered Species Consultation Handbook (USFWS & NMFS 1998).

The Hawaii-based shallow-set longline fishery is one component of the Hawaii-based longline fishery, which also includes a deep-set component. The two components were not managed separately until 2000. Thus, an overview of the Hawaii-based longline fishery is given below to provide context for the shallow-set component.

1.1 The Hawaii-based Longline Fishery

Longline fishing utilizes a type of fishing gear consisting of a mainline that exceeds 1 nautical mile (6,076 ft) in length that is suspended horizontally in the water column, from which branchlines with hooks are attached (NMFS 2008a). The term "Hawaii-based" is used to specify those longline vessels operating out of Hawaii, in order to distinguish them from other longline vessels operating in the same waters, but based in other states or nations. The Hawaii-based longline fleet grew to 141 vessels in 1991 when the Council established a limited entry program to control the fishery's growth. The limited entry program allows a ceiling of 164 vessels, and vessel size is limited to a maximum of 101 feet in length (NMFS 2001, WPFMC 2006a, WPFMC 2008). Some 120-125 vessels typically are active during any given year.

The Hawaii-based longline fishery consists of 2 separately managed components: the deep-set gear configuration fishery (targeting tuna), and the shallow-set gear configuration fishery (targeting swordfish). No regulatory distinction was made between these 2 components of the

Hawaii-based longline fishery until 2000, when the Court ordered the closure of the swordfishing area north of Hawaii due to the bycatch of sea turtles by shallow-set fishing in this area. The Court order led to a complete closure of the swordfish fishery in 2001, while the deep-set fishery was allowed to continue operation, but with seasonal restrictions (NMFS 2001).

After the implementation of numerous measures to reduce turtle bycatch, the shallow-set fishery was reopened in 2004, but it was restricted to considerably less fishing effort than pre-2001 effort levels (NMFS 2004b). The deep-set component became an increasingly larger proportion of the total Hawaii-based longline fishery until there was only deep-setting during the shallow-set closure in 2001-2004. Since 2004, the shallow-set component has made up a small proportion of the total fishery (see figure on PIFSC website http://www.pifsc.noaa.gov/fmsd/reports.php). The regulatory history of Hawaii-based longline fishery is described in the 2001 Pelagics FEIS (NMFS 2001), the 2004 BiOp (NMFS 2004a), and the 2004 Pelagics FSEIS (NMFS 2004b).

Longline fishing allows a vessel to distribute effort over a large area to harvest fish that are not concentrated in great numbers. Overall catch rates in relation to the number of hooks are generally low, especially for tuna. Longline fishing involves setting a mainline horizontally at a preferred depth in the water column using floats spaced at regular intervals. Three to 5 radio buoys are usually attached at fairly regular intervals along the mainline so that the line may be easily located both for initial retrieval and in case the mainline parts during fishing operations. Branchlines are clipped to the mainline at regular intervals, and each branchline has a single baited hook. Mainlines are typically 30 to 100 km (18 to 60 nm) long, and after the mainline is completely deployed, the gear is allowed to "soak" for several hours before being retrieved ("hauled"). In longlining, a "set" is a discrete unbroken section of line floats and branchlines. Usually, only 1 set is fished per day. Fishing trips are typically 2 to 3 weeks long (NMFS 2001, NMFS 2005, WPFMC 2006a, Beverly & Chapman 2007, WPFMC 2008).

Longline fishing for swordfish is known as shallow-set longline fishing because the bait is set at depths of 30 – 90 m. The portion of the mainline with branchlines attached is suspended between floats at about 20 – 75 m of depth, and the branchlines hang off the mainline another 10 – 15 m. Only 4 – 6 branchlines are clipped to the mainline between floats, and a typical set for swordfish uses about 700 – 1,000 hooks. Shallow-set longline gear is set at night, with luminescent light sticks attached to the branchlines. Formerly, J-hooks and squid bait were used, but since 2004, circle hooks and mackerel-type bait have been required. These gear restrictions were implemented to reduce turtle bycatch. The most productive swordfishing areas for Hawaii-based longliners are north of Hawaii outside the U.S. Exclusive Economic Zone (EEZ) on the high seas.

Tunas, primarily bigeye and yellowfin, are targeted in the deep-set fishery, which sets bait at 150 – 400 m depth (depending on the target species). A line shooter is used on deep sets to deploy the mainline faster than the speed of the vessel, so that loops are formed which sink to the desired depth. Deep-set longline gear is typically set in the morning and hauled in the afternoon. In contrast to shallow-set longline fishing, a minimum of 15, but typically 20 to 30, branchlines are clipped to the mainline at regular intervals between the floats. A typical deep-set consists of 1,200 to 1,900 hooks. Lightsticks are not attached to the branchlines, as they are prohibited onboard Hawaii-based deep-set longline fishing vessels. The most productive tuna fishing areas are south of the swordfish areas. A comparison of shallow-set and deep-set longline fishing methods is provided in Bartram and Kaneko (2004).

The Hawaii-based longline fishery is managed by Federal regulations pertaining to the Pelagics FMP, as well as other Federal fisheries regulations that apply to the western Pacific. For the complete set of these Federal regulations, see 50 CFR Part 665, and for a summary see Summary of Hawaii Longline Fishing Regulations (NMFS 2008a).

1.2 The Shallow-set Component of the Hawaii Longline Fishery

The Hawaii-based shallow-set longline fishery began operations in late 2004 to test the effectiveness in the Pacific of a hook-and-bait combination that was found to dramatically reduce interactions[1] with sea turtles when tested on Atlantic pelagic longline vessels. A final rule that implemented Regulatory Amendment 3 (WPFMC 2004) was published and effective on April 2, 2004 (69 FR 17329), established a limited "model" Hawaii-based shallow-set swordfish fishery using circle hooks with mackerel-type bait. This combination had been found to reduce interactions with leatherback and loggerhead turtles by 65 and 90 percent, respectively, in the U.S. Atlantic longline fishery (Watson et al. 2005). In order to test and model the use of this gear in the Hawaii-based shallow-set longline fishery, fishing effort in the model fishery was limited to 50 percent of the 1994-99 annual average number of sets, or 2,120 sets. Those sets were distributed equally among those permit holders who applied each year to participate in the fishery. As an additional safeguard, a limit was implemented for the number of turtle interactions that could occur in the swordfish fishery, and the fishery would be closed for the remainder of the calendar year, if and when either limit was reached. That regulatory amendment also included proposals for a range of conservation measures to protect sea turtles in their nesting and coastal habitats, although these were not regulatory measures for the fishery.

Under the requirements implemented by the April 2, 2004 (69 FR 17329) final rule, vessel operators in the Hawaii-based shallow-set fishery must now use large (18/0) circle hooks with a 10 degree offset and mackerel-type bait, comply with a set certificate program to ensure that the fleet as a whole does not make more than a total of 2,120 shallow-sets per year, and the fleet as whole may not interact with (hook or entangle) more than a total of 17 loggerhead sea turtles or 16 leatherback sea turtles each year. In addition to those requirements, all vessels must carry an observer when shallow-setting (100 percent observer coverage). The sea turtle interaction limits were not intended to represent the upper limit of interactions that would avoid jeopardizing the continued existence of sea turtles, but instead are the annual number of sea turtle interactions anticipated to occur in this fishery, as calculated by multiplying expected fishing effort by interaction rates derived from studies using circle hooks and mackerel bait in U.S. longline fisheries in the Atlantic. The use of circle hooks and mackerel-type bait in Hawaii's shallow-set longline fishery has reduced sea turtle interaction rates by approximately 90 percent for loggerheads and 83 percent for leatherbacks compared to the previous period 1994-2002 when the fishery was operating without these requirements (Gilman et al. 2007a).

[1] ‘Interaction’ is defined as being hooked or entangled by fishing gear, thus encompassing all hookings, entanglements, captures, and mortalities, whether the turtle is brought on board the vessel or not.

2 Consultation History

The proposed federal action addressed by this biological opinion is modification of the management program for the Hawaii-based shallow-set longline fishery, as recommended in Amendment 18 to the Pelagics FMP. On August 12, 2008, a public review Draft Supplemental Environmental Impact Statement (DSEIS) was completed for the proposed action, and adopted by NMFS' Pacific Islands Regional Office – Sustainable Fisheries Division (PIRO/SFD) as the Biological Assessment (BA) for this ESA consultation. The notice of availability of the DSEIS was published in the *Federal Register* on August 22, 2008 (73 FR 49667). On August 15, 2008, PIRO/SFD sent a memorandum to PIRO's Protected Resources Division (PIRO/PRD) requesting reinitiation of formal consultation on effects of Amendment 18 on ESA-listed marine species, using the DSEIS (2008) as the BA for the consultation. PRD participated in the development of the DSEIS for use as the BA in this consultation, and PRD agreed that the DSEIS was adequate for ESA consultation. Thus, formal consultation was reinitiated on August 15, 2008.

The August 15, 2008, consultation request constitutes a reinitiation of formal consultation: NMFS previously issued a biological opinion on proposed regulatory amendments to the Pelagics FMP on February 23rd, 2004 (2004 BiOp) (NMFS 2004a), which included the Hawaii-based shallow-set longline, the Hawaii-based deep-set longline, the American Samoa longline, and the regional non-longline pelagic fisheries. Reinitiation of consultation is required if "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" (50 CFR 402.16(c)). Amendment 18 proposes to remove the effort limits from the fishery, hence requiring reinitiation. This reinitiation of formal consultation and resulting biological opinion only covers the shallow-set component of the Pelagics FMP and supersedes the shallow-set longline component of the 2004 BiOp.

The 2004 BiOp (NMFS 2004a) included an Incidental Take Statement (ITS) specifying take limits for 3 fishery components of the pelagic longline fishery: (1) Hawaii shallow-set longline; (2) Hawaii deep-set longline; and (3) American Samoa longline and regional non-longline pelagic fisheries combined, such that exceedance of take in 1 component would not require reinitiation of formal consultation in the other 2 components of the fishery in which take levels were not exceeded. In 2004, the Hawaii deep-set longline component of the pelagic longline fishery was estimated to have exceeded the take of olive ridley turtles authorized in the 2004 ITS. Thus, formal consultation was reinitiated on the deep-set component, resulting in a biological opinion on October 4, 2005 (NMFS 2005). In 2006 and 2007, the American Samoa longline component of the pelagic longline fishery exceeded the take of green turtles authorized in the 2004 ITS. Reinitiation of consultation was requested on July 31, 2008, on the American Samoa longline fishery, as well as the regional non-longline pelagic fisheries. Therefore, since the 2004 BiOp was issued, consultation has either been reinitiated (Hawaii-based shallow-set longline, American Samoa longline, non-longline pelagics) or completed (Hawaii-based deep-set longline) on all of the fisheries covered by the 2004 BiOp (NMFS 2004a).

PIRO/PRD provided a draft biological opinion to PIRO/SFD and PIFSC, with a request for comments, on August 22, 2008. On August 27, 2008, PIRO/PRD responded to PIRO/SFD's August 15, 2008 consultation request memo by concurring that the Hawaiian monk seal and blue, fin, sei, sperm, and North Pacific right whales are not likely to be adversely affected by the proposed action. Comments were received from PIFSC on September 3, 2008, and from

PIRO/SFD on September 8, 2008. On September 19, 2008, the draft biological opinion was provided to the Applicant for the proposed action, the Hawaii Longline Association (HLA). A conference call was conducted with HLA on September 23, 2008. Comments were received from HLA on September 26, 2008.

3 Description of the Action

The proposed action addressed by this biological opinion is the continued operation of the Hawaii-based shallow-set longline fishery for swordfish under the Pelagics FMP, with incorporation of the management changes proposed in Amendment 18. The purpose of Amendment 18 is "to provide increased opportunities for the shallow-set fishery to sustainably harvest swordfish and other fish species while continuing to avoid jeopardizing the continued existence and recovery of threatened and endangered sea turtles as well as other protected species" (WPFMC 2008). To achieve this objective, the Council has recommended that NMFS remove the annual limit on fishing effort, specifically the number of fishing gear deployments (sets). Currently, that limit is 2,120 sets per year. Associated with this action, the Council has also recommended that the set certificate program, which is used to monitor and control the number of sets, also be removed because it would be unnecessary in the absence of an effort limit. Amendment 18 and Draft Supplemental Environmental Impact Statement (DSEIS) estimates that the removal of the effort limit could result in 2,120 to 5,550 sets annually (WPFMC 2008). With the effort limitation program removed as recommended, Amendment 18 also recommends a related increase in the loggerhead and leatherback interaction limits (i.e., maximum number of annual allowable interactions). The revised interaction limits correspond to the numbers of interactions expected to result as the fishery expands as a result of removing the effort limit. All other measures currently applicable to the fishery would remain unchanged.

Under ESA section 7(a)(2), NMFS is mandated to ensure that removal of the effort (set) limit for this fishery, and any resulting increase in fishing effort, 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. This opinion defines the proposed action as the continued operation of the Hawaii-based shallow-set longline fishery at an effort level of 5,550 sets annually. The proposed action for this consultation is consistent with the purpose of Amendment 18 and the Council's intent to eliminate the set certificates and to establish new sea turtle interaction caps that would continue to avoid jeopardizing the existence of threatened and endangered sea turtles or their habitat.

A synopsis of the current shallow-set regulations is provided below. Those regulations that would be affected by the changes proposed in Amendment 18, and which are being considered in this opinion, **are noted in bold**. These proposed changes are described in more detail in Section 3.3. The regulations governing the Hawaii-based shallow-set longline fishery are grouped into the following categories, and each category is summarized below:

- Fishing Permits and Certificates:
  - Hawaii Longline Limited Entry Permit.
  - Marine Mammal Authorization Program Certificate.
  - High Seas Fishing Compliance Act Permit, for vessel fishing on the high seas.

- **A Shallow-set Certificate for every shallow-set made north of the Equator (the proposed action would remove this requirement).**
- Protected Species Workshop Certificate.
- Western Pacific Receiving Vessel Permit, if applicable.
- State of Hawaii Commercial Marine License.

- Reporting, Monitoring, and Gear Identification:
  - Logbook for recording catch, effort and other data.
  - Transshipping Logbook, if applicable.
  - Marine Mammal Authorization Program (MMAP) Mortality/Injury Reporting Form.
  - Vessel Monitoring System (VMS).
  - Vessel Identification.
  - Gear Identification.

- Notification Requirement and Observer Placement:
  - Notify the PIRO Observer Program contractor at least 72 hours before departure on a fishing trip to declare the trip type (shallow-set or deep-set).
  - All longline fishing trips are required to have a fisheries observer on board if requested by the Regional Administrator; NMFS policy is to place observers on board every shallow-set longline trip.
  - Fisheries observer guidelines must be followed.

- Prohibited Areas in Hawaii:
  - Northwestern Hawaiian Islands Longline Protected Species Zone.
  - Main Hawaiian Islands winter and summer Longline Fishing Prohibited Areas.

- **Shallow-set Certificate Program and Turtle Interaction limits (the proposed action would remove the certificate requirement and revise the turtle interaction limits):**
  - **A maximum of 2,120 shallow-set certificates are available annually.**
  - **Interested Hawaii longline limited entry permit holders must submit a written request for certificates at the beginning of the fishing year.**
  - **Each Hawaii longline limited entry permit holder receive equal proportions of available certificates.**
  - **Certificates can be transferred only among Hawaii longline limited entry permit holders.**
  - **Maximum annual limits are established on the numbers of physical interactions that occur each calendar year between leatherback and loggerhead sea turtles and vessels registered for use under Hawaii longline limited access permits while shallow-setting: 16 for leatherbacks and 17 for loggerheads.**
  - **If either turtle interaction limit is reached, the shallow-set fishery is closed for the remainder of the calendar year.**

- Protected Species Workshop:
  - Each year, longline vessel owners and operators must attend a Protected Species Workshop, and receive a Protected Species Workshop (PSW) certificate.
  - A valid PSW certificate is required to renew a Hawaii longline limited entry permit.

- The operator of a longline vessel must have a valid PSW certificate on board the vessel while fishing.

- Sea Turtle and Seabird Handling and Mitigation Measures:
  - Longline vessel owners/operators are required to adhere to the regulations for the safe handling and release of sea turtles and seabirds presented in the PSWs.
  - Longline vessel owners/operators must have on board the vessel all required turtle handling/dehooking gear specified in the regulations.
  - Longline vessel owners/operators can choose between side-setting or stern-setting to reduce seabird interactions:
    - Side-setting requirements:
      - Mainline deployed as far forward as possible.
      - If line shooter is used, mount as far forward as possible, and at least 1 m forward of the stern.
      - Branchlines must have 45 g weight within 1 m of hook.
      - When seabirds are present, deploy gear so hooks remain submerged.
      - Deploy a bird curtain.
    - Stern-setting requirements:
      - When seabirds are present, discharge offal while setting or hauling on opposite side of the vessel.
      - Retain sufficient offal between sets.
      - Remove all hooks from offal before discharge.
      - Use swordfish liver and head for offal. The swordfish bill must be removed, and the head split in half vertically.
  - When using basket-style gear, ensure mainline is set slack (seabird measure).
  - Use completely thawed bait, and dye all bait to match NOAA Fisheries-issued color control card (seabird measure).
  - Maintain at least 2 cans of blue dye on board (seabird measure).
  - Deploy set ≥1 hour after sunset, complete deployment before sunrise (seabird measure).
  - When shallow-set longline fishing north of the Equator:
    - Use 18/0 or larger circle hooks with 10° offset.
    - Use mackerel-type bait.
    - **Must have 1 valid shallow-set certificate per set (the proposed action would remove this requirement).**

- Marine Mammal Handling and Release:
  - Longline vessel owners/operators must follow the marine mammal handling guidelines provided at the PSW.
  - Submit the MMPA Mortality/Injury Reporting Form to NOAA Fisheries to report injuries or mortalities of marine mammals.

- Shark Finning and Landings
  - Shark fins, including the tail, cannot be removed from sharks and the carcass disposed at sea.

- Shark fins can be removed if the corresponding carcass is kept. Shark fins can only be sold if the fins and corresponding carcass are weighted at the same time after returning to port.
- Shark fins received from another vessel must be accompanied by the corresponding carcass.
- The total weight of shark fins landed may not exceed 5 percent of the total dressed weight of shark carcasses on board or landed from the vessel.
- NOAA Fisheries must be granted access to shark fin records.

The above regulations can be found at 50 CFR Part 665. A summary of the regulations for the Hawaii-based longline fishery (shallow-set and deep-set components combined) is provided by the Summary of Hawaii Longline Fishing Regulations (NMFS 2008a).

4 Action Area

The action area for this proposed action includes all areas where vessels permitted by the Hawaii-based shallow-set longline fishery operate shallow-set gear, and areas that such vessels travel through on shallow-set fishing trips. Hawaii-based shallow-set longline fishing in 2005-07 all occurred between 180° - 140° W longitude and 20° N - 40° N latitude, hence this rectangle is the action area (Figure 1). The action area includes part of the U.S. Exclusive Economic Zone (EEZ) around the Hawaiian Islands, but as described and shown in the Summary of Hawaii Longline Fishing Regulations (NMFS 2008a), portions of this EEZ are closed to longline fishing. However, these closed areas are included in the action area where longline vessels travel through them on shallow-set fishing trips.

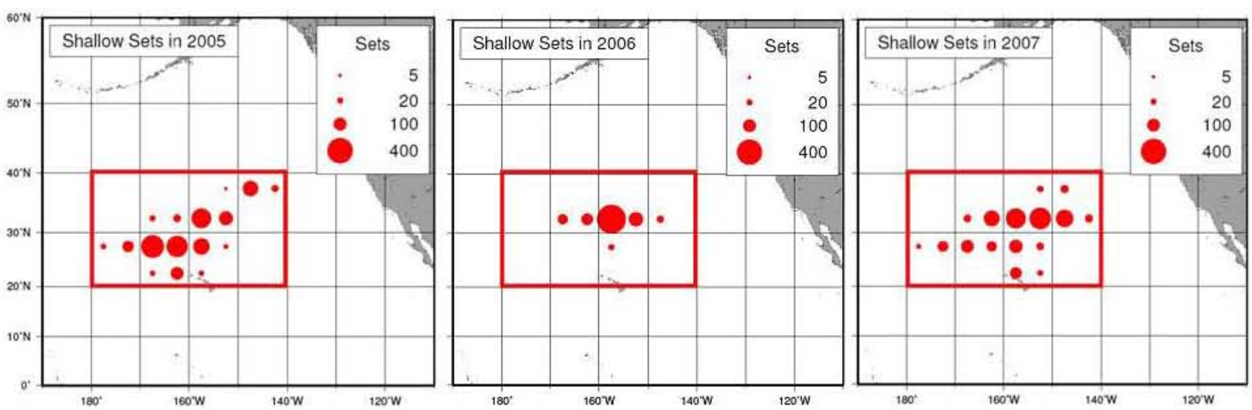

Figure 1. Locations of shallow-sets made in 2005-2007. Action area is shown by the red square (maps provided by Karen Sender, Pacific Islands Fisheries Science Center, 7/24/08).

There is spatial overlap between the shallow-set and deep-set components of the Hawaii-based longline fishery. The proposed action addressed by this biological opinion is management modifications to the shallow-set component only. The shallow-set component of the Hawaii-based longline fishery operates almost entirely north of Hawaii. In some years, depending on the seawater temperature, this component of the longline fishery may operate mostly north of 30° N, such as in 2007 (Figure 1). The deep-set component of the fishery operates primarily to the south of Hawaii between the Equator and 20° N. In some years there may be considerable fishing north of Hawaii also. Thus, the 2 components overlap spatially near Hawaii between 20° N and 30° N (Figure 2).

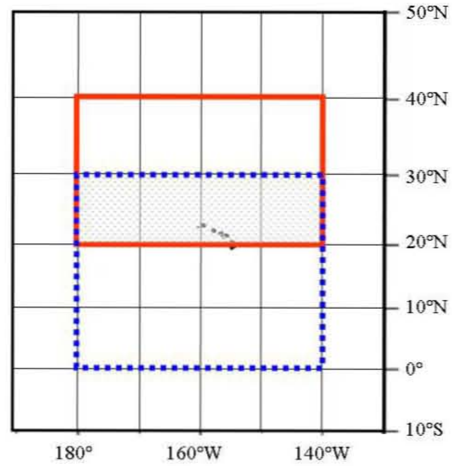

Figure 2: Shallow-set (solid red line) vs. deep-set (dashed blue line) areas of the HI-based longline fishery, with overlap in stippling.

5 Status of Listed Species

The memo of August 15, 2008, from SFD to PRD requesting consultation on the shallow-set longline fishery under Amendment 18 determined that the proposed action may affect the 12 ESA-listed marine species shown in Table 1. The memo further determined that the 6 species shown in Table 1a below are not likely to be adversely affected by the proposed action, and requested concurrence on this determination from PRD. On August 27, 2008, PRD responded with a letter concurring with these determinations, hence these 6 species (Hawaiian monk seal and the 5 whale species except humpbacks) are not addressed further in this biological opinion. The August 15, 2008, consultation request also determined that the 6 species shown in Table 1b below are likely to be adversely affected by the proposed action, and requested formal consultation on these species. The remainder of this biological opinion deals exclusively with these 6 species (humpback whale and 5 sea turtle species).

Table 1. ESA-listed marine species that may be affected by proposed action.

Species	Scientific Name	ESA Status	Listing Date	Federal Register Reference
Table 1a. Species not likely to be adversely affected by the proposed action.				
Hawaiian Monk Seal	*Monachus schauinslandi*	Endangered	11/23/1976	41 FR 51612
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*B. physalus*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*B. borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970	35 FR 18319
N. Pacific Right Whale	*Eubalaena japonica*	Endangered	12/27/2006	71 FR 77694
Table 1b. Species likely to be adversely affected by the proposed action.				
Humpback Whale	*Megaptera novaeangliae*	Endangered	12/02/1970	35 FR 18319
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	7/28/1978	43 FR 32800
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
Olive Ridley Sea Turtle	*Lepidochelys olivacea*			
Nesting aggregations on west coast of Mexico		Endangered	7/28/1978	43 FR 32800
All other Olive Ridley turtles		Threatened	7/28/1978	43 FR 32800
Green Sea Turtle	*Chelonia mydas*		7/28/1978	43 FR 32800
Nesting aggregations, west coast Mexico, Florida		Endangered	7/28/1978	43 FR 32800
All other Green turtles		Threatened	7/28/1978	43 FR 32800
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	7/28/1978	43 FR 32800

This section presents the biological or ecological information relevant to formulating the biological opinion, including population characteristics (population structure, size, trends) for the populations affected by the proposed action, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts, and other relevant information (USFWS & NMFS 1998). Factors affecting the species within the action area are described in more detail in the Environmental Baseline section. The status of the species is first summarized below, followed by more detailed descriptions for each of the 6 species addressed by this biological opinion (humpback whale and the 5 sea turtle species). No critical habitat has been designated for any of these listed species in the Pacific Ocean.

The 6 species addressed by this biological opinion have global distributions, and are listed globally at the species level (Table 1). Under the ESA, a sub-species or a "distinct population segment" (DPS) can also be listed (see ESA Section 7 Implementing Regulations; 50 CFR 402), but none are for these 6 species[2]. However, as shown above in Figure 1, the action area is relatively small compared to the distributions of the 6 species. Since the proposed action can only affect the populations of these species that occur within the action area, this opinion will focus on the affected populations, then relate the effects on the affected populations to the listed species in the Conclusion. In the absence of DPSs or other formally-recognized populations for these species, affected populations must first be identified. For the purposes of this opinion, the 6 species addressed by this biological opinion (humpback whale and the 5 sea turtle species) occur in the Pacific Ocean as the following Pacific populations:

1. Humpback whales: North Pacific and South Pacific populations. NMFS has identified 3 'stocks' in the North Pacific that overlap (see humpback whale Stock Assessment Reports), and likely function as a single population (SPLASH report; Calambokidis et al. 2008). The humpback whale recovery plan (NMFS 1991) states that the Central South Pacific and Eastern South Pacific stocks are 'population sub-units' in the South Pacific.
2. Loggerhead turtles: North Pacific and South Pacific populations. The most recent loggerhead 5-year status review (NMFS & USFWS 2007a) describes the status of loggerhead populations in geographic areas, including the North Pacific and South Pacific areas within the Pacific Ocean.
3. Leatherback turtles: Eastern Pacific and Western Pacific populations. The most recent leatherback 5-year status review (NMFS & USFWS 2007b) describes the status of leatherback populations in geographic areas, including the Eastern Pacific and Western Pacific areas within the Pacific Ocean.
4. Olive Ridley turtles: Eastern Pacific and Western Pacific populations. The most recent olive ridley 5-year status review (NMFS & USFWS 2007c) describes the status of olive ridley populations in geographic areas, including the Eastern Pacific and Western Pacific areas within the Pacific Ocean.
5. Green turtles: Western Pacific, Central Pacific, and Eastern Pacific populations. The most recent green turtle 5-year status review (NMFS & USFWS 2007d) describes the status of green turtle populations in geographic areas, including the Western Pacific, Central Pacific, and Eastern Pacific areas within the Pacific Ocean.
6. Hawksbill turtles: Western Pacific, Central Pacific, and Eastern Pacific populations. The most recent hawksbill turtle 5-year status review (NMFS & USFWS 2007e) describes the

[2] Certain nesting aggregations of olive ridley and green turtles are listed as 'endangered' while each species as a whole is listed as 'threatened' (Table 1). These nesting aggregations are treated as DPSs by NMFS and the USFWS. Also, on July 16, 2007, a petition to designate the North Pacific population of loggerheads as a DPS was received by NMFS. On November 16, 2007, NMFS published a 90-day finding that the petition may be warranted, thereby initiating a status review that is ongoing (72 FR 64585).

status of hawksbill turtle populations in geographically, including the Western Pacific, Central Pacific, and Eastern Pacific areas in the Pacific Ocean.

Not all of the Pacific populations identified above occur within the action area (Figure 1). All humpbacks in the action area are thought to be from the North Pacific population (NMFS 1991, Calambokidis et al. 2008), although these conclusions are not yet based on genetic evidence. For turtles, genetic work has been done to determine the source populations of individuals that interacted with the Hawaii-based longline fishery (shallow-set and deep-set components; Table 2). Over 100 loggerhead samples have been analyzed so far from the shallow-set fishery, and all were from the North Pacific population. The few loggerhead samples from the deep-set component were also from the North Pacific population. The 18 leatherbacks sampled from the shallow-set component were all from the Western Pacific population. However, 1 of the 12 leatherback samples from the deep-set component was from the Eastern Pacific population, but this interaction occurred approximately 6° of latitude south of the shallow-set action area. Olive ridley and green turtles interactions are very rare in the shallow-set component. However, olive ridleys are the most common turtle species in the deep-set component, and about two-thirds are from the Eastern Pacific population. Green turtle bycatch in the deep-set fishery is about evenly split between the Central and Eastern Pacific populations (Table 2).

Table 2. Genetics results from incidentally-caught turtles in HI-based shallow-set longline fishery, 1995-2007 (P. Dutton, personal communication, 7-08).

Species	Shallow-set		Deep-set	
	Samples	Source Pop^{n} (%)	Samples	Source Pop^{n} (%)
Loggerhead	125	125 N. Pacific (100%)	8	8 N. Pacific (100%)
Leatherback	18	18 W. Pacific (100%)	12	11 W. Pacific (92%) 1 E. Pacific (8%)
Olive ridley	3	1 W. Pacific (33%) 2 E. Pacific (67%)	75	23 W. Pacific (31%) 52 E. Pacific (69%)
Green	2	1 E. Pacific (50%) 1 C Pacific (50%)	15	8 E. Pacific (53%) 7 C. Pacific (47%)
Hawksbill	1*	C. Pacific (100%)	0	-

* Turtle was not caught alive in longline gear (rather, it drowned in a derelict net that was then inadvertently snagged by longline gear).

Table 3 below shows sea turtle interactions since the Hawaii-based shallow-set longline fishery re-opened in late 2004 (samples for which genetics results are available were taken from turtles caught between October 2004 and March 2008). During this 3 and a half year period, 45 loggerhead, 17 leatherback, 2 olive ridley, and 1 green turtle interactions occurred in the shallow-set fishery. The number of genetics samples taken and analyzed, and their results, are shown in Table 3 below.

Table 3. Species composition and source populations of incidentally-caught turtles in HI-based shallow-set longline fishery, 10/04-3/08 (P. Dutton, personal communication, 7-08).

Species	Total Caught	Genetics Samples Taken	Genetics Samples Analyzed	Source Pop^n (%)
Loggerhead	45	41	30	30 N. Pacific (100%)
Leatherback	17	9	6	6 W. Pacific (100%)
Olive ridley	2	2	0	N/A
Green	1	1	0	N/A
Hawksbill	0	0	0	N/A

Based on the genetics results shown in Table 2 above (i.e., all samples available from the shallow-set fishery since 1995), for the purposes of this opinion, the affected populations of the 6 species addressed by this biological opinion (humpback whale and the 5 sea turtle species) are defined as follows:

1. Humpback whales: North Pacific population.
2. Loggerhead turtles: North Pacific population.
3. Leatherback turtles: Western Pacific population.
4. Olive Ridley turtles: Eastern Pacific and Western Pacific populations.
5. Green turtles: Central Pacific and Eastern Pacific populations.
6. Hawksbill turtles: Central Pacific population.

"Affected populations" of sea turtle species are defined by direct interactions with the Hawaii-based shallow-set fishery, as determined by the genetics results summarized in Table 2 above. The focus of this opinion is on these directly affected populations. However, other populations may be indirectly affected because of the market transfer effect (see Section 7, Effects of the Action).

5.1 Humpback Whales

Information in this section is summarized from the humpback whale recovery plan (NMFS 1991), the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the November 1st, 2006 biological opinion on effects of purse seining on sea turtles (2006 BiOp, NMFS 2006a), the biological opinion on the effects of the activities associated with the Navy's Hawaii Range Complex (NMFS 2008b), the humpback whale Stock Assessment Reports (e.g., Angliss & Outlaw 2007), the SPLASH report (Calambokidis et al. 2008), and other sources cited below.

5.1.1. Population Characteristics

Humpback whales are distributed worldwide in all ocean basins, from subtropical to subpolar waters. They carry out seasonal migrations between warmer temperate and subtropical waters in winter for reproduction, and cooler temperate and subpolar waters of high prey productivity in summer for feeding. At least 13 'stocks' have been recognized based on geography of migratory behavior (NMFS 1991), 3 of which occur within the EEZs of the U.S. (Angliss & Outlaw 2007), although genetic evidence may eventually show that some stocks are part of the same population due to extensive gene flow. For example, an individual humpback whale migrated from the

Indian Ocean to the South Atlantic Ocean, demonstrating that individual whales may migrate from 1 ocean basin to another (NMFS 2008b).

Within the North Pacific Ocean, 3 stocks make up the North Pacific population:: 1) the Eastern North Pacific stock that migrates between coastal areas of Mexico/Central America and the west coast of the U.S./southern British Columbia; 2) the Central North Pacific stock that migrates between the Hawaiian Islands and northern British Columbia/Southeast Alaska; and 3) the Western North Pacific stock that migrates between Japan and the Kodiak Archipelago/ Aleutian Islands (Angliss & Outlaw 2007). Based on whaling statistics, North Pacific population of before 1905 was estimated to be 15,000, but this population was reduced by whaling to approximately 1,000 before it was placed under international protection in 1965 (NMFS 1991). Protection from whaling was effective, resulting in the North Pacific population rebounding to approximately 18,000 individuals by 2008. About half of the population winters in Hawaii (the Central North Pacific stock of the population). Annual growth rate for the North Pacific population over the last several decades is estimated at 4.9 to 6.8 percent, depending on which area and time frame are considered (Calambokidis et al. 2008).

5.1.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Depth preference, migration routes, and diving behavior may affect vulnerability of humpback whales to Hawaii-based shallow-set longline fishing. In Hawaii, humpback whales have been sighted as early in the season as October and as late as June, with most mating and calving occurring from December to April. They are generally found in water <600 ft (182 m) deep, and cow and calf pairs appear to prefer even shallower water. However, after arriving in Hawaiian wintering habitat, most humpback whales are unlikely to interact with the Hawaii-based shallow-set longline fishery because of the MHI Longline Fishing Prohibited Area, which varies from 50 to 75 nm from shore, depending on the location and season, as described above in the Action Area section. But while migrating between feeding grounds and Hawaii, humpback whales pass through the action area where they may be exposed to shallow-set longline gear. In addition, humpbacks are shallow divers, with most dives < 60 m. Since shallow-set longline gear is typically set so hooks are < 100 m deep, humpback dives largely overlap with this gear.

5.1.3. Threats to the Species

Whaling was formerly by far the most serious threat to the species, as described in the humpback whale recovery plan (NMFS 1991), the Stock Assessment Reports (e.g., Angliss & Outlaw 2007), and the SPLASH report (Calambokidis et al. 2008): From 1900 - 1965, nearly 30,000 whales were taken in modern whaling operations of the Pacific Ocean. There has been a prohibition on hunting humpback whales since 1966. Current threats include hookings and entanglement in fishing gear, ship strikes, tourism, noise, and possibly the effects of climate change.

Humpback whales are likely hooked or entangled by fishing gear throughout their global range, but data are scarce outside the U.S., especially in the Pacific. Reports of entangled humpback whales found swimming, floating, or stranded with fishing gear attached have increased in recent years in both Alaskan and Hawaiian waters. For example, there was a total of 23 entanglement reports from Hawaii from 2001 through 2006, but 16 of those were from 2005 and 2006. Many of the whales reported entangled in Hawaiian waters most likely brought the gear with them from higher latitude feeding grounds. While the whales are not typically at risk from drowning or immediate death, they are at increased risk of starvation, infection, physical trauma from the gear, and ship strikes as a result of the entanglement.

Many humpback whales are killed by ship strikes throughout the world, including along both coasts of the U.S. On the Pacific coast, a humpback whale is killed about every other year by ship strikes. Worldwide records of vessel collisions and stranding information indicate that humpback whales are one of the more common species to have ship strikes documented (Jensen and Silber 2003, Laist et al. 2001). Humpback whales, especially calves and juveniles, are highly vulnerable to ship strikes and other interactions with non-fishing vessels. Younger whales spend more time at the surface, are less visible and closer to shore, thereby making them more susceptible to collisions. Humpback whale distribution overlaps significantly with the transit routes of large commercial vessels that ply the waters off Alaska. Records of vessel collisions with large whales in Alaska indicate that strikes have involved cruise ships, recreational cruisers, whale watching catamarans, fishing vessels, and skiffs. Vessel lengths associated with these records ranged from approximately 20 feet to over 250 feet, indicating that all types and sizes of watercraft pose a threat of collision for whales. Between 2001 and 2005, reports of vessel collisions with humpback whales indicate an average of 5 whales struck per year in Alaska, whereas in Hawaii 3-4 vessel collisions with humpback whales were reported per year in 2001-2006. During the 2008 humpback whale season in Hawaii, there were 12 humpbacks reported with ship-strikes: 9 reported as hit by vessels, and 3 observed with wounds indicating a recent ship strike (D. Schofield, NMFS PIRO, pers. comm.).

Several other threats affect humpback whales throughout their range. For example, the Central North Pacific stock is the focus of a large whale watching industry in both Hawaii and Alaska. The growth of the whale watching industry is a concern for humpback whales since harassment may occur, preferred habitats may be abandoned, and fitness or survivability may be compromised if disturbance levels are too high. Also humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft. Their responses to noise are variable and have been correlated with the size and behavior of the whales when the noises occurred. Noise from the U.S. Navy's Low Frequency Active (LFA) sonar program, and other anthropogenic sources (e.g., hydrographic research and shipping noise) throughout the North Pacific may be of concern for this population (NMFS 2006a, NMFS 2008b)

Central North Pacific humpback whales travel to the Hawaiian Islands in the winter/spring to mate and give birth to their young, and then migrate to northern British Columbia and Southeast Alaska to forage on krill and zooplankton during the summer months (NMFS 1991). Global warming resulting from climate change may require humpbacks to extend their foraging range farther north, and also to increase the duration of their foraging periods (Moore and Huntington 2008). Climate change may also affect the wintering areas and ranges of humpback whales because seawater temperature appears to influence the selection of wintering areas. For example, surveys off of Central America (Rasmussen et al, 2007) and in the Northwestern Hawaiian Islands (Johnston et al, 2007) found that wintering areas all had seawater temperatures >21 ^{o}C.

5.1.4. Conservation of the Species

To minimize the possibility of collision and the potential for harassment in Hawaii and Alaska, NMFS implemented regulations that prohibits approach to humpback whales within 100 yards (90 m) when on the water or to operate an aircraft within 1,000 feet (300 m) (50 CFR 224.103). The regulations also make it unlawful to disrupt the normal behavior or prior activity of the whales, which may be manifested in several, specific ways that include but are not limited to interruptions to breeding, nursing or resting activities.

The Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) also protects the winter breeding, calving and nursing range of the largest Pacific population of the endangered humpback whale. The U.S. Congress designated the HIHWNMS on November 4, 1992, and the Hawaiian Islands National Marine Sanctuary Act designated the Sanctuary for the primary purpose of protecting humpback whales and their habitat within the Hawaiian Islands marine environment. It is the only National Marine Sanctuary dedicated to a species of whales and their habitat. The Sanctuary works collaboratively to conserve, enhance and protect humpback whales and their habitat by promoting and coordinating research, enhance public awareness, and fostering traditional uses by Native Hawaiians. The sanctuary is jointly managed by the sanctuary manager, the state of Hawaii co-manager, and other field staff via a cooperative Federal-state partnership. The Sanctuary is a series of 5 noncontiguous marine protected areas distributed across the main Hawaiian Islands (MHI). The total area of the Sanctuary is 1,370 square miles. Encompassing about half of the total Sanctuary area, the largest contiguous portion of the Sanctuary is delineated around Maui, Lanai, and Molokai. The 4 smaller portions are located off the north shore of Kauai, off Hawaii's Kona coast, and off the north and southeast coasts of Oahu (www.hawaiihumpbackwhale.noaa.gov).

The Hawaiian Islands Disentanglement Network is a community based network that was formed in 2002 in an attempt to free endangered humpback whales and other marine animals from life threatening entanglements and at the same time gather valuable information that will help mitigate the issue of marine debris and future entanglements (www.hawaiihumpbackwhale.noaa.gov). Between 2002 and 2007, the network received over 146 reports of animals in distress, 79 of those reports represented entangled animals, including humpback whales. The network has mounted 43 (on-the-water or in-the-air) responses to these reports. To date, 6 humpbacks reported entangled in Hawaii have been confirmed to have gear from Alaska. Five of these represent commercial pot gear. The mean distance traveled with this gear is at least 1200 nm. The greatest known straight line distance a whale may have carried gear is 2350 nm (between the Pribilof Islands in the Bering Sea and the island of Maui where the whale was first reported).

5.2 Loggerhead Turtles

Information in this section is summarized primarily from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the proceedings of a 2005 loggerhead workshop (WPFMC 2006b), Volume II of the State of the World's Sea Turtles Report (SWOT 2006-2007), the most recent loggerhead 5-year status review (NMFS & USFWS 2007a), the DSEIS for the proposed action (WPFMC 2008), and other sources cited below.

Although this species is listed globally (Table 1), it is difficult to characterize the global status and trend of the loggerhead turtle as a whole because the species consists of many populations (see Section 5.2.1 below) that may increase or decrease independently of one another. The most recent loggerhead 5-year status review (NMFS & USFWS 2007a) does not make a determination regarding global status and trends, but rather limits its conclusions to the status and trends of populations for which information is available. Some populations are increasing, but most populations for which information is available are decreasing, while there is not sufficient information to determine status and trends of many populations (NMFS & USFWS 2007a). The available information is not sufficient to determine the status and trend of the species as a whole.

5.2.1 Population Characteristics

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics. Natal homing of female loggerheads to nesting beaches maintains regional population structure, and loggerhead populations occur in at least the North Pacific, South Pacific, the Western North Atlantic, the Western South Atlantic, the East Atlantic, the Mediterranean, and the Indian Ocean. Populations in the Atlantic and Indian Oceans are much larger than in the Pacific, as described in the recent 5-year review (NMFS & USFWS 2007a). Of the 125 loggerheads sampled so far in bycatch of the Hawaii-based shallow-set longline fishery, all have been determined to be from the North Pacific population, based on genetic analyses (Table 2).

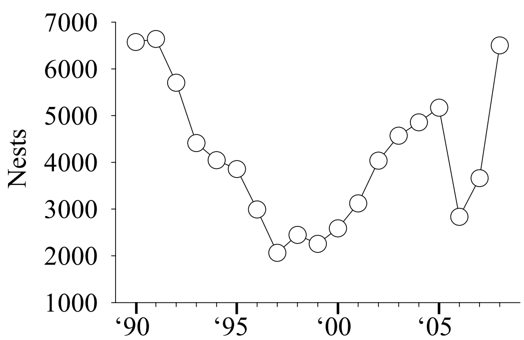

Figure 3. Loggerhead nests, Japan, 1990 – 2008 (data thru 2007 from Sea Turtle Association of Japan, as cited in Snover 2008; 2008 data estimated from Matsuzawa 2008, as explained in text).

North Pacific loggerheads nest exclusively in Japan, where monitoring of loggerheads nesting began in the 1950s on some beaches, and grew to encompass all known nesting beaches starting in 1990 (Kamezaki et al. 2003, Kamezaki et al., in press). The annual total number of nests for all nesting beaches combined are shown in Figure 3 for 1990-2008. Data for 1990 to 2007 were provided by the Sea Turtle Association of Japan, and used in Snover (2008). The majority of nesting is typically completed by the end of July, and the 2008 data point is an estimate based on a total of 3,927 nests through the end of July 2008 on Yakushima provided by the Sea Turtle Association of Japan (STAJ) on August 15, 2008 (Matsuzawa 2008). In recent years, approximately 60 percent of the total nests in Japan have been laid on Yakushima (Sea Turtle Association of Japan unpublished data; Kamezaki et al., In press). Hence, the total for 2008 is estimated in this opinion at 6,500 nests based on the best available data from STAJ at the time this opinion was completed (Matsuzawa 2008). However, the actual total for 2008 may exceed 10,000 nests, after the STAJ data are tallied and verified. Various conservation measures are funded by WPFMC and implemented by STAJ to protect nests and nesting habitat, as described in Section 5.2.4.

For the 19-year period 1990-2008, the total number of nests per year for the North Pacific population ranged between 2,064 – 6,638 nests (using 6,500 as the 2008 total, not 10,000).

Assuming a clutch frequency of 3.49 per female per year (NMFS 2005), the number of nesting females per year during 1990-2008 was 591 – 1,902. The total number of adult females in the population was estimated at 2,915 for the period 2005-07 by Snover (2008).

For the reasons discussed in Section 5.1, population estimates for sea turtles are problematic due to lack of demographic information. Few population estimates are available, especially for Pacific populations. However, in order to estimate loggerhead and leatherback bycatch in Pacific longline fisheries, Lewison et al. (2004) made several assumptions regarding numbers of nesting females, remigration interval, the proportion of nesting-age females to the total population, and sex ratio, leading to a total population estimate across all life stages in 2000 for Pacific loggerheads (North Pacific and South Pacific populations combined) of 335,000 individuals (all ages, both sexes). In addition, they estimated that approximately 20 percent of the population (67,000) was in size classes susceptible to longline fishing (Lewison et al. 2004). Due to the uncertainty of the assumptions used to derive sea turtle population estimates, in this opinion NMFS uses nesting or nesting female data as population indices.

Nesting data from the 2 nesting beaches that have been monitored since the 1950s suggest that the North Pacific loggerhead population declined by 50-90% in the latter half of the 20^{th} century (Kamezaki et al. 2003). However, from 1999 to 2005, annual nests more than doubled (Kamezaki et al., In press), before declining in 2006 and 2007 (Figure 3). Preliminary data for 2008 indicate at least a similar number of nests as the early 1990s (Figure 3, Matsuzawa 2008).

5.2.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Loggerhead life history is characterized by early development in the oceanic (pelagic) zone followed by later development in the neritic zone over continental shelves. The oceanic developmental period may last for over a decade, followed by recruitment to the neritic zone where maturation is reached. Adults forage primarily in neritic zones rather than oceanic zones, but adult migrations across oceanic zones may be undertaken for reproduction (NMFS 2004a, 2005, 2006a; NMFS & USFWS 2007a). Given that the action area is oceanic, the main aspects of North Pacific loggerhead life history affecting their vulnerability to Hawaii-based shallow-set longline fishing are juvenile foraging behavior in the oceanic zone, and migration across the oceanic zone, as discussed below.

The Hawaii-based shallow-set fishery interacts mostly with juvenile loggerhead turtles, typically 50 – 80 cm carapace length. In the oceanic zone of the central north Pacific Ocean, foraging juvenile loggerheads congregate in the boundary between the warm, vertically-stratified, low chlorophyll water of the subtropical gyre and the vertically-mixed, cool, high chlorophyll transition zone water. This boundary area is referred to as the Transition Zone Chlorophyll Front, and is favored foraging habitat for both juvenile loggerhead turtles (Polovina et al. 2006, Kobayashi et al. 2008) and swordfish, hence bringing the loggerheads into contact with the shallow-set fishery. Data collected from stomach samples of juvenile loggerheads indicate a diverse diet of pelagic food items (NMFS 2006a, Parker et al. 2005).

In addition to the geographic overlap of juvenile loggerheads with the shallow-set fishery, tagging studies indicate that juvenile loggerheads are shallow divers that forage frequently at depths fished by shallow-set gear (<100 m; Polovina et al. 2003, 2004). Because juvenile loggerheads forage within the action area, and they often forage at depths fished by the shallow-set fishery, this species is the most susceptible of the Pacific sea turtle species to interactions with shallow-set gear: About 75 percent of the bycaught turtles observed in the shallow-set fishery from 1994 to early 2008 were loggerheads, whereas only 10 percent of the deep-set observed bycatch was loggerheads during this period. Because deep-set gear is typically set >100 m depth, loggerheads rarely encounter it. The opposite occurs with olive ridleys, which have little bycatch in the shallow-set fishery but make up the majority of the turtle bycatch in the deep-set fishery (PIRO Observer Program).

Loggerheads are a slow-growing species that reach sexual maturity at 25 to 37 years of age, depending on the subpopulation (NMFS & USFWS 2007a). Generation time for the North Pacific population is estimated at 33 years (Snover 2008). North Pacific loggerhead range spans the entire north Pacific Ocean, hence migration of juveniles and adults between terrestrial (nesting), near-shore and pelagic habitats may result in criss-crossing of the action area during all life stages, thereby exposing an individual loggerhead to shallow-set longlining for many years or even decades. Juveniles are likely more abundant than adults in the action area, as most loggerhead bycatch is from this life history stage in the Hawaii-based shallow-set longline fishery. However, adult loggerhead interactions occasionally occur in the fishery (NMFS 2004a, 2005, 2006a).

5.2.3 Threats to the Species

Global threats to loggerhead turtles are spelled out in the recent 5-year review (NMFS & USFWS 2007a), and threats to the North Pacific loggerhead population are described in more detail in the proceedings of the 2005 workshop (WPFMC 2005). A Council workshop was held on December 19-20, 2007 to bring together loggerhead experts in order to provide NMFS with the best available data on loggerhead issues for use in this opinion. Proceedings were not available at the time this opinion was signed, but some presentations were used (e.g., Ishihara 2007). The major threats to the species, according to these sources, are fishing bycatch, alteration of nesting habitat, and direct harvest and predation, which are briefly described below. In addition, climate change appears to be a growing threat to this species, and is also mentioned below.

The most serious threat to loggerhead turtles is believed to be incidental capture (bycatch) in fisheries, including longline, drift gillnet, set gillnet, bottom trawling, dredge, and trap net fisheries that are operated either on the high seas or in coastal areas throughout the species' range. In the Atlantic, where the loggerhead population is much larger than in the Pacific, fisheries kill tens of thousands of turtles annually (NMFS & USFWS 2007a). Bycatch and fisheries-related strandings numbering in the thousands annually have been reported from gillnet and longline fisheries operating in loggerhead 'hotspots' off of Baja Mexico (Peckham et al. 2007, 2008). Peckham et al. (2007) was funded by the Council, and this paper provides the first estimates of these major artisanal fishing impacts on North Pacific loggerheads in their major foraging ground.

Bottom trawl fisheries operating out of Australia and New Zealand are thought to result in high bycatch and high mortality rates. In the north Pacific, longline fisheries operating out of Hawaii were estimated to kill hundreds of loggerheads a year before the fishery was closed in 2001, and then modified and reopened with measures to minimize byactch and post-hooking mortality in 2004. However, longline fisheries operating out of other countries are still using traditional methods (J style hooks with squid bait), and are likely injuring and killing at least many hundreds of turtles annually in the North Pacific (NMFS & USFWS 2007a). In addition, coastal fisheries using more traditional methods, like trap nets or pound nets in Japan, are also resulting in high mortality (Ishihara 2007). Pound net and gillnet fisheries are reported to have declined or disappeared around the primary North Pacific loggerhead nesting beaches at Yakushima Island, Japan (Ohmuta 2006), however, further investigation of potential nearshore fishery threats is needed.

Destruction and alteration of loggerhead nesting habitats are occurring throughout the species' global range, especially coastal development, beach armoring, beachfront lighting, and vehicular/pedestrian traffic. Coastal development includes roads, buildings, seawalls, etc., all of which reduce suitability of nesting beaches for nesting by reducing beach size and restricting beach migration in response to environmental variability. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss (NMFS & USFWS 2007a). In Japan, where the entire North Pacific loggerhead population nests, many nesting beaches are lined with concrete armoring, thereby causing turtles to nest below the high tide line where most eggs are washed away unless the eggs are moved to higher ground (Matsuzawa 2006). Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicle and foot traffic on beaches, which may result in compaction of nests and reduction of emergence success (NMFS & USFWS 2007a). In Japan, threats to nesting and nest success include light pollution, poorly managed ecotourism operations, and trampling due to the thriving tourist economy on Yakushima Island, and increasing numbers of beachfront hotels and roadways (Kudo et al. 2003).

Deliberate hunting of loggerheads for their meat, shells, and eggs is reduced from previous levels, but still exists in some parts of the species' range. The South Pacific loggerhead population nests in Australia and New Caledonia. Laws prohibit harvest of turtles or eggs in Australia, but harvest of nesting females may be common in New Caledonia (Limpus et al. 2006). The North Pacific loggerhead population nests exclusively in Japan, especially on Yakushima Island. In 1973, a law was enacted on Yakushima Island prohibiting harvest of sea turtle eggs. A similar law was enacted in 1988 encompassing most of the other loggerhead nesting beaches in Japan, resulting in great reductions in egg harvest. The 1973 law may in part explain the increasing number of nesting turtles from 2001 to 2005, given that loggerheads mature in about 29 years (Ohmuta 2006). Predation of eggs is a common problem throughout the species' range, for example by raccoons and feral pigs in the southeast U.S., by feral foxes in Australia, and by feral dogs in New Caledonia (NMFS & USFWS 2007a).

Loggerhead turtles are probably already being affected by anthropogenic climate change. The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (NMFS & USFWS 2007a). Warmer temperatures within the nest chamber produce females while cooler ones produce males. Loggerheads nesting in the US are already skewed towards females (Hansen et al. 1998). As global temperatures increase, so will sand temperatures, which in turn will alter the thermal regime of incubating nests and alter natural sex ratios within hatchling cohorts, likely toward a larger proportion of females. Sea level rose approximately 15 cm during the 20th century (Baker et al. 2006) and further increases are expected, resulting in inundation of nesting beaches. While under natural conditions beaches can move landward or seaward with fluctuations in sea level, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Erosion due to increased typhoon frequency and extreme temperatures are documented and known to cause high nest mortality (Matsuzawa, 2006). Lower breeding capacity of North Pacific loggerheads in years following higher sea surface temperatures may reflect reduced ocean productivity during warmer years, an indirect effect of climate change on this species (Chaloupka et al. 2008a).

5.2.4 Conservation of the Species

Considerable effort has been made since the 1980s to document and reduce loggerhead bycatch in fisheries around the world, as this is the highest conservation priority for the species. In the U.S., observer programs have been implemented in most federally-managed fisheries to collect bycatch data, and several strategies have been pursued to reduce both bycatch rates and post-hooking mortality. These include developing gear solutions to prevent or reduce capture (e.g., circle hooks) or to allow the turtle to escape without harm (e.g., turtle exclusion devices), implementing seasonal time-area closures to prevent fishing when turtles are congregated, and modifying existing gear (e.g., reducing mesh size of gillnets; NMFS & USFWS 2007a). For example, switching to large circle hooks and mackerel bait in 2004 resulted in approximately 90 percent fewer loggerhead interactions in the Hawaii shallow-set longline fishery (Gilman et al. 2007a, WPFMC 2008). Since 2004, WPFMC has been supporting projects to reduce loggerhead bycatch and mortality in gillnet and longline fisheries that operate in a loggerhead foraging hotspot off Baja California, Mexico. Mortality reduction workshops with fishermen have been conducted, observers have been placed on local boats to quantify interaction rates and ensure that any live loggerheads bycaught in halibut gillnets are returned to the ocean, and agreements have been reached to retire gear (Peckham et al. 2007, WPFMC 2008).

Conservation efforts have also focused on protecting nesting beaches, nests, and hatchlings. For example, WPFMC has been working with Sea Turtle Association of Japan (STAJ) since 2004 to protect loggerhead nests and hatchlings at several nesting beaches in southern Japan, including on Yakushima Island where more than 50 percent of North Pacific loggerhead nesting occurs (Kamezaki et al., In press). Beach management activities include conducting nightly patrols during the summer nesting season to relocate nests from erosion prone areas, protect nests from predators and people with mesh and fences, and cool nests with water to prevent overheating during incubation. STAJ has developed techniques for nest relocation that now result in an average of 60 percent hatchling success rates (compared to nearly zero survival of the same nests laid in erosion prone areas). Nest relocation in 2004-07 resulted in an estimated 100,000 hatchlings being released that otherwise may have been lost (WPFMC 2008).

The conservation and recovery of loggerhead turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the Food and Agriculture Organization's (FAO) Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC), the Convention on International Trade in Endangered Species (CITES), and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas. Moreover, as shown by the above examples from Hawaii and Baja Mexico, international efforts are growing to reduce sea turtle interactions and mortality in artisanal and industrial fishing practices (Gilman et al. 2007b; Peckham et al. 2007; NMFS & USFWS 2007a).

5.3 Leatherback Turtles

Information in this section is summarized primarily from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the proceedings of a 2004 leatherback workshop (WPFMC 2005), Volume II of the State of the World's Sea Turtles Report (SWOT 2006-2007), the most recent leatherback 5-year status review (NMFS & USFWS 2007b), the May 2007 Leatherback focus issue of the journal Chelonian Conservation and Biology, the Turtle Expert Working Group's report on Atlantic leatherback (TEWG 2007), the DSEIS for the proposed action (WPFMC 2008), and other sources cited below.

Although this species is listed globally (Table 1), it is difficult to characterize the global status and trend of the leatherback turtle as a whole because the species consists of many discrete populations (see Section 5.3.1 below) that may increase or decrease independently of one another. The most recent leatherback 5-year status review (NMFS & USFWS 2007b) does not make a determination regarding global status and trends, but rather limits its conclusions to the status and trends of populations for which information is available. Some populations are stable or increasing, but other populations for which information is available are either decreasing or have collapsed, while there is not sufficient information to determine status and trends of many populations (NMFS & USFWS 2007a, TEWG 2007). The recent discovery of the world's fourth-largest leatherback nesting area on the Atlantic coast of Panama and Columbia (Patino-Martinez et al. 2008) supports the Turtle Experts Working Group's (TEWG) conclusion that leatherback nesting is increasing in parts of the Atlantic and Caribbean (TEWG 2007). However, as with loggerheads, the available information is not sufficient to determine the status and trend of the species as a whole.

5.3.1 Population Characteristics

Leatherbacks have the widest distribution of any sea turtle and can be found from the equator to subpolar regions in both hemispheres. In the Pacific, tagging studies have shown that leatherbacks can traverse entire ocean basins when foraging. Nesting occurs on tropical coastlines and insular beaches. However, the global leatherback population is not homogeneous because natal homing of female leatherbacks to nesting beaches maintains regional population structure. Leatherback populations occur in at least the Western Pacific, the Eastern Pacific, the Indian Ocean, Florida, the Caribbean, Africa, and Brazil, with further population structure at smaller spatial scales in some areas (e.g., the Caribbean), as described in the recent 5-year review (NMFS & USFWS 2007b) and the Turtle Expert Working Group's report on Atlantic leatherback (TEWG 2007).

All 18 leatherbacks sampled so far in bycatch of the Hawaii-based shallow-set longline fishery are from the Western Pacific population, based on genetic analyses. However, of the 12 leatherbacks sampled so far in bycatch of the deep-set component of the Hawaii-based longline fishery, 1 individual was determined to be from the Eastern Pacific population (Table 2). This interaction occurred 6° of latitude south of the shallow-set action area. Recent tagging studies have shown that Eastern Pacific females migrate southward to the South Pacific after nesting in Costa Rica (Shillinger et al. 2008), whereas Western Pacific females migrate northward to the North Pacific after nesting in Papua (Benson et al. 2007a, b). Individual Eastern Pacific leatherbacks are not considered likely to interact with the Hawaii-based shallow-set longline fishery, as modified by the proposed action, because: (1) 100 percent of the sampled leatherbacks from the shallow-set fishery (18/18) were of Western Pacific origin (Table 2); (2) the 1 Eastern Pacific interaction in the deep-set fishery was 6° of latitude south of the shallow-set action area; and (3) a recent study of 46 tagged leatherbacks tracked over 12,095 cumulative tracking days demonstrated that Eastern Pacific leatherbacks migrate south of the action area after nesting (Shillinger et al. 2008). However, Eastern Pacific leatherbacks may benefit from the "market transfer effect" associated with the proposed action (see Section 7 below).

Western Pacific leatherbacks nest primarily in Papua Indonesia (formerly Irian Jaya, hereafter referred to as Papua), Papua New Guinea (PNG), and the Solomon Islands. Minor nesting occurs on Vanuatu and possibly elsewhere in the region. The total number of nests per year in the Western Pacific population was estimated at 5,067 – 9,176 for the period 1999-2006 (Dutton et al. 2007). Based on 5,067 – 9,176 Western Pacific nests, estimates of nesting females (844 – 3294) and breeding females (2,110 – 5,735) in this population were derived, but the authors recommended using nest numbers instead of estimated female numbers because of uncertainty in the assumptions (Dutton et al. 2007). Estimates derived from Dutton et al. (2007) suggest that during 1999-2006, two-thirds of the nesting occurred in Papua, most of the remainder occurred in PNG and the Solomon Islands, and a small fraction (about 1 percent) occurred in Vanuatu. Of the 28 nesting sites identified by Dutton et al. (2007) in these 4 countries, nesting data for more than 5 years are only available for the Jamursba-Medi site (hereafter referred to as the 'Jamursba-Medi component' of the Western Pacific population). The status and trends at Jamursba-Medi are described below, followed by a description based on the little information that is available for the other sites (hereafter collectively referred to as the 'non-Jamursba-Medi component' of the Western Pacific population).

5.3.1.1 Jamursba-Medi Component of the Western Pacific Population

The largest nesting site for the Western Pacific population is at Jamursba-Medi, with an estimated mean of 2,733 nests annually in 1999-2006, making up approximately 38 percent of the total estimated nesting for the Western Pacific population during this time period (Dutton et al. 2007). Nest data were not collected consistently or reliably until the early 1990s, hence most reports of Jamursba-Medi nesting trends start at that time. However, anecdotal reports from the early 1980s suggest that nesting at Jamursba-Medi declined during the decade preceding initiation of nest counts in 1993 (Dutton et al., Hitipeuw et al. 2007).

Leatherback nesting at Jamursba-Medi occurs primarily between April and October. Nest data from Jamursba-Medi are highly variable from year to year, and no data are available from 1998. Nesting data suggest a decline from the 1993-1997 period to the 1999-2007 period, although the higher nesting level during 1993-1997 is due primarily to the high data point for 1996 (Figure 4; annual data points based on totals for Apr-Oct from Hitipeuw et al. 2007, Wurlianty & Hitipeuw

2007). Nesting during the 1999-2007 period has fluctuated annually, with the overall trend stable or slightly declining. These nesting data may be over-estimates: Nesting data collected from the same beaches during the same seasons and years by Japanese turtle researcher Hiroyuki Suganuma (Suganuma 2005, Minami 2008) were 31 – 38 percent lower for 2003 - 2007 than the data points shown in Figure 4, which are from Hitipeuw et al. (2007).

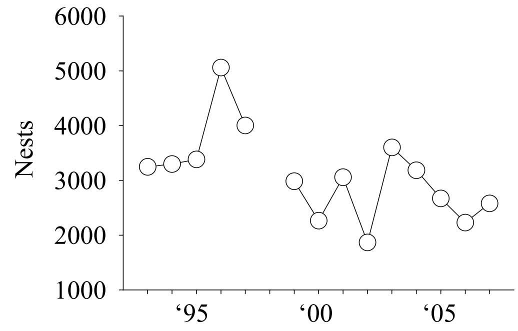

Figure 4. Leatherback nests, Jamursba-Medi, 1993 – 2007 (no data for1998; Hitipeuw et al. 2007; Wurlianty & Hitipeuw 2007).

5.3.1.2 Non-Jamursba-Medi Component of the Western Pacific Population

Besides Jamursba-Medi, Dutton et al. (2007) reported leatherback nesting at 27 other sites in the Western Pacific region (6 in Papua, 10 in PNG, 8 in the Solomon Islands, and 3 in Vanuatu). Approximately 62 percent of the leatherback nesting in 1999-2006 occurred at these 27 sites, while the remaining 38 percent occurred at Jamursba-Medi, the largest nesting site. The largest of the non-Jamursba-Medi sites is Wermon, 30 km east of Jamursba-Medi. Wermon produced approximately 30 percent of all Western Pacific nests in 1999-2006 (Dutton et al. 2007). Leatherback nesting at Wermon occurs primarily between November and March, the opposite of Jamursba-Medi (Wurlianty & Hitipeuw 2007).

Nest counts have been carried out at Wermon since 2002, thus data are available for the 5 year period from 2002–03 (Nov-Oct) to 2006-07 (Nov-Oct): 2002-03 = 1,788 nests, 2003-04 = 2,881 nests, 2004-05 = 2,080 nests, 2005-06 = 1,345 nests, and 2006-07 = 1,319 nests. Since the first complete survey in 2002-03, nesting levels at Wermon have been variable, with fewer nests during the last 2 years (2005-06, 2006-07) than in previous years (NMFS 2008h).

The Huon Coast of PNG hosts an estimated 50 percent of leatherback nesting in that country (NMFS 2008h). Anecdotal information in Quinn et al. (1983), Quinn and Kojis (1985), and Bedding and Lockhart (1989) suggest that 200 to 300 females nested annually between Labu Tali and Busama on the Huon Coast in the late 1980s (summarized in Hirth et al. 1993), but less than 50 females nested annually in 2005-06 and 2006-07 at this location (Pilcher 2006, 2007). Further south along the Huon Coast, an estimated 260 females nested at Kamiali during the 2001-02 nesting season, but only 30 were counted during the 2006-07 nesting season on the same section of beach (WPFMC 2008, Figure 15). Current monitoring data indicate continuing impacts to leatherbacks from egg harvesting, beach erosion and wave inundation, and domestic dog predation (NMFS 2008h).

The Solomon Islands support leatherback nesting (Steering Committee Bellagio II 2008) that 30 years ago was widely distributed across at least 61 beaches (Vaughan 1981). Dutton et al. (2007) estimated that approximately 640 – 700 nests were laid annually in the Solomon Islands in 1999 – 2006. No information exists regarding populations trends over time, but it is believed that local consumption of turtles and eggs has reduced nesting populations over the last few decades (Steering Committee Bellagio II 2008, NMFS 2008h).

Leatherback turtles have only recently been reported nesting in Vanuatu. Petro et al (2007) reviewed archival data and unpublished reports, and interviewed residents of coastal communities, all of which suggested that leatherback nesting has declined in recent years. There appears to be low levels of scattered nesting on at least 4 or 5 beaches with a total of approximately 50 nests laid per year (Dutton et al. 2007). Adult leatherbacks are opportunistically hunted for meat in some areas. In addition, leatherback eggs are occasionally collected from these beaches (Steering Committee Bellagio II, 2008, NMFS 2008h).

5.3.1.3 Conclusion for Western Pacific Population

Population estimates for sea turtles are problematic due to lack of demographic information. Few population estimates are available, especially for Pacific populations. The total number of Pacific leatherbacks susceptible to longline fishing was estimated at 32,000 individuals in 2000 (Lewison et al. 2004). The total number of adult females in the Jamursba-Medi component of the Western Pacific population was estimated at 1,515 for the period 2005-07 by Snover (2008), which is estimated to make up 38 percent of the population (Dutton et al. 2007), giving a total number of adult females in the Western Pacific population of 1,515/0.38 = 3,987. This estimate lies within the range of 2,110 – 5,735 breeding females estimated for this population by Dutton et al. (2007). However, due to the uncertainty of the assumptions used to derive sea turtle population estimates, in this opinion NMFS uses nesting or nesting female data as population indices, as recommended by Dutton et al. (2007).

5.3.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Leatherback life history is characterized by juvenile and adult life history stages occurring primarily in the oceanic zone. Adult leatherbacks range more widely across oceanic habitat than any other reptile, including into subpolar waters (NMFS 2004a, 2005, 2006a; NMFS & USFWS 2007b). Recent tagging studies have shown that adults sometimes migrate to highly productive upwelling areas near continental shelves, such as off Oregon and Washington (Benson et al. 2007a). Given that the action area is oceanic, the main aspects of Western Pacific loggerhead life history affecting their vulnerability to Hawaii-based shallow-set longline fishing are migration and foraging behavior, as discussed below.

The Hawaii-based shallow-set fishery interacts mostly with adult leatherback turtles (WPFMC 2008). In recent years, nesting females of the Western and Eastern Pacific populations have been tagged, allowing tracking of their post-nesting migration routes. Western Pacific leatherbacks nesting during the northern summer (Jun-Aug) in Papua go northeast, passing through the action area on their way to productive temperate waters off of the west coast of the U.S (Benson et al. 2007a). In contrast, leatherbacks nesting during the northern winter (Nov-Mar) in Papua migrate southeast after nesting, towards Australian and New Zealand waters (Benson et al. 2007a). Additionally, leatherbacks nesting in PNG have also been documented to migrate southeast after nesting (Benson et al. 2007b). Eastern Pacific leatherbacks are not known to migrate through the action area after nesting – rather, they migrate south to foraging areas off of South America (Shillinger et al. 2008). Post-nesting migration routes of tagged females can be viewed on the Tagging of Pacific Predators (TOPP) website. Migratory routes of non-breeding adult females, and of adult males, are unknown for Western and Eastern Pacific leatherbacks.

Adult leatherbacks typically feed on pelagic soft-bodied animals, especially jellyfish, siphonophores, and tunicates. Despite the low nutritive value of their prey, leatherbacks grow rapidly and attain large sizes, hence they must consume enormous quantities of prey. Most water content of the prey is expelled before swallowing to maximize nutritive value per unit volume. Leatherbacks feed from near the surface to depths exceeding 1,000 m, including nocturnal feeding on tunicate colonies within the deep scattering layer (Spotila 2004). Although leatherbacks can dive deeper than any other reptile, most dives are < 80 m, thus primary foraging depth overlaps with fishing depth of the Hawaii-based shallow-set fishery. Approximately 69 percent of the observed leatherback interactions in the Hawaii-based longline fishery (shallow-set and deep-set component combined) from 1994 to early 2008 were in the shallow-set component (PIRO Observer Program). Migrating leatherbacks spend a majority of their time submerged and display a pattern of continual diving. Further, they appear to spend almost the entire portion of each dive traveling to and from maximum depth, suggesting continual foraging along the entire depth profile (NMFS 2006a).

5.3.3 Threats to the Species

Global threats to leatherback turtles are spelled out in the recent 5-year review (NMFS & USFWS 2007b), and threats to the Western Pacific leatherback population are described in more detail in the proceedings of a 2004 leatherback workshop (WPFMC 2005). The major threats to the species, according to these 2 documents, are fishing bycatch, alteration of nesting habitat, and direct harvest and predation, which are briefly described below. In addition, climate change appears to be a growing threat to this species, and is also mentioned below.

A major threat to leatherback turtles is believed to be bycatch in fisheries, including longline, drift gillnet, set gillnet, bottom trawling, dredge, and trap net fisheries that are operated on the high seas or in coastal areas throughout the species' range. In the Atlantic, where the leatherback population is much larger than in the Pacific, fisheries bycatch results in the mortality of thousands of turtles annually. In the eastern Pacific, significant bycatch has been reported in longline and gillnet fisheries, especially those operating off the west coast of South America. Fisheries operating out of Australia and New Zealand are thought to result in high bycatch and high mortality rates of Western Pacific leatherbacks that migrate there after nesting. In the north Pacific, the Hawaii-based shallow-set longline fishery was estimated to kill many leatherbacks annually before the fishery was closed in 2001, then modified and reopened with measures to minimize bycatch and post-hooking mortality in 2004. However, other longline fisheries operating out of other countries are still using traditional methods (J style hooks with squid bait), and are likely killing at least hundreds of leatherbacks annually in the Pacific. In addition, coastal fisheries using gillnetting or trap nets are also resulting in high mortality (NMFS & USFWS 2007b).

Destruction and alteration of leatherback nesting habitats are occurring throughout the species' global range, especially coastal development, beach armoring, beachfront lighting, and vehicular/pedestrian traffic. Coastal development includes roads, buildings, seawalls, etc., all of which reduces suitability of nesting beaches for nesting by reducing beach size. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Fortunately, some of the major nesting beaches for leatherback turtles, including those for the Western Pacific population, occur in remote areas where the development described above is less prevalent (NMFS & USFWS 2007b).

Harvest of leatherbacks for their meat and eggs has resulted in the extirpation of major nesting aggregations, such as occurred in the 1980s and 90s in Malaysia and Mexico due to egg collection (potentially exacerbated by simultaneous mortality of adults due to fisheries bycatch). Globally, harvest is reduced from previous levels, but in the Western Pacific egg harvest continues throughout the species' range, including hunting of adults near the primary nesting beaches. Predation of eggs is a major problem for Western and Eastern Pacific leatherbacks, for example by feral pigs in Papua and feral dogs in PNG (NMFS & USFWS 2007b).

Leatherback turtles have most likely already been affected by anthropogenic climate change. The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (NMFS & USFWS 2007b). As global temperatures continue to increase, so will sand temperatures, which in turn will alter the thermal regime of incubating nests and alter natural sex ratios within hatchling cohorts, presumably toward a heavier female bias. Sea level rose approximately 15cm during the 20th century (Baker et al. 2006) and further increases are expected, resulting in inundation of nesting beaches. While under natural conditions beaches can move landward or seaward with fluctuations in sea level, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. This may be more of a problem for Eastern Pacific leatherbacks that nest in Costa Rica where development is occurring rapidly near nesting beaches, then for Western Pacific leatherbacks that nest mostly or entirely on undeveloped beaches. Leatherbacks range more widely than any other reptile species, and feed primarily on jellyfish which may become more common with global warming, so effects of climate change on leatherback foraging are difficult to predict (NMFS & USFWS 2007b).

5.3.4 Conservation of the Species

Considerable effort has been made since the 1980s to document and address leatherback bycatch in fisheries around the world. In the U.S., observer programs have been implemented in most federally-managed fisheries to collect bycatch data, and several strategies have been pursued to reduce both bycatch rates and post-hooking mortality. These include developing gear solutions to prevent or reduce capture (e.g., circle hooks) or to allow turtles to escape without harm (e.g., turtle exclusion devices, but may be too small for adult leatherbacks), implementing seasonal time-area closures to prevent fishing when turtles are congregated, and modifying existing gear (e.g., reducing mesh size of gillnets; NMFS & USFWS 2007b). For example, switching to large circle hooks and mackerel bait in 2004 resulted in approximately 85 percent fewer leatherback interactions in the Hawaii shallow-set longline fishery (Gilman et al. 2007a, WPFMC 2008).

Since 2003, WPFMC has been supporting projects to reduce leatherback hunting and egg collection in Papua and PNG. At Wermon and Jamursba-Medi[3] in Papua, village rangers were

[3] Wermon project supported by the Council and the Jamursba-Medi supported by NMFS SWFSC and WWF-Indonesia.

hired to collect population demographic data (tag turtles and record nesting activity), and through their presence on the beach have been able to guard leatherback nests from predation by feral pigs and egg collectors, resulting in protection of approximately 4,400 nests and 143,000 hatchlings at Wermon alone through 2006. From 2003 to 2007, WPFMC worked with local villagers to reduce harvest of adult leatherbacks in the coastal foraging habitats of Kei Kecil Islands of Papua Indonesia. This project resulted in identification of a new harvest baseline from a previously estimated harvest level of 100 individuals per year (Suarez and Starbird 1996) to 50 adults per year. From 2003 to 2007, WPFMC worked with local villagers in the Huon area of PNG to reduce harvest of adults and eggs, and to protect nesting beaches and nests (Steering Committee Bellagio II 2008, WPFMC 2005, 2008).

The conservation and recovery of leatherback turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the FAO Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, CITES, and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas (Gilman et al. 2007b; NMFS & USFWS 2007b).

5.4 Olive Ridley Turtles

Information in this section is summarized primarily from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the most recent olive ridley 5-year status review (NMFS & USFWS 2007c), the DSEIS for the proposed action (WPFMC 2008), and other sources cited below.

5.4.1 Population Characteristics

Olive ridleys are the most abundant sea turtle species and are known for major nesting aggregations called *arribadas* with tens of thousands to over a million nests annually, the largest of which occur on the west coasts of Mexico and Costa Rica, and on the east coast of India. Minor *arribadas* and solitary nesters are found throughout the remaining tropical and warm temperate areas of the world, except in the western Pacific and eastern Indian Oceans where the species is uncommon. Population structure and genetics are poorly understood for this species, but populations occur in at least the Eastern Pacific, Western Pacific, Eastern Indian, Central Indian, Western Indian, West Africa, and Western Atlantic areas (Spotila 2004, NMFS & USFWS 2007c). The Eastern Pacific population includes nesting aggregations on the west coast of Mexico, which are listed under the ESA as endangered. All other olive ridleys are listed as threatened (Table 1).

The Eastern Pacific population is thought to be increasing, while there is inadequate information to suggest trends for the other populations. The global status of olive ridleys is described in the most recent 5-year status review (NMFS & USFWS 2007c). While olive ridleys are the most common turtle species that interact with the Hawaii-based deep-set longline fishery, they are very uncommon in the shallow-set fishery. Only 3 genetics samples have been collected from the shallow-set fishery and analyzed since 1995; 2 were from the Eastern Pacific population and 1 was from the Western Pacific population (Table 2).

Eastern Pacific olive ridleys nest primarily in the world's largest *arribadas* on the west coasts of Mexico and Costa Rica. Since reduction or cessation of egg and turtle harvest in both countries in the early 1990s, annual nest totals have increased substantially. On the Mexican coast alone, in 2004-2006, the annual total was estimated at 1,021,500 – 1,206,000 nests annually (NMFS & USFWS 2007c). Eguchi et al. (2007) counted olive ridleys at sea, leading to an estimate of 1,150,000 – 1,620,000 turtles in the eastern tropical Pacific in 1998-2006 (Eguchi et al. 2007). In contrast, there are no known *arribadas* of any size in the Western Pacific, and apparently only a few hundred nests scattered across Indonesia, Thailand and Australia. Data are not available to analyze trends (NMFS 2005, NMFS & USFWS 2007c).

5.4.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Life history of the Eastern Pacific population of olive ridleys is characterized by juvenile and adult life history stages occurring in the oceanic zone. Along with leatherbacks, olive ridleys are the most pelagic of all sea turtle species (NMFS 2004a, 2005, 2006a; NMFS & USFWS 2007c). Given that the action area is oceanic, the Hawaii-based shallow-set longline fishery might be expected to frequently encounter olive ridleys. However, the diving behavior and distribution of the species reduces the likelihood of olive ridleys interacting with this fishery, as discussed below.

Similar to leatherbacks, olive ridleys prey primarily on soft-bodied animals that migrate with the deep scattering layer. As a result, olive ridleys typically forage in deep water, often diving deeper than shallow-set gear is fished. In addition, the distribution of this species in the north Pacific tends to be south of the action area for the Hawaii-based shallow-set longline fishery (Polovina et al. 2003, 2004a, NMFS 2006a). Therefore, in contrast to loggerheads, foraging in deep water and distribution generally to the south of the action area provides some spatial separation of olive ridleys from the Hawaii-based shallow-set fishery, resulting in very low olive ridley bycatch rates in this fishery. The opposite situation occurs in the Hawaii-based deep-set longline fishery, which fishes >100 m deep and primarily to the south of the Hawaiian Islands, resulting in olive ridleys being by far the most common turtle species that interacts with that fishery.

5.4.3 Threats to the Species

Global threats to olive ridley turtles are spelled out in the recent 5-year status review (NMFS & USFWS 2007c). The major threats to the species, according to this document, are direct harvest and fishing bycatch, which are briefly described below. Climate change also appears to be a growing threat to this species, as it is for loggerheads and leatherbacks (see Sections 5.2.3 and 5.3.3 above).

The largest harvest of sea turtles in human history most likely occurred on the west coasts of Central and South America in the 1950s through the 1970s, when millions of adult olive ridleys were harvested at sea for meat and leather, simultaneously with the collection of many millions of eggs from nesting beaches in Mexico, Costa Rica and elsewhere. The unsustainable harvest led to the extirpation of major *arribadas*, such as at Mismaloya and Chacahua in Mexico by the 1970s, prompting the listing of these nesting aggregations as endangered under the ESA. Globally, the legal harvest of olive ridley adults and eggs was reduced in the late 1980s and early 1990s, but legal harvest of eggs continues in some parts of the species' range, such as in Costa

Rica. Illegal harvest of eggs is common in much of the species' range, such as throughout Central America and in India (NMFS & USFWS 2007c).

A major threat to olive ridleys turtles is believed to be bycatch in fisheries, including longline, drift gillnet, set gillnet, bottom trawling, dredge, and trap net fisheries that are operated either on the high seas or in coastal areas throughout the species' range. Fisheries operating near *arribadas* can take tens of thousands of adults as they congregate. For example, trawl and gillnet fisheries off the east coast of India drown so many olive ridleys that tens of thousands dead adults wash up on the coast annually (NMFS & USFWS 2007c). In the eastern Pacific, fishery interactions are a major threat to the species, primarily because of the development of the shrimp trawl fishery along the Pacific coasts of Central American starting in the 1950s, which is thought to kill tens of thousands of olive ridleys annually. In addition, the growth in the longline fisheries of this region in recent years represents a growing bycatch threat to the species, with the potential to interact with hundreds of thousands of turtles annually (Frazier et al. 2007).

5.4.4 Conservation of the Species

Since large-scale direct harvest of adult olive ridleys became illegal, conservation efforts have focused on reducing bycatch of olive ridleys in fisheries, especially those operating near *arribadas* such as the Pacific coast of Mexico/Central America and the east coast of India. Some areas offshore of Central American *arribadas* are closed to fishing in order to reduce turtle bycatch (Frazier et al. 2007). Likewise, no mechanized fishing is allowed within 20 km of the *arribada* in India, and turtle excluder devices are mandatory on trawlers operating out of Orissa state (Shankar et al. 2004). Enforcement is reported to be lacking in both areas (Frazier et al. 2007, Shankar et al. 2004).

Between 2004 and 2007, the Inter American Tropical Tuna Commission (IATTC) coordinated and implemented a circle hook exchange program to experimentally test and introduce circle hooks and safe handling measures to reduce sea turtle bycatch in mahi-mahi and tuna/billfish artisanal longline fisheries in Ecuador, Peru, Panama, Costa Rica, Guatemala and El Salvador. Almost all (99 percent) of fishery/turtle interactions identified by this program were with green and olive ridley sea turtles. By the end of 2006, over 1.5 million J hooks had been exchanged for turtle-friendly circle hooks (approximately 100 boats). Overall, circle hooks have reduced interaction rates by 40 to 80 percent in most artisanal fisheries that switched gear types, with deep hookings reduced by 20 to 50 percent. Experiments to reduce longline gear entanglements have also been successful. Importantly, the project has demonstrated that turtle interaction rates in artisanal mahi-mahi and tuna/billfish fisheries can be studied and reduced (Largachia et al. 2005; Hall et al. 2006).

The conservation and recovery of olive ridleys is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the Indian Ocean Southeast Asian Marine Turtle Memorandum of Understanding, the Inter-American Convention for the Protection and Conservation of Sea Turtles, CITES, and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas (Gilman et al. 2007b; NMFS & USFWS 2007c).

5.5 Green Turtles

Information in this section is summarized primarily from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the most recent green turtle 5-year status review (NMFS & USFWS 2007d), the PIFSC draft green and hawksbill turtle research plan (Snover et al. 2007), and the DSEIS for the proposed action (WPFMC 2008).

5.5.1 Population Characteristics

Green turtle populations occur in at least the Western, Central, and Eastern Atlantic, the Mediterranean, the Western, Northern, and Eastern Indian Ocean, Southeast Asia, and the Western, Central, and Eastern Pacific, according to the recent 5-year review (NMFS & USFWS 2007d). In the 5-year review, the only archipelago included in the Central Pacific was Hawaii, where green turtles have increased since 1975 (NMFS & USFWS 2007d). However, the Central Pacific population also includes green turtles nesting in other archipelagos, such as Federated States of Micronesia and the Marshall Islands, and at least some of these sub-populations appear to be declining (Snover et al. 2007). The Eastern Pacific population includes turtles that nest on the west coast of Mexico, which are listed under the ESA as endangered. The Western Atlantic population includes turtles that nest in Florida, which are listed under the ESA as endangered. All other green turtles (including those in the Eastern Pacific population that nest outside of Mexico, and those in the Western Atlantic population that nest outside of Florida) are listed as threatened (see Table 1 above).

The Hawaii-based shallow-set longline fishery rarely interacts with green turtles, so only 2 turtles have been sampled so far in bycatch of this fishery, and 1 was from the Hawaii component of the Central Pacific population, while the other was from the Eastern Pacific population, based on genetic analyses (Table 2). The Hawaii-based deep-set longline fishery interacts with some green turtles, and of the 15 turtles that have been sampled from this fishery, 7 were from the Central Pacific population and 8 were from the Eastern Pacific population (Table 2). Although the 2 fisheries do not generally fish in the same areas (deep-set fishery is to the south of shallow-set fishery), no other information is available on the source populations of green turtles that interact with the shallow-set fishery. Thus, this opinion assumes that green turtle bycatch from the shallow-set fishery is equally distributed between the Central and Eastern Pacific green turtle populations.

Information is only available for the Hawaii component of the Central Pacific population. The Hawaii component nests exclusively in the Hawaiian Archipelago, with over 90 percent of the nesting at French Frigate Shoals in the Northwestern Hawaiian Islands. Since the initial nesting surveys at French Frigate Shoals (FFS) in 1973, there has been a marked increase in annual green turtle nesting. The increase over the last 30+ years corresponds to an underlying near-linear increase of about 5.7 percent per year. Information on in-water abundance is consistent with the increase in nesting. For example, a significant increase in catch per unit effort of green sea turtles was seen from 1989-1999 during bull-pen fishing for in-water research studies on Molokai. The number of juveniles residing in foraging areas of the MHI has increased. In addition, there has been a dramatic increase in the number of basking turtles in the MHI and throughout the Northwestern Hawaiian Islands. Long-term monitoring of the population indicates a strong degree of island fidelity within the rookery, and tagging studies have shown that turtles nesting at FFS come from numerous foraging areas where they reside throughout the Hawaiian Archipelago (Balazs et al. 1976; Balazs 1980, 1983). This linkage has been firmly established through genetics, satellite telemetry, flipper tagging and direct observation (Balazs 1983, 1994; Leroux et al. 2003). More information is available on green turtle population and trends in the 5-year review (NMFS & USFWS 2007d) and in the PIFSC draft green and hawksbill turtle research plan (Snover et al. 2007).

Eastern Pacific green turtles nest on at least the west coasts of Mexico and elsewhere in Central America, as well as in the Revillagigados Islands (Mexico) and Galapagos Islands (Ecuador). An estimated 3,319 – 3,479 Eastern Pacific females nested annually in the past few years. Nesting has been steadily increasing at the primary nesting sites in Michoacan, Mexico, and in the Galapagos Islands since the 1970s. Both sites are reported in the 5-year status review to host between 1,000 and 2,000 nesting females annually (NMFS & USFWS 2007d), but in recent years nesting females have increased to over 2,000 annually at Michoacan. In addition, previously unknown nesting areas have recently come to the attention of scientists, such as in El Salvador (J. Seminoff, pers. comm.), further boosting estimates of the Eastern Pacific population.

5.5.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Green turtle life history is characterized by early development in the oceanic (pelagic) zone followed by later development in the coastal areas. Recruitment to the coastal areas occurs when carapace length is < 40 cm (smaller than for loggerheads, which spend more years in the pelagic zone, and recruit to coastal areas at a larger size). Adults forage in shallow coastal areas, primarily on algae and seagrass. Unlike loggerheads, upon maturation adults do not typically undertake trans-oceanic migrations to breeding sites, but long migrations may still occur between foraging and nesting areas, such as those undertaken by Hawaiian green turtles between the MHI and FFS (Spotila 2004, NMFS 2004a, 2005, 2006a; NMFS & USFWS 2007d). However, as described above in Section 4 (Description of Action Area), the proposed action does not include fishing within 50 miles of the Hawaiian Islands, and adults migrate directly between the MHI and FFS (Balasz 1994), hence the proposed action is unlikely to encounter migrating adult green turtles from the Hawaii component of the Central Pacific population. Migrating adults are unlikely to be found as far northwest as the action area. Hence, the main aspect of green turtle life history affecting their vulnerability to Hawaii-based shallow-set longline fishing appears to be juveniles utilizing oceanic habitats. Bycatch patterns in Pacific longline fisheries provide limited information on the vulnerability of juvenile green turtles to the various types of longline fishing.

Although foraging juvenile green turtles are more likely to interact with the Hawaii-based shallow-set fishery than adults, even juvenile interactions are very rare in this fishery: Since the fishery re-opened in 2004, 1 green turtle interaction has occurred (in 2008), and green turtle bycatch has been very rare historically in the Hawaii-based shallow-set fishery. Far more juvenile green turtle interactions occur in the Hawaii-based deep-set fishery and the American Samoa longline fishery (albacore fishery operating at 100-200 m depth) than the shallow-set fishery. Because very little is known of juvenile green turtle pelagic habitat use or foraging behavior, the reasons for the much smaller green turtle bycatch in the shallow-set fishery than the other 2 fisheries is not known. Juvenile green turtles would be expected to occur in the action area, and bycatch in the American Samoa longline fisheries demonstrates that juvenile green turtles are susceptible to interacting with longline gear fished at the approximate depth of the shallow-set fishery. Because of the lack of information, it is unknown if juvenile green turtles are less vulnerable than juvenile loggerheads to shallow-set gear (e.g., because of the smaller size of juvenile greens), or if juvenile green turtles are simply scarce in the action area, or if some unknown aspect of juvenile green turtle life history reduces their vulnerability to shallow-set longline fishing.

5.5.3 Threats to the Species

Global threats to green turtles are spelled out in the 5-year review (NMFS & USFWS 2007d). The major threats to the species, according to this document, are alteration of nesting and foraging habitat, fishing bycatch, and direct harvest, which are briefly described below. Climate change also appears to be a growing threat to this species, as it is for loggerheads and leatherbacks (see Sections 5.3.3 and 5.4.3 above).

Destruction and alteration of green turtle nesting and foraging habitats are occurring throughout the species' global range, especially coastal development, beach armoring, beachfront lighting, and vehicular/ pedestrian traffic. While under natural conditions beaches can move landward or seaward with fluctuations in sea level, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Adult green turtles are primarily herbivores that forage on seagrass and algae in shallow areas. Contamination from runoff degrades seagrass beds, and introduced algae species may reduce native algae species preferred by green turtles (NMFS & USFWS 2007d).

Although fisheries bycatch of loggerheads and leatherbacks has received most of the attention relative to sea turtle bycatch, green turtles are also susceptible, particularly in nearshore artisanal fisheries gear. These fisheries use a vast diversity of gears, including drift gillnets, long-lining, set-nets, pound-nets, trawls, and others, and are typically the least regulated of all fisheries while operating in the areas with greatest density of adult green turtles (NMFS & USFWS 2007d). Industrial fisheries also interact with green turtles, especially juveniles, like in the Hawaii-based deep-set and American Samoa longline fisheries.

Harvest of green turtles for their meat, shells, and eggs has been a major factor in the past declines of green turtles, and continues to be a major factor in some areas. For example, a legal fishery operates in Madagascar that harvested about 10,000 green turtles annually in the mid-1990s. On the Pacific coast of Mexico in the mid-1970s, >70,000 green turtle eggs were harvested every night. Globally, harvest of adults and eggs is reduced from previous levels, but still exists in some parts of the species' range. In Mexico, extensive illegal adult harvest still takes place. The curio trade in Southeast Asia also harvests a large but unknown number of green turtles annually (NMFS & USFWS 2007d).

5.5.4 Conservation of the Species

Green turtles nesting in the U.S. have benefited from both State and Federal laws passed in the early 1970s banning the harvest of turtles and their eggs. Protection and management activities since 1974 throughout the Hawaiian Archipelago and habitat protection at the FFS rookery since the 1950's have resulted in increased population trends of both nesting and foraging turtles (Balazs and Chaloupka 2004). Elsewhere, the protection of nesting beaches from large-scale egg harvest appears to have reversed downward nesting trends in some cases. For example, nesting beach protection began at Colola, Mexico in 1979, and the number of nesting green turtles began to increase 17 years later in 1996 after reaching a low point in the late 1980s through the mid-1990s. Using long-term data sets, encouraging trends in green turtle nester or nest abundance over the past 25 years has become apparent in at least six locations including Hawaii, Australia, Japan, Costa Rica and Florida (Chaloupka et al. 2007). Efforts to reduce fisheries bycatch of loggerheads, leatherbacks, and olive ridleys also benefit green turtles, such as the improvements made in the Hawaii-based longline fishery since the 1990s (NMFS & USFWS 2007d).

The conservation and recovery of green turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the FAO Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, CITES, and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas (Gilman et al. 2007b; NMFS & USFWS 2007d).

5.6 Hawksbill Turtles

Information in this section is summarized primarily from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the most recent hawksbill turtle 5-year status review (NMFS & USFWS 2007e), Volume III of the State of the World's Sea Turtles Report (SWOT 2007-2008), the DSEIS for the proposed action (WPFMC 2008), and other sources cited below.

5.6.1 Population Characteristics

Hawksbill populations occur in at least the Insular and Western Caribbean, Southwestern and Eastern Atlantic, the Southwestern, Northwestern, and Central/ Eastern Indian Ocean, and the Western, Central, and Eastern Pacific. As described in the recent 5-year review (NMFS & USFWS 2007e), available trend data for the past 20 years suggest that while some Caribbean/Atlantic sub-populations may be increasing, nearly all Indian and Pacific sub-populations are decreasing. Neither the shallow-set nor deep-set components of the Hawaii-based longline fishery are known to have interacted with a live hawksbill. However, hawksbill interactions occasionally occur in other longline fisheries in the Atlantic (Yeung 1998) and Pacific (Robins et al. 2002). In the shallow-set Hawaii-based fishery in 2007, a derelict net with a decomposed hawksbill was hooked and retrieved (the turtle had clearly been killed by the derelict net, not the longline gear). Also, a hawksbill was found entangled in derelict fishing gear on Pearl and Hermes Reef in the Northwestern Hawaiian Islands in 2003, but was released apparently unharmed (Donahue 2003). Hawksbill juveniles from the Central Pacific population are thought to inhabit the action area (NMFS & USFWS 2007e), thus an expanded Hawaii-based shallow-set longline fishery could interact with hawksbills from this population.

Central Pacific hawksbills nest in small numbers in several archipelagos, including Samoa, Fiji, the Marianas, Hawaii, Micronesia, Palau, the Solomons, and Vanuatu. All are declining, except possibly at the small Hawaii rookery (NMFS & USFWS 2007e), where an estimated 10-15 females have nested annually since the early 1990s (Seitz & Kagimoto 2008). The largest Central Pacific hawksbill rookeries are in Fiji and the Solomon Islands, where harvest of adults and eggs still appears to be occurring at unsustainable levels. Total number of nesting females for the Central Pacific hawksbill population was estimated at 940 – 1,200 females annually for the last few years, with an overall downward trend (NMFS & USFWS 2007e).

5.6.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Hawksbill life history is characterized by early development in the pelagic zone followed by later development in nearshore habitats. As with green turtles, hawksbill recruitment to the neritic zone appears to occur at a younger age and smaller size than for loggerheads. Adults forage on coral reefs, primarily on sponges. Unlike loggerheads, upon maturation adults do not typically undertake trans-oceanic migrations to breeding sites, but hawksbills are known to undertake long migrations in the Caribbean between foraging and nesting areas (Spotila 2004; NMFS & USFWS 2007e). In Hawaii, tracking of adult hawksbills suggest that primary adult foraging and nesting areas are around the Big Island (Parker et al., in review), hence migrating adults may not often enter the action area (>50 miles from MHI – see Description of Action Area above in Section 4).

As with green turtles, the main aspect of hawksbill life history affecting their vulnerability to Hawaii-based shallow-set longline fishing appears to be oceanic juvenile foraging or pelagic habitat, but almost nothing is known of this life history stage of hawksbill turtles. Unlike with green turtles, there is no bycatch in Pacific U.S. longline fisheries to provide information on the relative vulnerability of juvenile hawksbill turtles to the various types of longline fishing. In the entire North Pacific, only a few dozen females are thought to nest annually, thus perhaps there is low abundance with very few pelagic juveniles foraging in the action area. Also, because juvenile hawksbills recruit to coastal habitat at < 40 cm carapace length, perhaps they are too small to ingest bait and hooks used in the shallow-set fishery during their pelagic phase (Spotila 2004, NMFS & USFWS 2007e).

5.6.3 Threats to the Species

Global threats to hawksbill turtles are spelled out in the 5-year review (NMFS & USFWS 2007e). The major threats to the species, according to this document, are alteration of nesting and foraging habitat, and direct harvest, which are briefly described below. While hawksbill interactions occur in fisheries, their bycatch rates are much lower than for the other sea turtle species, especially in industrial fisheries. Climate change also appears to be a growing threat to this species, as it is for loggerheads and leatherbacks (see Sections 5.2.3 and 5.3.3 above).

Destruction and alteration of hawksbill nesting and foraging habitats are occurring throughout the species' global range, especially coastal development, beach armoring, beachfront lighting, and vehicular/ pedestrian traffic. While under natural conditions beaches can move landward or seaward with fluctuations in sea level, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Adult hawksbills are primarily spongivores that forage on coral reefs, hence human impacts on their foraging habitat can be devastating. Contamination from runoff degrades coral reefs, and introduced algae species may outcompete and overgrow coral reefs, eventually killing them and the sponges they harbor. In addition, increasing boat traffic increases the likelihood of boat strikes (NMFS & USFWS 2007e).

Hawksbills are harvested for their shells ('tortoiseshell') and eggs. Because of the beauty of their shells, hawksbill adults have been harvested more heavily than other sea turtle species. Between 1950 and 1992, approximately 1.3 million hawksbill shells were collected to supply tortoiseshell to the Japanese market, the world's largest. Japan stopped importing tortoiseshell in 1993 in order to comply with CITES. However, tortoiseshell trade continues in the Americas and Southeast Asia for both tortoiseshell and the curio trade. As with other sea turtle species, egg harvest has occurred on a large scale in the past, but is somewhat reduced globally. However, egg harvest continues unabated in Asia, especially in Sri Lanka, Thailand, Malaysia and Indonesia. In addition, adults are also still heavily harvested on their nesting beaches and in foraging areas, especially in Southeast Asia, Melanesia, and Polynesia (NMFS & USFWS 2007e).

5.6.4 Conservation of the Species

Numerous conservation programs are being implemented around the world to protect nesting habitat and reduce harvesting and fisheries bycatch of all sea turtle species, and numerous regulatory mechanisms are in place at international, regional, national and local levels to protect sea turtles (see Sections 5.3.4, 5.4.4, 5.5.4, and 5.6.4 above). Many of these programs undoubtedly help hawksbills, but the species continues to rapidly decline in the Pacific and Indian Ocean areas. Some sub-populations in the Insular Caribbean appear to be increasing (NMFS & USFWS 2007e).

6 Environmental Baseline

The environmental baseline for a biological opinion includes 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 which are contemporaneous with the consultation in process (50 CFR 402.02). The Consultation Handbook further clarifies that the environmental baseline is "an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area." (USFWS & NMFS 1998). The purpose of describing the environmental baseline in this manner in a biological opinion is to provide the context for the effects of the proposed action on the listed species.

The past and present impacts of human and natural factors leading to the status of the 6 species addressed by this opinion within the action area include fishing interactions, vessel strikes, climate change, pollution, marine debris, and entanglement. The environmental baselines for the 6 ESA-listed marine species addressed by this opinion (humpback whale and the 5 sea turtles) are first briefly summarized below, then followed by more detailed descriptions.

6.1 Humpback Whales

Information in this section is summarized from the humpback whale Stock Assessment Reports (e.g., Angliss & Outlaw 2007), the humpback whale recovery plan (NMFS 1991), the SPLASH report (Calambokidis et al. 2008), and other sources cited below. The primary past and present impacts of human activities within the action area on the North Pacific humpback population are fishery interactions and ship strikes. The estimated annual mortality rates of fishery interactions and ship strikes on this stock is 3.2 and 1.8 whales per year, respectively, for a total 5.0 whales per year. Of the 3.2 killed by fishing interactions, 0.2 are estimated to be caused by U.S. commercial fisheries (Angliss & Outlaw 2007).

Because the North Pacific population inhabits an area much larger than the action area, and fishing interactions with whales occur at a much lower rate in Hawaiian waters than in Alaskan waters (Angliss & Outlaw 2007), the combined impact of past and present fishing interactions and ship strikes within the action area is likely to be less than 1 whale per year. In addition, impacts from sonar within the action area are possible. Floating marine debris in the action area may present an entanglement hazard for humpbacks, but is not likely to result in mortality. Whale-watching may affect humpbacks by vessel strikes and behavior disruption. The historic impact of whaling on this species is at most a minor part of the current environmental baseline, because; (1) the population has recovered from whaling, in terms of the numbers of individuals, and (2) whaling was around the northern Pacific Rim, thus little if any whaling occurred within the action area (NMFS 1991, Gilman et al. 2006, Calambokidis et al. 2008).

6.2 Loggerhead Turtles

Information in this section is summarized from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 pelagics report (WPFMC 2006a), the DSEIS for the proposed action (WPFMC 2008), and the other sources cited below. Past and present fisheries interactions have been, and continue to be, the greatest human impact on loggerhead turtles within the action area. Currently, the major type of fishing activity in the action area is longline fishing, except for nearshore fisheries that operate within the longline prohibited areas around the Hawaiian Islands. In the past, drift gillnetting also occurred on a large scale within the action area, but because of high bycatch rates of protected species, a United Nations resolution banned this fishing method, hence instituting a global prohibition in 1992. Other types of fishing may occur in the action area outside of the longline prohibited areas (e.g., purse seining), but on such a small scale and with such low mortality rates as to be insignificant with regard to the loggerhead environmental baseline. Within the longline prohibited areas around the Hawaiian Islands, numerous fisheries operate, but these do not affect loggerheads. Therefore, the impact on loggerheads in the action area is longline fishing, the past and present impacts of which are described below.

6.2.1 Longline Fishing

The action area lies entirely within the Western Central Pacific (WCP) region. Longline fishing is done by many countries in this region, and there are 2 types of vessels: (1) Large distant-water freezer vessels that undertake long voyages (months) and operate over large areas of the region; and (2) Smaller offshore vessels with ice or chill capacity that typically undertake trips of less than 1 month (like the Hawaii longline fleet). The total number of longline vessels in the WCP region was roughly 5,000 vessels in 2004, including 100-125 vessels in the Hawaii longline fishery (a minority of which are involved in the shallow-set fishery). The 4 main target species are yellowfin, bigeye, and albacore tuna, and swordfish. The distribution of total reported longline catch of these 4 species in 2004 is shown in Figure 5 below (WPFMC 2006). The action area is shown by the red rectangle, and consists mostly of international waters. The 2 main target species in the action area are albacore and swordfish, but yellowfin and bigeye tuna are caught too (Figure 5).

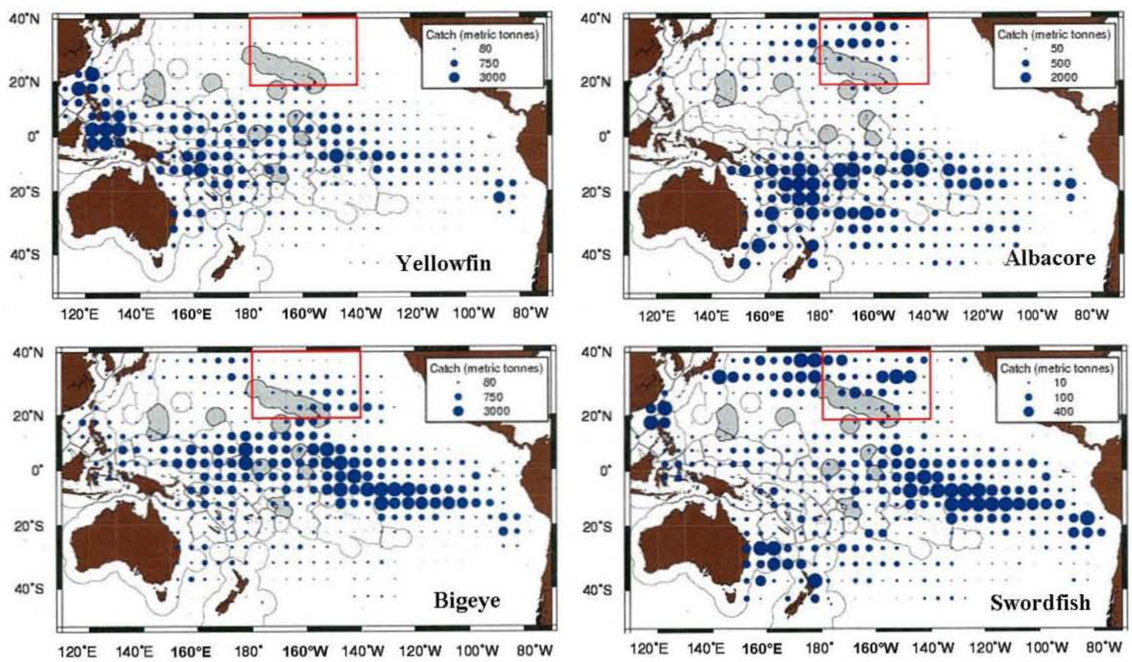

Figure 5. Distribution of Pacific longline catches (all countries) in 2004 for the 4 primary target fish species (WPRFMC 2006a). Action area for this consultation is indicated by the red rectangle.

Estimating the total number of sea turtle interactions in the total longline fishery is difficult because of low observer coverage and inconsistent reporting. However, Lewison et al. (2004) collected fish catch data from 40 nations and turtle bycatch data from 13 international observer programs to estimate global longline bycatch of loggerhead and leatherback turtles in 2000. In the Pacific, they estimated that 2,600 – 6,000 loggerhead juveniles and adults were killed by pelagic longlining in 2000 (Lewison et al. 2004). However, using effort data from Lewison et al. (2004) and bycatch data from Molony (2005), Beverly and Chapman (2007) estimated loggerhead and leatherback longline bycatch to be approximately 20 percent of that estimated by Lewison et al. (2004), or 520 – 1,200 juvenile and adult loggerheads annually.

As for the number of loggerheads killed by longlining in the action area, at least 3 other factors should be considered: (1) the action area represents less than 10 percent of the area fished and longlining effort in the Pacific, (2) loggerheads may be denser in the action area than elsewhere in the Pacific, and (3) longline fishing effort has increased since 2000. For purposes of providing the environmental baseline for loggerheads in this opinion, NMFS estimates that longlining since 2000 in the action area has killed, and continues to kill, 10 percent of the Pacific totals estimated by Beverly and Chapman (2007) and Lewison et al. (2004): 50 – 120 (10 percent of Beverly and Chapman's 2007 estimate) to 260 – 600 (10 percent of Lewison et al.'s 2004 estimate), or 50 - 600 North Pacific juvenile and adult loggerheads annually.

The shallow-set component of the fishery traditionally interacted with far more turtles than the deep-set component, although mortality of turtles in shallow-set gear is lower than in deep-set gear. Loggerheads are particularly susceptible to shallow-set gear, and in the 1990s the Hawaii-

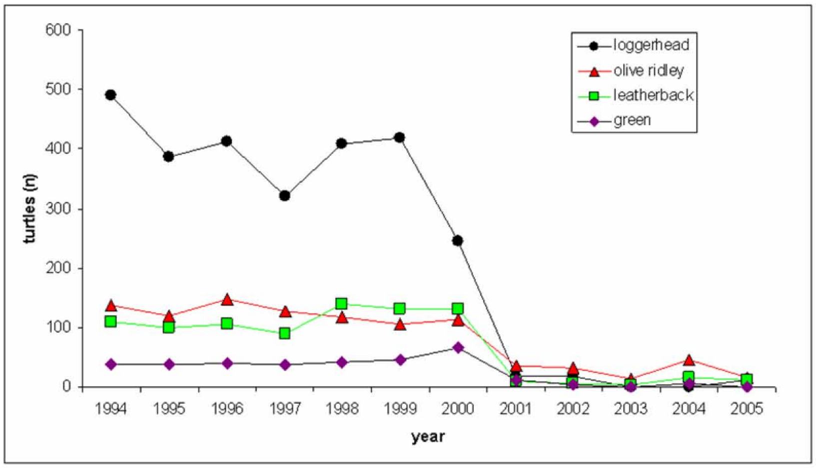

Figure 6. Estimated annual turtle interactions in the Hawaii-based longline fishery (deep-set and shallow-set combined), 1994-2005 (WPRFMC 2008)

based shallow-set fishery interacted with several hundred loggerheads annually in the action area. However, the shallow-set fishery was closed in 2001, and only re-opened in 2004 after instituting many measures for reducing turtle interactions. This reformation of the Hawaii-based shallow-set fishery has resulted in an approximately 90 percent reduction in loggerhead bycatch in this fishery since the 1990s (Figure 6).

Bycatch rates in the Hawaii-based shallow-set fishery (swordfish) are lower than other swordfish or tuna longline fisheries, except for the Hawaii-based deep-set longline fishery for tuna. Other longline fisheries operating in the action area, such as the Taiwan and China tuna fisheries, have bycatch rates several times higher than the Hawaii-based shallow-set fishery (Figure 7, modified from Kaneko & Bartram 2008). In 2005-07, turtle bycatch in the Hawaii longline fishery

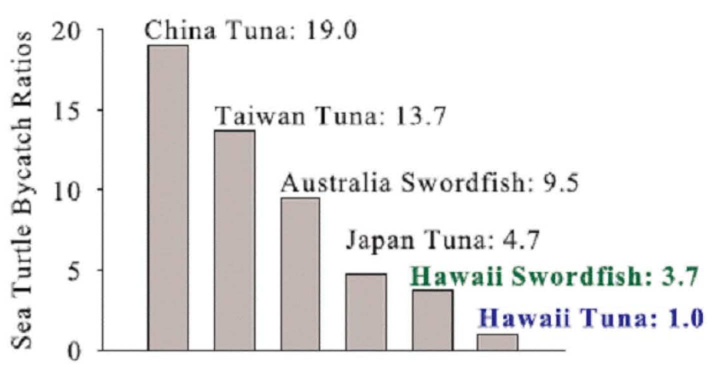

Figure 7. Sea Turtle Bycatch to Catch Ratios (per 190,000 kg of fish) of the Hawaii longline fisheries for **swordfish** and **tuna** compared with other longline fisheries operating in the central and western Pacific (Kaneko & Bartram 2008). All operate in the action area but Australia Swordfish.

(shallow-set and deep-set components combined) within the action area is estimated to have resulted in mean annual mortality of 3 to 4 loggerheads per year (NMFS 2008c,d).

6.2.2 Other Impacts

As mentioned in Section 5.2.3, climate change may be affecting pelagic loggerhead habitat within the action area. Lower breeding capacity of North Pacific loggerheads in years following higher sea surface temperatures may reflect reduced ocean productivity during warmer years within the action area, an indirect effect of climate change on this species (Chaloupka et al. 2008a). In addition, marine debris may be ingested by turtles, leading to injury or possibly starvation, and derelict fishing gear may cause entanglement and possibly drowning. Data are not available to estimate the number of loggerhead mortalities resulting from climate change and marine debris in the past few years in the action area.

6.3 Leatherback Turtles

Information in this section is summarized from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 pelagics report (WPFMC 2006a), DSEIS for the proposed action (WPFMC 2008), and other sources cited below. Like the other sea turtle species addressed by this opinion, past and present fisheries interactions have been, and continue to be, the greatest human impact on leatherback turtles within the action area. The major type of fishing activity in the action area is longline fishing, which is the most important past and present impact on leatherbacks.

6.3.1 Longline Fishing

Longline fishing within the action area is described in Section 6.3.1 and represented in Figure 5 above. Estimating the total number of sea turtle interactions in the total longline fishery is difficult because of low observer coverage and inconsistent reporting. However, Lewison et al. (2004) collected fish catch data from 40 nations and turtle bycatch data from 13 international observer programs to estimate global longline bycatch of loggerhead and leatherback turtles in 2000. In the Pacific, they estimated that 1,000 – 3,200 leatherbacks were killed by pelagic longlining in 2000 (Lewison et al. 2004). An estimate of 626 adult female mortalities from pelagic longlining in 1998 was made by Kaplan (2005), or roughly 2,500 juveniles and adults. However, using effort data from Lewison et al. (2004) and bycatch data from Molony (2005), Beverly and Chapman (2007) estimated loggerhead and leatherback longline bycatch to be approximately 20 percent of that estimated by Lewison et al. (2004), or 200 – 640 juvenile and adult leatherbacks annually.

As for the number of leatherbacks killed by longlining in the action area, at least 3 other factors should be considered: (1) the action area represents slightly less than 10 percent of the area fished and longlining effort in the Pacific; (2) leatherbacks may be denser in the action area than elsewhere in the action area ; and (3) longline fishing effort has increased since 1998-2000. For purposes of providing the environmental baseline for leatherbacks in this opinion, NMFS estimates that longlining since 2000 in the action area has killed, and continues to kill, 10 percent of the Pacific totals estimated by Beverly and Chapman (2007), Kaplan (2005), and Lewison et al. (2004): 20 – 64 (10 percent of Beverly and Chapman's 2007 estimate) to 100 – 320 (10 percent of Lewison et al.'s 2004 estimate), or 20 - 320 Western Pacific leatherback juveniles and adults annually (10 percent of Kaplan's 2005 estimate = 63).

The shallow-set component of the fishery traditionally interacted with far more turtles than the deep-set component, although mortality of turtles in shallow-set gear is lower than in deep-set gear. Leatherbacks are not as susceptible to shallow-set gear as loggerheads, but nevertheless in the 1990s the Hawaii-based shallow-set fishery was estimated to have interacted with about a hundred leatherbacks annually in the action area (Figure 6). However, the shallow-set fishery was closed in 2001, and only re-opened in 2004 after instituting many measures for reducing turtle interactions. This reformation of the Hawaii-based shallow-set fishery has resulted in an approximately 90 percent reduction in leatherback bycatch in this fishery since the 1990s (Figure 6). Bycatch rates in the Hawaii-based shallow-set fishery (swordfish) are lower than other swordfish or tuna longline fisheries, except for the Hawaii-based deep-set longline fishery for tuna. Other longline fisheries operating in the action area, such as the Taiwan and China tuna fisheries, are thought to have bycatch rates several times higher than the Hawaii-based shallow-set fishery (Figure 7). In 2005-07, turtle bycatch in the Hawaii longline fishery (shallow-set and deep-set components combined) within the action area is estimated to have resulted in mean annual mortality of 1 to 2 leatherbacks per year (NMFS 2008c,d).

6.3.2 Other Impacts

As mentioned in Section 5.3.3, climate change may be affecting pelagic leatherback habitat within the action area. Leatherbacks may be particularly susceptible to ingesting of marine debris because plastic bags resemble jellyfish, their primary prey. Derelict fishing gear may cause entanglement and possibly drowning. Data are not available to estimate the number of leatherback mortalities resulting from climate change and marine debris in the past few years in the action area.

6.4 Olive Ridley Turtles

Information in this section is summarized from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the most recent olive ridley 5-year status review (NMFS & USFWS 2007c), the DSEIS for the proposed action (WPFMC 2008), and other sources cited below. Like the other sea turtle species addressed by this opinion, past and present fisheries interactions have been, and continue to be, the greatest human impact on olive ridley turtles within the action area. The longline fishing described above is the most important past and present impact on olive ridleys. Much less attention has been paid to effects of longline fishing on this species than on loggerheads and leatherbacks, hence no estimates are available for olive ridley mortality from longline fishing in the Pacific. Olive ridleys and leatherbacks are both susceptible to deep-set longlining because of their deep foraging (loggerhead interactions are rare in deep-set fishing because of shallow foraging). In the Hawaii-based deep-set longline fishery, bycatch rate of olive ridleys is about ten times that of leatherbacks. In addition, mortality of bycaught olive ridleys is higher than the other sea turtle species (Beverly & Chapman 2007), most likely because they are hooked when in such deep water that they rarely have a chance to get to the surface before drowning. Bycatch rates in foreign deep-set fisheries (for tuna) are >10 times higher than in the Hawaii-based deep-set fishery (Figure 7), and constitute much more fishing effort than the Hawaii-based fishery. Thus it is likely that tens of thousands of olive ridleys are killed annually in the Pacific by longlining.

However, the action area for the proposed action is 20° - 40° north (see Figure 1 in Section 4), and olive ridleys are primarily limited to tropical waters (NMFS & USFWS 2007c). While a substantial amount of longlining occurs in the action area (Figure 5), the bycatch rate of olive ridleys is much lower than in tropical waters. Nevertheless, because of the abundance of this species, and amount of longlining occurring within the action area by all fleets combined, at least several hundred olive ridleys have probably been killed, and continue to be killed, annually by longlining (most from the Eastern Pacific population, but some from the Western Pacific population).

The vast majority of olive ridley bycatch in the Hawaii-based longline fishery occurs in the deep-set component of the fishery, which operates primarily to the south of the action area (Figure 2). In 2005-07, turtle bycatch in the Hawaii longline fishery (shallow-set and deep-set components combined) within the action area is estimated to have resulted in mean annual mortality of 8 to 9 olive ridleys per year (NMFS 2008c,d).

As mentioned in Section 5.4.3, climate change may be affecting pelagic olive ridley habitat within the action area. Marine debris and derelict fishing gear may cause entanglement and possibly drowning. Data are not available to estimate the number of olive ridley mortalities resulting from climate change and marine debris in the past few years in the action area.

6.5 Green Turtles

Information in this section is summarized from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the most recent green turtle 5-year status review (NMFS & USFWS 2007d), the DSEIS for the proposed action (WPFMC 2008), and the other sources cited below. Like the other sea turtle species addressed by this opinion, past and present fisheries interactions have been, and continue to be, the greatest human impact on green turtles within the action area. However, unlike loggerheads, leatherbacks, olive ridleys, green turtles are affected by both longline fishing and nearshore fishing within the action area. As explained in Section 5.5.2, this is because juvenile green turtles in the Hawaiian population recruit to nearshore areas throughout the Hawaiian Archipelago, hence juveniles are affected by longline fishing while utilizing pelagic habitats, and by nearshore fishing during the adult nearshore life history stage.

Much less attention has been paid to effects of longline fishing on green turtles than on loggerheads and leatherbacks, thus no estimates are available for green turtle mortality due to longline fishing in the Pacific. Approximately 10 times more green turtle interactions occur in the deep-set component than the shallow-set component of the Hawaii-based longline fishery (almost all juveniles). Turtle interactions in deep-set gear have a high mortality rate because they frequently drown. While few green turtle interactions occur in the Hawaii-based deep-set fishery, general turtle bycatch rates in foreign deep-set fisheries (for tuna) are >10 times higher than in the Hawaii-based deep-set fishery (Figure 7), and constitute much more fishing effort than the Hawaii-based fishery. Therefore it is likely that within the action area, up to several hundred juvenile green turtles are killed annually by longlining (about equally split between the Hawaiian and Eastern Pacific populations).

The majority of green turtle bycatch occurs in the deep-set component of the fishery, which operates primarily to the south of the action area. In 2005-07, turtle bycatch in the Hawaii longline fishery (shallow-set and deep-set components combined) within the action area is estimated to have resulted in mean annual mortality of 0 to 1 green turtles per year (NMFS 2008c,d).

Extensive nearshore fisheries in the MHI (e.g. lay gillnets, hook-and-line, etc.) sometimes result in entanglement and drowning of green turtles. Of the many kinds of nets used in Hawaii, gillnets are the most problematic for turtles, because they are left untended, and entangled animals usually drown. Revised State of Hawaii regulation governing lay gillnets began in March 2007, but they can still be legally left untended, hence the likelihood of turtle entanglement and drowning is still considerable. Hook-and-line fishing from shore or boats also hooks or entangles green turtles, although the chance of survival is higher than if caught in a gillnet. Turtles drowned in fishing gear do not typically 'strand' (come ashore to die, or wash up on shore dead), so there are no estimates for the total number of green turtles killed annually by fishing interactions (NMFS 2008e). The most common known cause of green turtle strandings is the tumor-forming disease, fibropapillomatosis (28%) followed by hook-and-line fishing gear-induced trauma (7%) and gillnet fishing gear-induced trauma (5%) (Chaloupka et al. 2008b).

The total number of green sea turtles killed each year in recent years (1998-2007) in the MHI by boat collisions was estimated by NMFS (2008e) based on the numbers of stranded turtles determined to have been killed by boat collisions (Chaloupka et al. 2008b, Hawaii Sea Turtle Stranding Database 2007). NMFS (2008e) estimated that 10 stranded turtles per year in the MHI are killed by boat collisions (see Figure 3, p. 25, NMFS 2008e), and that these 10 turtles represent 20 – 40% of all green sea turtles killed in the MHI annually by boat collisions, giving a range for of 25 – 50 turtles killed per year. Thus the average number of green turtles killed per year by boat collisions was estimated at 37.5 (NMFS 2008e).

As mentioned in Section 5.5.3, climate change may be affecting pelagic green turtle habitat within the action area. Marine debris and derelict fishing gear may cause entanglement and possibly drowning. Data are not available to estimate the number of green turtle mortalities resulting from climate change and marine debris in the past few years in the action area.

6.6 Hawksbill Turtles

Information in this section is summarized from the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the most recent hawksbill turtle 5-year status review (NMFS & USFWS 2007e), the DSEIS for the proposed action (WPFMC 2008), and other sources cited below. Like the other sea turtle species addressed by this opinion, past and present fisheries interactions have been, and continue to be, the greatest human impact on hawksbills within the action area. Like green turtles, hawksbills are affected by both longline fishing and nearshore fishing within the action area. As explained in Section 5.6.2, this is because juvenile hawksbills turtles in the Central Pacific population recruit to nearshore areas, including in the Hawaiian Islands, hence they are affected by longline fishing while utilizing pelagic habitats, and by nearshore fishing during the adult nearshore life history stage.

Much less attention has been paid to effects of longline fishing on hawksbills than on loggerheads and leatherbacks, thus no estimates are available for hawksbill mortality due to longline fishing in the Pacific. No hawksbill bycatch has ever been recorded in the Hawaii-based longline fishery. A decomposed hawksbill that was entangled in derelict fishing gear that was retrieved by longline gear (i.e., the hawksbill was killed by the derelict gear, not the longline gear). However, because: 1) general turtle bycatch rates in foreign longline fisheries are higher than in the Hawaii-based longline fishery (Figure 7); 2) foreign longline fisheries constitute more fishing effort than the Hawaii-based fishery; and 3) hawksbill interactions occur in other longline fisheries both in the Atlantic (Yeung 1999) and Pacific (Robins et al. 2002), some hawksbill bycatch is likely to be occurring in the foreign longline fisheries. Therefore it is likely that within the action area, up to 1 or 2 dozen juvenile hawksbills from the Central Pacific population are killed annually by longlining.

As with green turtles, extensive nearshore fisheries in the MHI may sometimes result in entanglement and drowning of hawksbills. Likewise, because hawksbills forage in shallow areas, often remain just below the surface, and often surface to breathe, they are vulnerable to being struck by vessels. However, because hawksbills are much rarer than green turtles, and forage primarily along remote coastlines, hawksbill mortality from nearshore fishing and vessel strikes in the MHI is probably a rare event.

As mentioned in Section 5.6.3, climate change may be affecting pelagic hawksbill habitat within the action area. Marine debris may cause entanglement and possibly drowning. In addition, derelict fishing gear may cause entanglement, especially monofilament line. For example, a hawksbill was found entangled in derelict fishing gear on Pearl and Hermes Island in the Northwestern Hawaiian Islands in 2003, but was released apparently unharmed (Donahue 2003). Data are not available to estimate the number of hawksbill mortalities resulting from climate change and marine debris in the past few years in the action area.

7 Effects of the Action

In this section of a biological opinion, NMFS assesses the probable effects of the proposed action on threatened and endangered species. ‘Effects of the action’ refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. “Indirect effects” are those that are likely to occur later in time (50 CFR 402.02). The ‘Effects of the action’ are considered within the context of the ‘Status of Listed Species’ and ‘Environmental Baseline’ sections of this opinion to determine if the proposed action can be expected to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination.

Approach. NMFS determines the effects of the action using a sequence of steps. The first step identifies stressors (or benefits) associated with the proposed action with regard to listed species. The second step identifies the magnitude of stressors (e.g., how many individuals of a listed species will be exposed to the stressors; *exposure analysis*). In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to a proposed action’s effects, and the populations or subpopulations those individuals represent. The third step describes how the exposed individuals are likely to respond to these stressors (e.g., the mortality rate of exposed individuals; *response analysis*).

The final step in determining the effects of the action is establishing the risks those responses pose to listed resources (*risk analysis*). The risk analysis is different for listed species and designated critical habitat. However, the action area does not include proposed or designated critical habitat, thus it is not considered in this opinion. Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (probability of extinction or probability of persistence) of listed species depends on the viability of their populations. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them; populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

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

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

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

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

Potential Stressors. The potential stressors associated with the proposed action are listed here, then described in more detail for each species in the following sections. The proposed action is the continued operation of the Hawaii-based shallow-set longline fishery at an effort level of 5,550 sets annually. The greatest stressor associated with this action on the 6 listed species considered in this opinion is interactions (defined in footnote 1 in Section 1) with fishing gear. The fishery re-opened in late 2004, and thus has been operating for approximately 4 years. The number of interactions of the fishery with these 6 species during that 4-year period is shown in Table 4 below.

Table 4. Fishing effort (sets), interactions, and interaction rates in the Hawaii-based shallow-set longline fishery for the 6 species considered in this opinion over a 4-year period (4th quarter 2004 – 3rd quarter 2008).

Year	Sets	Interactions					
		Humpbacks	Loggerheads	Leatherbacks	OliveRidleys	Greens	Hawksbills
2004	135[a]	0	1	1	0	0	0
2005	1,645[a]	0	12	8	0	0	0
2006	850[a]	1	17	2	0	0	0
2007	1,570[b]	0	15	5	1	0	0
2008	1,225[c]	1	0	2	2	1	0
Total	5,425	2	45	18	3	1	0
Interaction Rate[d]		0.00037	0.00829	0.00332	0.00055	0.00018	0
Estimated Annual Interactions from Proposed Action[e]		3 (2.1)[e]	46 (46.0)[e]	19 (18.4)[e]	4 (3.1)[e]	1 (1.0)[e]	0

[a] DSEIS, p.44-45.
[b] PIFSC 2008. Hawaii Longline Fishery Logbook Statistics—Summary Tables: 2007 annual tables, p. 6.
[c] Sum of the following 3 sources: For 1st and 2nd Quarters 2008, the PIFSC Hawaii Longline Fishery Logbook Statistics webpage had posted, as of October 6, 2008, a 1st Quarter 2008 Report, p. 7 (744 sets) and a "Quarterly Table of Nominal Effort" for 2nd Quarter 2008 (381 sets). For the 3rd Quarter 2008, on October 6, 2008, the PIRO Observer Program estimated that approximately 100 sets were made, giving the total of 1,225 sets for the first 3 quarters of 2008.
[d] Interaction rates are calculated by dividing total interactions by total sets. The interaction rates then provide the basis for estimating the annual interactions from the proposed action in the final row.
[e] Interactions rounded up from one significant digit (e.g., 1.1 to 1.9 round to 2, but 1.01 to 1.04 round to 1): For humpbacks, 0.00037 x 5,550 = 2.1, round to 3. For loggerheads, 0.00829 x 5,550 = 46.01, round to 46. For leatherbacks, 0.00332 x 5,550 = 18.4, round to 19. For olive ridleys, 0.00055 x 5,550 = 3.1, round to 4. For greens, 0.00018 x 5,550 = 0.999, round to 1.

Another potential stressor associated with the proposed action is collisions with fishing vessels. Vessels travel through areas with dense concentrations of some listed species, such as when vessels travel to and from port, passing through nearshore waters with green turtles. While additional effects may occur due to the proposed action (e.g., exposure to waste from fishing vessels), they are not considered likely to adversely affect individuals of listed species, and thus are not considered stressors. The potential direct stressors of interactions and collisions are described in detail below in the species sections, because they vary considerably between species.

Potential Beneficial "Market Transfer Effect". The proposed action has the potential to result in a beneficial market transfer effect for sea turtles. When multiple fleets compete for the same fishery resource, regulation of one country's fleet may lead to increased or decreased fishing by the other fleets, which may in turn affect the overall impact of fishing on the resource. This phenomenon is known as the "market transfer effect", because it is driven by supply and demand for the resource. The swordfish market and the distribution of most sea turtle species are both global. Hence, regulation of a swordfish fleet in one part of the world may affect swordfish fishing and sea turtle impacts in another part of the world, resulting in a net change in mortalities of the affected sea turtle species. Such a market transfer effect appears to have occurred as a result of the closure of the Hawaii-based shallow-set longline fishery in 2001-2004 (Sarmiento 2006, WPFMC 2008, Rausser et al. 2008), as predicted in 2001 (NMFS 2001, Chapter 4).

Sarmiento (2006) and Rausser et al. (2008) studied the effects of the 2001-2004 closure, and both studies concluded that a market transfer effect had occurred: Swordfish from the Hawaii-based fishery were replaced in the U.S. market by swordfish caught by longline fleets based in Central and South American countries. Since the Hawaii-based swordfish fishery had/has stronger, non-discretionary turtle conservation measures, the shift in swordfish production for the U.S. market from the Hawaii-based fleet to Central and South America-based fleets resulted in an estimated increase of 2,882 sea turtle interactions over the 3-year closure (Rausser et al. 2008). Sarmiento (2006) did not quantify the transfer effect in terms of increased sea turtle interactions. Both authors concluded that the 2001-2004 closure of the Hawaii-based shallow-set swordfish fishery was detrimental for sea turtles because the market transfer effect resulted in more fishing for the U.S. swordfish market by less turtle-friendly longline fleets (Sarmiento 2006, Rausser et al. 2008).

The proposed action may result in a market transfer effect, because the Hawaii-based shallow-set longline fishery has stronger turtle conservation measures than rival fleets competing for U.S. swordfish market share. That is, the expansion of the Hawaii-based fishery may cause a reduction in effort in less turtle-friendly swordfish fisheries, thereby decreasing the overall sea turtle bycatch. In contrast to the market transfer effect in response to the 2001-2004 closure, which was detrimental to sea turtles by increasing overall interactions (Sarmiento 2006, Rausser et al. 2008), the proposed action may result in a market transfer effect that is beneficial to sea turtles by decreasing overall interactions (NMFS 2001). The potential beneficial market transfer effect on each affected sea turtle species is discussed in the species sections below.

7.1 Humpback Whales

The stressors, exposure, response and risk steps of the effects analysis for humpback whales with regard to implementation of the proposed action are described below. The following information was used to conduct these analyses of the proposed action on humpback whales: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the humpback whale Stock Assessment Reports (e.g., Angliss & Outlaw 2007), the humpback whale recovery plan (NMFS 1991), the SPLASH report (Calambokidis et al. 2008), and other sources cited below.

7.1.1 Stressors.

The primary stressor of the Hawaii-based shallow-set longline fishery on humpback whales is entanglement with fishing gear. Humpbacks are present in the action area as they migrate to and from waters surrounding the Hawaiian Islands during the winter months. However, the longline fishery generally occurs at locations where humpbacks are uncommon. Thus, interactions between the Hawaii-based longline fishery and humpback whales are rare and unpredictable events. Since 2001, there have been 5 observed interactions between humpbacks and the entire Hawaii-based longline fleet, 2 of which were with the shallow-set component (Table 4).

According to descriptions of these interactions by NOAA Fishery observers, the whales were entangled in the mainline. In each instance, efforts were taken to disentangle the whale, and all whales were either released or able to break free from the gear without noticeable impairment of the animal's ability to swim or feed. However, if entanglement results in the gear wrapping around the animal and breaking off, the animal may trail the gear for a long period of time. The effects of trailing longline fishing gear on large whale species are largely unknown. Available evidence from entangled north Atlantic right whales indicates that while it is not possible to predict whether an animal will free itself of gear, a large proportion are believed to extricate themselves based on scarring observed among apparently healthy animals (NMFS 2004a, 2005).

The potentially beneficial market transfer effect described above is likely not relevant to humpback whales. Humpback interactions with the Hawaii-based shallow-set longline fishery are typically with the mainline, and the configuration of the mainlines are similar in the Hawaii-based fishery and competing longline fleets. Thus, there are not likely to be major differences in humpback interaction rates between the Hawaii-based and competing longline fleets, hence a decrease or increase in the Hawaii-based shallow-set longline fishery would not be expected to affect the number of global humpback interactions in all swordfish longline fisheries combined.

7.1.2 Exposure.

Since the shallow-set fishery re-opened in 2004, there have been 2 interactions with humpback whales in 5,425 sets, giving an interaction rate of 0.00037 humpbacks per set (Table 4). The proposed action is defined as up to 5,550 sets annually, thus the number of humpback whales that are likely to be entangled as a result of interactions with longline gear associated with the proposed action is 3 annually (Table 4).

7.1.3 Response.

NMFS rates the severity of marine mammal interactions with fishing gear using serious injury guidelines developed for the MMPA. Interactions involving entanglement or hooking of the head are considered 'serious'. Interactions involving entanglement or hooking of a part of the body other than the head, that result in the animal being released or escaping with no or minimal gear attached, and that are not expected to impede mobility or result in mortality, are considered 'not serious' (Angliss and Demaster 1998). Of the 5 interactions of humpbacks with the Hawaii-based longline fishery since 2001 (3 in deep-set, 2 in shallow-set), 3 were 'not serious', 1 was 'serious', and 1 has yet to be determined (M. Yuen, NMFS PIRO, pers. comm.).

The effects of fishing gear interactions on adult humpback whales are not likely to be different between deep-set and shallow-set gear, because the animals are large enough to pull the deep-set gear to the surface. In contrast, mortality of turtles interacting with deep-set gear is much higher than for shallow-set gear because the turtles usually cannot pull the gear to the surface, and drown (NMFS 2005). Because the effects of deep-set vs. shallow-set gear on humpbacks are likely indistinguishable, the 3 humpback interactions with deep-set gear are considered applicable to this response analysis, along with the 1 shallow-set interaction with known injury. The fact that all 3 deep-set interactions resulted in 'not serious' injuries, and 1 (or possibly both) of the shallow-set interactions resulted in 'serious' injuries, is considered a coincidence, rather than evidence that shallow-set gear is likely to cause more serious injuries.

In the exposure analysis above, humpback exposure to the proposed action is estimated to result in 3 entanglements annually. Of the 4 interactions with known injuries that have occurred since 2001 in the Hawaii-based longline fishery, 1 resulted in serious injury. Thus, if 25 percent of the 3 entanglements result in serious injury, 1 humpback may be seriously injured by the proposed action every 1 – 2 years. The most conservative possible interpretation is that 100 percent of serious injuries result in mortality. Therefore, the proposed action is expected to kill up to 1 humpback whale every 1 – 2 years.

7.1.4 Risk.

As described in Section 5.2, the North Pacific humpback population was recently estimated to number approximately 18,000 individuals, about half of which winter in Hawaii. Annual growth rate for the North Pacific population was estimated at 4.9 to 6.8 percent, depending on which area and time frame are considered (Calambokidis et al. 2008). Based on these growth rates, the population is currently growing at several hundred individuals annually. Thus, the mortality of up to 1 individual humpback whale every 1 – 2 years is not expected to increase the risk of the population to extinction. That is, NMFS does not expect the proposed action to result in a reduction in the numbers, distribution, or reproduction of the North Pacific population of humpback whales.

7.2 Loggerhead Turtles

The stressors, exposure, response and risk steps of the effects analysis for loggerhead turtles with regard to implementation of the proposed action are described below. The loggerhead turtles directly affected by interactions resulting from the proposed action are expected to be from the North Pacific population. The direct and indirect effects of the action on this population, and any indirect effects on other populations, are related to the species as a whole in the Integration and Synthesis of Effects (Section 9). The following information was used to conduct these analyses of the proposed action on loggerheads: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the DSEIS for the proposed action (WPFMC 2008), the population assessment conducted by PIFSC for the proposed action (Snover 2008), and other documents cited below.

7.2.1 Stressors

Longline fishing affects loggerhead turtles primarily by hooking, but also by entanglement and trailing of gear. Shallow-set longlining is done at night with light-sticks. Since loggerheads feed at about the same depth as the shallow-set gear is fished, and they feed on bioluminescent organisms such as pelagic tunicates, they are highly susceptible to hooking by shallow-set gear. Hooking may be external, generally in the flippers, head, beak, or mouth, or internal, when the animal has attempted to forage on the bait, and the hook is ingested. When a hook is ingested, the process of movement, either by the turtle's attempt to get free of the hook or by being hauled in by the vessel, can traumatize the turtle by piercing the esophagus, stomach, or other organs, or by pulling the organs from their connective tissue. Once the hook is set and pierces an organ, infection may ensue, which may result in the death of the animal. If a hook does not become lodged or pierce an organ, it can pass through to the colon, and be expelled (NMFS 2004a, 2005).

Loggerheads are entangled less frequently than leatherbacks. Entanglement in monofilament line (mainline or branchline) or polypropylene (float line) can result in substantial wounds, including cuts, constriction, or bleeding on any body part. In addition, entanglement can directly or indirectly interfere with mobility, causing impairment in feeding, breeding, or migration. ‘Trailing line’ refers to line that is left on a turtle after it has been captured and released, particularly line trailing from an ingested hook. Turtles may swallow line trailing from an ingested hook, which may block the gastrointestinal tract. Trailing line can also become snagged on a floating or fixed object, further entangling the turtle, or the drag from the float can cause the line to constrict around a turtle’s appendages until the line cuts through it (NMFS 2004a, 2005).

While the primary direct effect of the proposed action on loggerhead turtles will be the stressor of fishing gear interactions, an indirect effect of the proposed action (one that is likely to occur later in time) may be a beneficial market transfer effect. A description of the “market transfer effect” is provided in the introduction to the effects section above. Since the Hawaii-based swordfish fishery had/has stronger, non-discretionary turtle conservation measures, the shift in swordfish production for the U.S. market from the Hawaii-based fleet to Central and South America-based fleets resulted in an estimated increase of 2,882 sea turtle interactions (all species combined) over the 3-year closure (Rausser et al. 2008). An estimate of the number of additional loggerhead mortalities represented by these interactions was made in a pre-publication version of the Rausser et al. (2008) paper (Rausser et al. undated). The species-specific estimates were removed from the published version. NMFS does not believe that adequate data are available to quantify loggerhead mortalities with any precision that may have resulted from the market transfer effect due to the 2001-2004 closure.

The proposed action would considerably expand the Hawaii-based shallow-set swordfish fishery, i.e., the opposite action of the 2001-2004 closure. Therefore, the proposed action would likely result in a decrease in swordfish imports to the U.S., and a reduction in swordfishing effort by less turtle-friendly competing fleets (NMFS 2001). Such a market transfer effect would be the opposite of that which occurred due to the 2001-2004 closure, and would likely result in a reduction in global loggerhead interactions in all swordfish longline fisheries combined. The reduction in loggerhead interactions may affect the North Pacific loggerhead population, and possibly other loggerhead populations.

7.2.2 Exposure

Loggerhead turtles are expected to be exposed to interactions directly caused by the proposed action, due to hooking and entanglement by fishing gear deployed by the Hawaii-based shallow-set longline fishery. This exposure can be quantified as the expected annual number of interactions. The proposed action would result in up to 5,550 sets annually. Based on the number of sets made, and the number of loggerhead interactions, during the 4-year period (100 percent observer coverage) since the re-opening of the shallow-set fishery (10/04 – 9/08), 5,550 sets would result in 46 loggerhead interactions (Table 4). Therefore, loggerhead exposure to the effects of the proposed action is considered to be 46 loggerhead interactions annually.

A global decrease in loggerhead exposure to interactions with shallow-set gear deployed by other swordfishing fleets is expected to be indirectly caused by the proposed action, due to a market transfer effect. However, information is not available to quantify the reduction in exposure with any precision. Although Rausser et al. (2008) quantified the increased interactions resulting from the 2001-2004 closure (an additional 2,882 sea turtle interactions, all species combined over the 3-year period), uncertainty resulted in a very large 95 percent confidence interval (-59 to 30,680 additional sea turtle interactions). Thus, NMFS cannot quantify the market transfer effect likely to result from the proposed action with any precision for loggerheads. The North Pacific loggerhead population may be affected, and possibly other loggerhead populations.

7.2.3 Response

Loggerhead response to the predicted exposure (46 interactions annually) can be characterized as the annual number of mortalities resulting from this exposure. For the 45 loggerhead interactions observed in the shallow-set fishery from when it re-opened in late 2004 until the end of 2007, based on NMFS' post-hooking mortality criteria (NMFS 2006b), post-hooking mortality of loggerheads in this fishery was 20.5 percent (NMFS 2008c). Using this post-hooking mortality rate, 46 interactions annually would lead to 10 (46 x 0.205 = 9.4, round to 10) loggerhead mortalities (either sex, all ages). However, in order to estimate the risk that the proposed action poses to the North Pacific loggerhead population, a population assessment was done by PIFSC (Snover 2008), which is based on the number of adult females removed from the population. Adult females are the only component of the population for which data are available, from counts of adult females on nesting beaches. The response of loggerheads to 46 interactions must be quantified in terms of adult females in order to interpret the population assessment.

The shallow-set fishery interacts with males and females, and most of these loggerheads are juveniles. In order to estimate the number of adult females that would be killed by 46 interactions, 2 corrections must be applied to the calculation above: (1) the proportion of females in the adult population; and (2) the adult equivalent represented by each juvenile interaction. Sex ratio of the North Pacific loggerhead population is unknown, but studies of Atlantic and Caribbean loggerhead populations suggest that sex ratio is not 50:50. Rather, these studies indicate there are more females than males in many sub-populations, hence NMFS estimates the sex ratio in the North Pacific population to be 65 percent female (NMFS 2008f).

Most loggerheads interacting with the shallow-set fishery are juveniles. The smallest of 443 nesting North Pacific loggerheads in Japan was 74 cm standard carapace length (SCL; Hatase et al. 2004). Of the 41 measured loggerheads interacting with the shallow-set fishery from late 2004 through 2007, 30 were <74 cm SCL (NMFS 2008f), hence at least 73 percent (30/41) of these turtles were juveniles. In order to estimate the fraction of 1 adult equivalent represented by each captured juvenile, a reproductive value model was developed by PIFSC for application to the juveniles captured by the shallow-set fishery. The model was run with different assumptions regarding age to maturity, size at maturity, and survival. The mean reproductive values of the loggerheads interacting with the shallow-set fishery ranged from 0.22 to 0.41, depending on age to maturity, size at maturity, and survival (NMFS 2008f). The highest value (0.41) was selected because it is the most conservative.

In order to estimate the response of loggerheads to an annual rate of 46 interactions in terms of annual adult female mortalities, the interactions were multiplied by the post-hooking mortality rate (0.205), the female sex ratio (0.65), and the adult equivalent (0.41), giving an estimate of 2.51 adult female mortalities annually (Table 5)[4]. This number of adult female mortalities per year is the expected loggerhead response to exposure to hooking and entanglement caused by the proposed action. The impact of this level of mortality on the North Pacific loggerhead population was assessed by Snover (2008), and is summarized below in the Risk Analysis, the final step in the analysis of effects of the proposed action.

Table 5. Annual adult female loggerhead mortality from the proposed action.

Variable	Estimate
Maximum annual interactions	46 interactions
Post-hooking mortality	0.205 mortalities/capture
Sex ratio	65:35 (♀:♂) = 0.65 females
Adult equivalents	0.41 adult equivalent
Annual adult female mortalities	2.51 adult females*

*(46 captures)(0.205 mortalities/capture)(0.65 females)(0.41 adult equivalent) = 2.51 adult females

All variables used for the estimate of annual adult female mortalities were selected conservatively in an attempt to estimate the maximum possible number of adult females that could be killed by the proposed action: We used the maximum possible number of interactions per year (46) rather than the more likely scenario of less than 46 interactions per year. For example, while the maximum number of loggerhead interactions in the shallow-set fishery has been 17 per year since 2004, the mean annual number of actual interactions for the 3-year period 2005-07 was 14.7 (NMFS 2008c). The post-hooking mortality rate of 20.5 percent is based on application of the current NMFS criteria (NMFS 2006b) to the 45 observed interactions in the fishery from late 2004 to the end of 2007. However, a more recent study suggests a considerably lower post-hooking mortality rate of 9.5 percent for loggerheads (Swimmer et al. In Press). Likewise, rather than using a 50:50 sex ratio based on absence of information for this population, a female ratio of 0.65 was used based on information from the Atlantic. Finally, the reproductive value model indicated adult equivalents of 0.22 to 0.41 were appropriate, based on the available data, and the highest value was chosen (NMFS 2008f) and applied in the population assessment (Snover 2008). A recently published study using a large sample size from the Hawaii-based longline fishery (n = 44) indicates that the lower end of the 0.22 to 0.41 range is more appropriate (Wallace et al. 2008, Figure 2d). Thus, the estimate of 3 (rounded from 2.51)[4] adult females killed annually is considered to be the maximum number that would be killed by interactions associated with the proposed action, rather than a mean number.

As described in the exposure section above, a market transfer effect resulting from the proposed action is expected to reduce global loggerhead interactions. However, since the decrease in

[4] Snover (2008) used fractions for model inputs rather than rounded numbers. E.g., the effect of 2.51 adult female mortalities annually was tested in the model, rather than 3 adult female mortalities. Hence, fractions are used in this opinion when referring to inputs to the model. Otherwise, adult female mortalities are given in whole numbers, rounded up from one significant digit (e.g., 1.1 to 1.9 round to 2, but 1.01 to 1.04 round to 1).

interactions (exposure) cannot be quantified, the resulting decrease in loggerhead mortalities (response) cannot be quantified. Thus, NMFS cannot quantify with any precision the market transfer effect likely to result from the proposed action in terms of decreased loggerhead mortalities. The North Pacific loggerhead population may be affected by the market transfer effect, and possibly other loggerhead populations.

7.2.4 Risk

The response of loggerheads to interactions with gear deployed by the Hawaii-based shallow-set fishery is considered to be the mortality of 2.51 adult females annually (Tables 5 and 6; not rounded because this number is an input into the population model – see footnote 4 above). The risk posed by this level of mortality to the North Pacific loggerhead population was assessed by Snover (2008) for application to this opinion. Snover (2008) analyzed the proposed action using a risk index called Susceptibility to Quasi-Extinction (SQE), which is designed to assess how different levels of mortality affect a population's risk of extinction (Snover & Heppell, In Press). A Quasi-Extinction Threshold (QET), consisting of a minimum population size reached over a certain amount of time, must first be chosen in order to calculate the effects of different levels of mortality on the population's likelihood of reaching QET. If a low threshold is chosen (e.g., a population decline to 1% of current population in 1 generation), then the method will not be sensitive to minor population declines because the population would have to be nearly wiped out (99 percent decline in 1 generation) to reach QET. Thus, in order to enable the assessment to detect the effects of a small number of annual mortalities, a QET of 50 percent current population over 3 generations (100 years for loggerheads) was chosen for application of SQE to the North Pacific loggerhead assessment (Snover 2008). Such a sensitive, conservative QET is appropriate for assessing effects of actions on ESA-listed species, because the purpose of the ESA is to minimize impacts of human activities and foster recovery of listed species.

After setting QET, the risk assessment calculates a baseline SQE based on available data regarding the status, trends and size of the population. As mentioned above in Sections 5.2.1 and 7.2.3, the only population data available for North Pacific loggerheads are the annual numbers of nests, from which nesting females can be estimated. The approach developed by Snover & Heppell (In Press) is designed specifically for sea turtles to account for environmental and demographic sources of variability in the annual numbers of nesting females, which are used to estimate the baseline SQE. The value of SQE can range from 0.0 (no risk) to 1.0 (certainty of quasi-extinction), with SQE of >0.75 indicating that the population is at risk. Based on the 18 years of nesting data from Japan (1990-2007), the North Pacific loggerhead population is at risk of reaching QET, even in the absence of any Hawaii-based shallow-set fishery, because baseline SQE = 0.8311 (Snover 2008)[5]. Baseline SQE is shown by the flat, dotted line marked as '**E**' in Figure 8 below, which is SQE in the absence of any Hawaii-based shallow-set fishery.

The effect of the proposed action (2.51 adult female mortalities annually) on SQE is quantified in Table 6 and shown in Figure 8 below. Adding 2.51 adult female mortalities annually causes the population's SQE to increase by 0.71 percent (**H** in Figure 8). Another way of interpreting the data is to examine the effect of the additional adult female mortality on "what's left" between baseline SQE (0.8311) and extinction (1.00), or 1-SQE, which in this case is 0.1689 (1.00 – 0.8311). The proposed action would reduce 1-SQE of the North Pacific loggerhead population by 3.49 percent (also represented by **H** in Figure 8). Neither the 0.71 percent increase in SQE, nor the 3.49 percent reduction in 1-SQE, are statistically distinguishable from zero. That is, the effects of direct interactions resulting from the action on SQE and 1-SQE cannot be statistically distinguished from the effect of natural mortality on SQE and 1-SQE.

In order to minimize the risk of a population to quasi-extinction, 1-SQE should not be reduced by more than 5 percent (Snover 2008). The threshold of 5 percent lies between 3 and 4 adult female mortalities annually (i.e., 3 mortalities reduce 1-SQE by <5%, but 4 mortalities reduce 1-SQE by >5%), suggesting that less than 4 mortalities annually minimizes risk. The proposed action is estimated to result in a maximum of 3 adult female mortalities annually due to direct interactions (rounding up from 2.51, Table 6)[5].

Table 6. Risk assessment for effects of proposed action on N. Pacific loggerhead population (Snover 2008).

Adult Female Mortalities (AFM)	
A. AFM w/ proposed action[1]	2.51
B. AFM w/ old interaction limit[2]	0.93
C. Increase in AFM from A to B	1.58
D. Effect of proposed action on AFM	+2.51
Susceptibility to Quasi-Extinction (SQE)	
E. Baseline SQE	0.8311
Baseline 1-SQE	0.1689
F. SQE w/ proposed action[1]	0.8370
1 - SQE w/ proposed action	0.1630
G. SQE w/ old interaction limit[2]	0.8333
1 - SQE w/ old interaction limit	0.1667
H. Increase in SQE from proposed action	0.0059
% increase in SQE (0.0059/0.8311)	0.71%
Decrease in 1 – SQE from proposed action	0.0059
% decrease in 1 – SQE (0.0059/0.1689)	3.49%

[1] Proposed action = 46 loggerhead interactions/yr.
[2] Old interaction limit = 17 loggerhead interactions/yr.

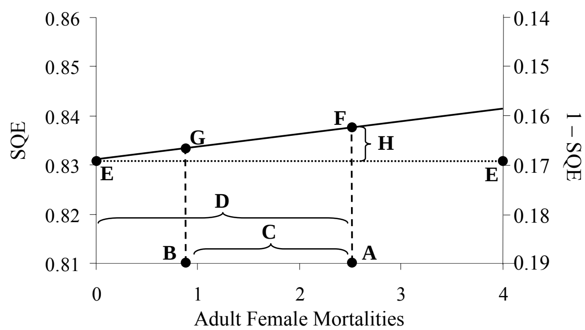

Figure 8. Effect of annual adult female mortalities (**D**) from proposed action on SQE and 1 – SQE (**H**), from data in Table 6 (modified from Snover 2008).

A beneficial market transfer effect from the proposed action may indirectly reduce North Pacific loggerhead mortality, but as described above, the reduction is not quantifiable with any precision. NMFS expects that direct interactions resulting from the proposed action are likely to kill the equivalent of up to 3 adult female North Pacific loggerheads annually. Thus, the overall effect of the action on this population may be the mortality of less than 3 adult females annually. However, since the market transfer effect is less certain and less quantifiable than the effects of direct interactions, it is not prudent to reduce our estimate of overall mortality from the proposed action to less than 3 North Pacific adult females annually. The results of the population assessment suggest that less than 4 adult female mortalities annually would minimize the risk of the proposed action to the North Pacific loggerhead population (Snover 2008)[5].

[5] The risk assessment (Snover 2008) was completed before the 2008 North Pacific loggerhead nesting season in Japan, which occurs primarily between May and August each year. On August 15, 2008, STAJ provided PIRO the nesting total from Yakushima through the end of July (3,927 nests; Matsuzawa 2008). From 2003 to 2006, Yakushima made up approximately 60 percent of the nesting total in Japan (unpublished data from STAJ, Kamezaki et al., In press). Thus, the preliminary estimate for the 2008 nesting total is 6,500 nests, as shown in Figure 3. However, as noted in Section 5.2, the actual number of 2008 nests may be closer to 10,000. If the population assessment (Snover 2008) had been able to include the 2008 data, then baseline SQE, as well as the effects of the proposed action on SQE and 1-SQE, would likely have been less than shown above in Table 6 and Figure 8.

7.3 Leatherback Turtles

The stressors, exposure, response and risk steps of the effects analysis for leatherback turtles with regard to implementation of the proposed action are described below. The leatherback turtles directly affected by fishing interactions resulting from the proposed action are expected to be entirely from the Western Pacific population. The direct and indirect effects of the action on this population, and any indirect effects on other populations, are related to the species as a whole in the Integration and Synthesis of Effects (Section 9). The following information was used to conduct these analyses of the proposed action on leatherbacks: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), the DSEIS for the proposed action (WPFMC 2008), the population assessment conducted by PIFSC for the proposed action (Snover 2008), and other documents cited below.

7.3.1 Stressors

Due to morphological and behavioural differences between loggerhead and leatherback turtles, effects of longline fishing on leatherbacks are somewhat different than those on loggerheads. Entanglement and foul hooking are the primary effects of longline fishing on leatherbacks, whereas internal hooking is more prevalent in hardshell turtles, especially loggerheads. Leatherbacks seem to be more vulnerable to entanglement and foul hooking, possibly due to their morphology (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, or some combination of these and/or other reasons. The effects of entanglement on leatherbacks are similar to those described above for loggerheads: substantial wounds and reduced mobility, causing impairment of feeding, breeding, or migration of the entangled individual. Besides entanglement and foul hooking, the other 2 primary effects of longline fishing on leatherbacks are internal hooking and trailing line, the effects of which are similar to those described above for loggerheads in Section 7.2.1. Because leatherbacks have more delicate skin and softer tissue and bone structures than hardshell turtles, their risk from longline-related injury is considered to be higher (NMFS 2004a, 2005, 2006a).

While the primary direct effect of the proposed action on leatherback turtles will be the stressor of fishing gear interactions, an indirect effect of the proposed action (one that is likely to occur later in time) may be a beneficial market transfer effect. A description of the "market transfer effect" is provided in the introduction to the effects section above. Since the Hawaii-based swordfish fishery had/has stronger, non-discretionary turtle conservation measures, the shift in swordfish production for the U.S. market from the Hawaii-based fleet to Central and South America-based fleets resulted in an estimated increase of 2,882 sea turtle interactions (all species combined) over the 3-year closure (Rausser et al. 2008). An estimate of the number of additional leatherback mortalities represented by these interactions was made in a pre-publication version of the Rausser et al. (2008) paper (Rausser et al. undated). The species-specific estimates were removed from the published version. NMFS does not believe that adequate data are available to quantify leatherback mortalities with any precision that may have resulted from the market transfer effect due to the 2001-2004 closure.

The proposed action would considerably expand the Hawaii-based shallow-set swordfish fishery, i.e., the opposite action of the 2001-2004 closure. Therefore, the proposed action would likely result in a decrease in swordfish imports to the U.S., and a reduction in swordfishing effort by less turtle-friendly competing fleets (NMFS 2001). Such a market transfer effect would be the opposite of that which occurred due to the 2001-2004 closure, and would likely result in a reduction in global leatherback interactions in all swordfish longline fisheries combined. The reduction in leatherback interactions may affect the Western Pacific leatherback population, and possibly other leatherback populations.

7.3.2 Exposure

Leatherback turtles are expected to be exposed to interactions directly caused by the proposed action, due to hooking and entanglement by fishing gear deployed by the Hawaii-based shallow-set longline fishery. This exposure can be quantified as the expected annual number of interactions. The proposed action would result in up to 5,550 sets annually. Based on the number of sets made, and the number of leatherback interactions, during the 4-year period (100 percent observer coverage) since the re-opening of the shallow-set fishery (10/04 – 9/08), 5,550 sets would result in 19 leatherback interactions (Table 4). Therefore, leatherback exposure to the effects of the proposed action is considered to be 19 leatherback interactions annually.

A decrease in global leatherback exposure to interactions with shallow-set gear deployed by other swordfishing fleets is expected to be indirectly caused by the proposed action, due to a market transfer effect. However, information is not available to quantify the reduction in exposure with any precision. Although Rausser et al. (2008) quantified the increased interactions resulting from the 2001-2004 closure (an additional 2,882 sea turtle interactions, all species combined over the 3 year period), uncertainty resulted in a very large 95 percent confidence interval (-59 to 30,680 additional sea turtle interactions). Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for leatherbacks. The Western Pacific leatherback population may be affected by the market transfer effect, as well as other leatherback populations.

7.3.3 Response

Leatherback response to the predicted exposure (19 interactions annually) can be characterized as the annual number of mortalities resulting from this exposure. For the 16 leatherback interactions observed in the shallow-set fishery from when it re-opened in late 2004 until the end of 2007, based on NMFS' post-hooking mortality criteria (NMFS 2006b), post-hooking mortality of leatherbacks in this fishery was 22.9 percent (NMFS 2008c, Snover 2008). Using this post-hooking mortality rate, 19 interactions annually would lead to 5 (rounded from 4.35) leatherback mortalities (either sex, all ages). However, in order to estimate the risk that the proposed action poses to the Western Pacific leatherback population, a population assessment was done by PIFSC (Snover 2008), based on the number of adult females removed from the population. Adult females are the only component of the population for which data are available, from counts of adult females on nesting beaches. Thus, the response of leatherback to 19 interactions must be quantified in terms of adult females in order to interpret the population assessment.

The shallow-set fishery interacts with male and female leatherbacks, some of which are juveniles. In order to estimate the number of adult females that would be killed by 19 interactions, 2 corrections must be applied to the calculation above: (1) the proportion of females in the adult population; and (2) the adult equivalent represented by each juvenile interaction. Sex ratio of the Western Pacific leatherback population is unknown, but studies of other leatherback populations suggest that sex ratio is not 50:50. Rather, these studies indicate more females than males in many sub-populations, hence NMFS estimates the sex ratio in the Western Pacific population to be 65 percent female (NMFS 2008g). Some leatherbacks interacting with the shallow-set fishery are juveniles. The mean size of nesting Western Pacific leatherback females at onset of maturity is estimated at 163 cm SCL. Mean SCL of the 12 measured leatherbacks interacting with the shallow-set fishery from late 2004 through 2007 was 139 cm SCL, thus each captured leatherback in this fishery is estimated to represent 0.85 of an adult equivalent (139/163; NMFS 2008g).

In order to estimate the response of leatherbacks to an annual rate of 19 interactions in terms of annual adult female mortalities, the interactions were multiplied by the post-hooking mortality rate (0.229), the female sex ratio (0.65), and the adult equivalent (0.85), giving an estimate of 2.40 adult female mortalities annually for the Western Pacific population. Unlike for North Pacific loggerheads, comprehensive nesting data are not available for Western Pacific leatherbacks. However, nesting data are available since 1993 for the Jamursba-Medi component, estimated to represent 38 percent of the Western Pacific population. Because of migration patterns, approximately 69 percent of leatherbacks interacting with the Hawaii-based shallow-set fishery are likely to be from the Jamursba-Medi component. The number of adult female mortalities from the Jamursba-Medi component was estimated using the formula shown in Table 7.

Table 7. Annual adult female leatherback mortality from the proposed action.

Variable	Estimate
Maximum annual interactions	19 interactions
Post-hooking mortality	0.229 mortalities/capture
Sex ratio	65:35 (♀:♂) = 0.65 females
Adult equivalents	0.85 adult equivalent
Annual adult female mortalities from Western Pacific population	2.40 adult females*
Annual adult female mortalities from Jamursba-Medi component	1.66 adult females**

*(19 captures)(0.229 mortalities/capture)(0.65 females)(0.85 adult equivalent) = 2.40 adult females, from the Jamursba-Medi + the non-Jamursba-Medi components of the Western Pacific population.
**Based on assumption that all captured leatherbacks are from the Western Pacific population, including 69% from the Jamursba-Medi component, and 31% from the non-Jamursba-Medi component (none from Eastern Pacific population).

As shown in Table 7, 1.66 adult female mortalities per year is the expected response of the Jamursba-Medi component to entanglement and hooking caused by the proposed action (not rounded because this number is an input into the population model – see footnote 4 above). The impact of this level of mortality on the Jamursba-Medi component of the Western Pacific population was assessed by Snover (2008). The Risk Analysis below includes a summary of Snover (2008) for the Jamursba-Medi component, as well as an analysis of the non-Jamursba-Medi component based on the best available information.

All variables used for the estimate of annual adult female mortalities were selected conservatively in an attempt to estimate the maximum possible number of adult females that could be killed by the proposed action: We used the maximum possible number of interactions per year (19) rather than the more likely scenario of less than 19 interactions per year. For example, while the maximum number of leatherback interactions in the shallow-set fishery has been 16 per year since 2004, the mean annual number of actual interactions for the 3-year period

2005-07 was 5.0 (NMFS 2008c). The post-hooking mortality rate of 22.9 percent is based on application of the current NMFS criteria (NMFS 2006b) to the 16 observed interactions in the fishery from late 2004 to the end of 2007. However, 1 of the 16 leatherbacks was deeply-hooked and entangled, a highly unusual occurrence for leatherbacks in this fishery (Gilman et al. 2007a). The mean estimated post-hooking mortality for the other 15 leatherbacks was 19.0 percent. Likewise, rather than using a 50:50 sex ratio based on absence of information for this population, a female ratio of 0.65 was used based on information from other leatherback populations. Finally, the adult equivalent estimate of 0.85 is based on a simple proportion of mean length of captured leatherbacks (139 cm SCL) to the estimated length at maturity for this population (163 cm SCL; NMFS 2008g). However, this calculation assumes 100 percent survival of the captured juveniles, so a more realistic adult equivalent estimate would be <0.85. Thus, the estimate of 3 (rounded from 2.40, see footnote 4 above regarding rounding) adult females killed annually from the Western Pacific leatherback population is considered to be the maximum number that would be killed by interactions associated with the proposed action, rather than a mean number.

As described in the exposure section above, a market transfer effect resulting from the proposed action is expected to reduce global leatherback interactions. However, since the decrease in interactions (exposure) cannot be quantified, the resulting decrease in leatherback mortalities (response) cannot be quantified. Thus, NMFS cannot quantify with any precision the market transfer effect that may result from the proposed action in terms of decreased leatherback mortalities. The Western Pacific leatherback population may be affected by the market transfer effect, and possibly other leatherback populations.

7.3.4 Risk

The risk assessment for Western Pacific leatherbacks is more complex than for loggerheads because the population assessment done for this proposed action (Snover 2008) only considered the Jamursba-Medi component of the population, due to data limitations[6]. However, this opinion must determine the risk posed by the proposed action to the Western Pacific population, because the fishery interacts with leatherbacks from the Jamursba-Medi and the non-Jamursba-Medi components of the population.

7.3.4.1 Jamursba-Medi Component of the Western Pacific Population

The Jamursba-Medi component of the Western Pacific leatherback population makes up 38 percent of the population (Dutton et al. 2007), but 69 percent of the leatherbacks interacting with the Hawaii-based shallow-set fishery are likely from this component due to migration patterns (Snover 2008). The description in Section 7.2.4 above of Snover's methodology applies here, except that the QET of 50 percent current population over 3 generations is for 63 years rather than 100 years, because leatherbacks mature at an earlier age than loggerheads.

The effect of the proposed action on SQE of the Jamursba-Medi component of the Western Pacific population is quantified in Table 8 and shown in Figure 9 below. The estimated 1.66 annual adult female mortalities (see footnote 4 above regarding rounding) causes the SQE of the

[6] Dutton et al. (2007) derived a total estimate for Western Pacific leatherback nesting for the period 1999-2006, but this was based in part on anecdotal information. The only nesting data of adequate quality and duration for a population assessment is from Jamursba-Medi (Snover 2008).

Jamursba-Medi component to increase by 0.87 percent (**H** in Figure 9). Another way of interpreting the data is to examine the effect of the additional adult female mortality on "what's left" between baseline SQE (0.8001) and extinction (1.00), or 1-SQE, which in this case is 0.1999 (1.00 – 0.8001). The proposed action would reduce 1-SQE of the Jamursba-Medi component by 3.50 percent (also represented by **H** in Figure 9). Neither the 0.87 percent increase in SQE, nor the 3.50 percent reduction in 1-SQE, are statistically distinguishable from zero. That is, the effects of direct interactions resulting from the action on SQE and 1-SQE cannot be statistically distinguished from the effect of natural mortality on SQE and 1-SQE.

In order to minimize the risk of a population to quasi-extinction, 1-SQE should not be reduced by more than 5 percent. The threshold of 5 percent lies between 2 and 3 adult female mortalities annually for the Jamursba-Medi component (i.e., 2 mortalities reduce 1-SQE by <5%, but 3 mortalities reduce 1-SQE by >5%), suggesting that less than 3 mortalities annually minimizes risk (Snover 2008). The proposed action is expected to result in 2 mortalities (1.66) annually from the Jamursba-Medi component (see Table 8), and a total of 3 mortalities (2.40) annually from the Western Pacific population, due to direct interactions.

Table 8. Risk assessment for effects of proposed action on the Jamursba-Medi component of the Western Pacific leatherback population (Snover 2008)[1].

Adult Female Mortalities (AFM)	
A. AFM w/ proposed action[2]	1.66[3]
B. AFM w/ old interaction limit[4]	1.39
C. Increase in AFM between A and B	0.27
D. Increase in AFM from proposed action	+1.66
Susceptibility to Quasi-Extinction (SQE)	
E. Baseline SQE	0.8001
Baseline 1-SQE	0.1999
F. SQE w/ proposed action[2]	0.8071
1 - SQE w/ proposed action	0.1929
G. SQE w/ old interaction limit[4]	0.8057
1 - SQE w/old interaction limit	0.1943
H. Increase in SQE from proposed action	0.0070
% increase in SQE (0.0070/0.8001)	0.87%
Decrease in 1 – SQE from proposed action	0.0070
% decrease in 1 – SQE (0.0070/0.1999)	3.50%

[1] Snover (2008) assumed that 6% of leatherbacks captured by the proposed action would be from Eastern Pacific population. However, as described in Section 5.4.1 above, all leatherbacks are expected to be from the Western Pacific population. Hence, Snover's (2008) leatherback proportions of 65% Jamursba-Medi, 29% non-Jamursba-Medi, and 6% Eastern Pacific, were changed to 69% Jamursba-Medi and 31% non-Jamursba-Medi. Therefore, Snover's estimate of 1.56 adult females killed from the Jamursba-Medi component was adjusted to 1.66, as described in footnote #3 below.
[2] Proposed action = 19 leatherback interactions/yr.
[3] Since 69% of leatherbacks caught by the fishery are from the Jamursba-Medi component (Snover 2008), new hard cap will kill (0.69)(2.40) = 1.66 AFM.
[4] Old interaction limit = 16 leatherback interactions/yr.

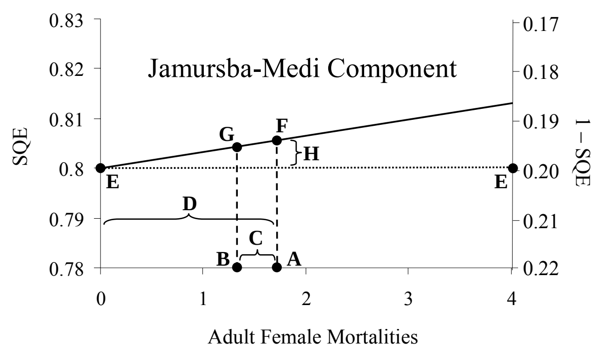

Figure 9. Effect of annual adult female mortalities (**D**) from proposed action on SQE and 1 – SQE (**H**) of the Jamursba-Medi component of the Western Pacific leatherback population, from data in Table 8 (modified from Snover 2008).

7.3.4.2 Non-Jamursba-Medi Component of the Western Pacific Population

A risk assessment could not be done for the Western Pacific leatherback population as a whole because of data limitations for the non-Jamursba-Medi component of the population, which refers to all nesting sites except for Jamursba-Medi. The non-Jamursba-Medi component makes up approximately 62 percent of the Western Pacific leatherback population (Dutton et al. 2007), consisting of 27 nesting sites in Papua, PNG, the Solomon Islands, and Vanuatu, as described in Section 5.4.1. Since 31 percent of the leatherbacks interacting with the Hawaii-based shallow-set fishery are expected to originate from the non-Jamursba-Medi component (Table 7), this opinion must determine the effect of the proposed action on the Western Pacific population as a whole. Is the risk assessment for the Jamursba-Medi component (Snover 2008) representative of the non-Jamursba-Medi component? The limited nesting information from the non-Jamursba-Medi sites is summarized below.

As described in Section 5.3.1, annual nest counts at Wermon in Papua have declined from an annual mean of 2,335 nests in 2002-03 and 2003-04, to an annual mean of 1,332 in 2005-06 and 2006-07 (NMFS 2008h). Leatherbacks nesting at sites in the Huon area of PNG appear to have declined by approximately 90 percent within the last 20 years (Hirth et al. 1993, Pilcher 2006, 2007; NMFS 2008h; WPFMC 2008). No information exists regarding populations trends in the Solomon Islands over time, but it is believed that local consumption of turtles and eggs has reduced nesting populations over the last few decades (Steering Committee Bellagio II 2008, NMFS 2008h). Furthermore, conservation activities at these sites are inconsistent and monitoring programs are still in development, hampered by local capacity and funding limitations.

The limited nesting data and other information for the non-Jamursba-Medi component of the Western Pacific leatherback population suggest a more rapid decline than for the Jamursba-Medi component (NFMS 2008h). Jamursba-Medi nesting declined from the 1993-1997 period to the 1999-2007 period, but the nesting trend throughout the 1999-2007 was generally stable (Figure 4). Since the non-Jamursba-Medi component of the Western Pacific population is almost twice as large as Jamursba-Medi component (Dutton et al. 2007), and the non-Jamursba-Medi component may be declining more rapidly than the Jamursba-Medi component (i.e., between the 1993-1997 and 1999-2007 periods), then the Western Pacific population as a whole may be declining more rapidly than Jamursba-Medi alone. Hence, it is reasonable to conclude that the recent Jamursba-Medi nesting trend (Figure 4) and assessment (Snover 2008) are <u>not</u> representative of the Western Pacific population, but rather that the Western Pacific population is declining at a greater rate than the Jamursba-Medi component alone. Therefore, the proposed action could potentially have a more adverse effect on the Western Pacific population than on the Jamursba-Medi component alone.

7.3.4.3 Conclusion for Western Pacific Leatherback Risk Assessment

In conclusion, the proposed action is expected to result in 0.87 and 3.50 percent changes in SQE and 1-SQE, respectively, of the Jamursba-Medi component (Table 8, Figure 9). Available information suggests that the non-Jamursba-Medi component and the Western Pacific population as a whole may be declining more rapidly

Table 9. Conclusion for Western Pacific leatherback risk assessment.

	Jamursba-Medi component	Non-Jamursaba-Medi component	Western Pacific population
Nesting	38% of total	62% of total	100%
Captured by fishery	69% of total	31% of total	100%
Increase in SQE	0.87%	>0.87%	>0.87%
Decrease in 1 - SQE	3.50%	>3.50%	>3.50%

than the Jamursba-Medi component. It follows that direct interactions from the proposed action would therefore result in greater changes in the SQE and 1 – SQE of the Western Pacific population as a whole than the Jamursba-Medi component (Table 9).

A beneficial market transfer effect from the proposed action may indirectly reduce Western Pacific leatherback mortality, but as described above, the reduction is not quantifiable with any precision. NMFS expects that direct interactions resulting from the proposed action are likely to kill the equivalent of up to 3 adult female Western Pacific leatherbacks annually. Thus, the overall effect of the action on this population may be the mortality of less than 3 adult females annually. However, since the market transfer effect is less certain and less quantifiable than the effects of direct interactions, it is not prudent to reduce our estimate of overall mortality from the proposed action to less than 3 Western Pacific adult females annually, 2 of which would be from the Jamursba-Medi component of the population. The results of the population assessment suggest that less than 3 adult female mortalities annually from the Jamursba-Medi component of the Western Pacific leatherback population would minimize the risk of the proposed action to this population (Snover 2008).

7.4 Olive Ridley Turtles

The stressors, exposure, response and risk steps of the effects analysis for olive ridley turtles with regard to implementation of the proposed action are described below. The following information was used to conduct these analyses of the proposed action on olive ridleys: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2006 BiOp (NMFS 2006a), and other documents cited below.

7.4.1 Stressors

Longline fishing affects olive ridleys primarily by hooking, but also by entanglement and trailing of gear. However, in contrast to loggerheads, olive ridleys only rarely interact with shallow-set gear, most likely because of a combination of deep-foraging and low density in temperate swordfish waters. Olive ridleys are the most commonly-caught sea turtle species in the deep-set component of the Hawaii-based longline fishery (NMFS 2005), which fishes between 150 and 400 m of depth, and operates mostly to the south of Hawaii (Figure 2).

While the primary direct effect of the proposed action on olive ridley turtles will be the stressor of fishing gear interactions, an indirect effect of the proposed action (one that is likely to occur later in time) may be a beneficial market transfer effect. A description of the “market transfer effect” is provided in the introduction to the effects section above. Since the Hawaii-based swordfish fishery had/has stronger, non-discretionary turtle conservation measures, the shift in swordfish production for the U.S. market from the Hawaii-based fleet to Central and South America-based fleets resulted in an estimated increase of 2,882 sea turtle interactions (all species combined) over the 3-year closure (Rausser et al. 2008). An estimate of the number of additional olive ridley mortalities represented by these interactions was made in a pre-publication version of the Rausser et al. (2008) paper (Rausser et al. undated). The species-specific estimates were removed from the published version. NMFS does not believe that adequate data are available to quantify olive ridley mortalities with any precision that may have resulted from the market transfer effect due to the 2001-2004 closure.

The proposed action would considerably expand the Hawaii-based shallow-set swordfish fishery, i.e., the opposite action of the 2001-2004 closure. Therefore, the proposed action may result in a decrease in swordfish imports to the U.S., and a reduction in swordfishing effort by less turtle-friendly competing fleets (NMFS 2001). Such a market transfer effect would be the opposite of that which occurred due to the 2001-2004 closure, and is likely to result in a reduction in global olive ridley interactions in all swordfish longline fisheries combined. The reduction in olive ridley interactions may affect the Eastern Pacific olive ridley population, and possibly other olive ridley populations as well.

7.4.2 Exposure

Olive ridley interactions in the shallow-set fishery are rare, unpredictable events; for example, only 1 olive ridley interacted with the shallow-set fishery in over 3 years between re-opening of the fishery in 2004 and the end of 2007 (NMFS 2008c), but then 2 interacted with the fishery in less than 3 months in early 2008. Based on the number of sets made since the fishery re-opened in 2004, the 3 olive ridley interactions resulting from these sets, and a proposed action of 5,550 sets, NMFS estimates that the proposed action could interact with up to 4 olive ridleys annually (Table 4).

A decrease in global olive ridley exposure to interactions with shallow-set gear deployed by other swordfishing fleets may be indirectly caused by the proposed action, due to a market transfer effect. However, information is not available to quantify the reduction in exposure with any precision. Although Rausser et al. (2008) quantified the increased interactions resulting from the 2001-2004 closure (an additional 2,882 sea turtle interactions, all species combined over the 3 year period), uncertainty resulted in a very large 95 percent confidence interval (-59 to 30,680 additional sea turtle interactions). Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for olive ridleys.

7.4.3 Response

Because of the rarity of olive ridley interactions in the shallow-set fishery, data is lacking on post-hooking mortality. Data from post-hooking mortality of this species in the deep-set fishery cannot be used because mortality is much higher (near 100%) in the deep-set than the shallow-set fishery (NMFS 2005). Hence we estimate a post-hooking mortality rate of 0.20 for this species, based on post-hooking mortality rates of the more commonly-caught loggerhead and leatherback turtles in the shallow-set fishery (NMFS 2008c). The population assessment done for this proposed action only included loggerheads and leatherbacks (Snover 2008), thus it is not necessary to estimate the number of adult female olive ridleys killed by the proposed action. Rather, we estimate that 1 olive ridley juvenile or adult (male or female) will be killed by the proposed action annually (4 interactions/yr x 0.20 post-hooking mortality = 0.8 mortality/yr, round to 1).

As described in the exposure section above, a market transfer effect resulting from the proposed action may reduce global olive ridley interactions. However, since the decrease in interactions (exposure) cannot be quantified, the resulting decrease in olive ridley mortalities (response) cannot be quantified. Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for olive ridleys. The Eastern Pacific olive ridley population may be affected by the market transfer effect, and possibly other olive ridley populations as well.

7.4.4 Risk

As shown by the few genetics samples of olive ridleys from the shallow-set (Table 2, Section 5), individuals may come from either the Eastern or Western Pacific populations, although most probably come from the Eastern Pacific population. Since we estimate a total of 1 individual will be killed annually by the proposed action, and 2 of the 3 genetic samples analyzed so far were from the Eastern Pacific population, we expect 2 turtles from the Eastern Pacific population to be killed every 3 years, and 1 turtle from the Western Pacific population to be killed every 3 years. In contrast, the Hawaii-based deep-set longline fishery was estimated to kill 39 olive ridleys annually, with about the same proportion of individuals from the Eastern and Western Pacific as in this proposed action. However, the olive ridley population assessment done for the deep-set biological opinion found that this level of mortality would have no effect on either population (NMFS 2005). Thus, even though the Western Pacific population is a small fraction of the size of the Eastern Pacific population, neither population is expected to be affected by 1 annual mortality from the proposed action, therefore the risk to both populations from the proposed action is considered negligible. In addition, a beneficial market transfer effect from the proposed action may indirectly reduce overall olive ridley mortality.

7.5 Green Turtles

The stressors, exposure, response and risk steps of the effects analysis for green turtles with regard to implementation of the proposed action are described below. The following information was used to conduct these analyses of the proposed action on olive ridleys: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2008 Hawaii bottomfish opinion, (NMFS 2008e), and other documents cited below.

7.5.1 Stressors

Longline fishing affects green turtles primarily by hooking, but also by entanglement and trailing of gear. Historically, the longline fishery has been more likely to hook green turtles externally than to entangle them or hook them internally. Juvenile and adult interactions both occur (NMFS 2005). In addition, because green turtles recruit to nearshore habitat in the MHI, and green turtles are now common in shallow MHI waters, fishing vessels traveling to and from port may occasionally strike green turtles (NMFS 2008e).

While the primary direct effect of the proposed action on loggerhead turtles will be the stressor of fishing gear interactions, an indirect effect of the proposed action (one that is likely to occur later in time) may be a beneficial market transfer effect. A description of the "market transfer effect" is provided in the introduction to the effects section above. Since the Hawaii-based swordfish fishery had/has stronger, non-discretionary turtle conservation measures, the shift in swordfish production for the U.S. market from the Hawaii-based fleet to Central and South America-based fleets resulted in an estimated increase of 2,882 sea turtle interactions (all species combined) over the 3-year closure (Rausser et al. 2008). An estimate of the number of additional green turtle mortalities represented by these interactions was made in a pre-publication version of the Rausser et al. (2008) paper (Rausser et al. undated). The species-specific estimates were removed from the published version. NMFS does not believe that adequate data are available to quantify green turtle mortalities with any precision that may have resulted from the market transfer effect due to the 2001-2004 closure.

The proposed action would considerably expand the Hawaii-based shallow-set swordfish fishery, i.e., the opposite action of the 2001-2004 closure. Therefore, the proposed action would likely result in a decrease in swordfish imports to the U.S., and a reduction in swordfishing effort by less turtle-friendly competing fleets (NMFS 2001). Such a market transfer effect would be the opposite of that which occurred due to the 2001-2004 closure, and would likely result in a reduction in global green turtle interactions in all swordfish longline fisheries combined. The reduction in green turtle interactions may affect the Eastern Pacific green turtle population, and possibly other green turtle populations.

7.5.2 Exposure

As with olive ridleys, green turtle interactions in the shallow-set fishery are rare, unpredictable events; for example, after re-opening in late 2004, the Hawaii-based shallow-set fishery operated for over 3 years without interacting with any green turtles (NMFS 2008c). Based on the number of sets made since the fishery re-opened in 2004, the 1 green turtle interaction resulting from these sets (in 2008), and a proposed action of 5,550 sets, NMFS estimates that the proposed action could interact with up to 1 green turtle annually (Table 4).

The proposed action may also affect green turtles due to boat collisions with turtles in nearshore waters around the MHI. The entire Hawaii-based longline fishery (deep-set and shallow-set components combined) took approximately 1,500 trips annually in 2005-07 (Figure 1), with only a small fraction shallow-set trips (≈100 trips/yr). The proposed action is expected to result in an approximate 4-fold increase in fishing effort (Table 4), hence number of trips resulting from the proposed action is estimated at 400 per year for the proposed action. The number of green turtles likely to be killed due to boat collisions from the Hawaii bottomfish fishery was estimated in a March 18th, 2008, biological opinion (NMFS 2008e). Using the 6-step methodology in the HI bottomfish opinion (Figure 3, p.25), and substituting 400 trips per year for the 71,800 bottomfishing trips per year, then completing Steps 3 and 4, the number of annual green turtle mortalities estimated to result from boat collisions from shallow-set longline boats is essentially zero (0.02).

A decrease in global green turtle exposure to interactions with shallow-set gear deployed by other swordfishing fleets may be indirectly caused by the proposed action, due to a market transfer effect. However, information is not available to quantify the reduction in exposure with any precision. Although Rausser et al. (2008) quantified the increased interactions resulting from the 2001-2004 closure (an additional 2,882 sea turtle interactions, all species combined over the 3 year period), uncertainty resulted in a very large 95 percent confidence interval (-59 to 30,680 additional sea turtle interactions). Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for green turtles. The Eastern Pacific green turtle population would likely be affected by the market transfer effect, and possibly other green turtle populations.

7.5.3 Response

Because of the rarity of green turtle interactions in the shallow-set fishery, data is lacking on post-hooking mortality. Data from post-hooking mortality of this species in the deep-set fishery cannot be used because mortality is much higher (near 100%) in the deep-set than the shallow-set fishery (NMFS 2005). Thus we estimate a post-hooking mortality rate of 0.20 for this species, based on post-hooking mortality rates of the more commonly-caught loggerhead and leatherback turtles in the shallow-set fishery (NMFS 2008c). The population assessment done for this proposed action only included loggerheads and leatherbacks (Snover 2008), hence it is not necessary to estimate the number of adult female green turtles killed by the proposed action. Rather, we estimate that 1 green turtle juvenile or adult (male or female) will be killed by the proposed action annually (1 interaction/yr x 0.20 post-hooking mortality = 0.20 mortality/yr from shallow-set fishing + 0.01 mortality/yr from shallow-set boat collisions, round to 1).

As described in the exposure section above, a market transfer effect resulting from the proposed action may reduce global green turtle interactions. However, since the decrease in interactions (exposure) cannot be quantified, the resulting decrease in green turtle mortalities (response) cannot be quantified. Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for green turtles. The Eastern Pacific green turtle population may be affected by the market transfer effect, and possibly other green turtle populations.

7.5.4 Risk

As shown by the few genetics samples of green turtles from the shallow-set (Table 3, Section 5), individuals may come from either the Central or Eastern Pacific populations. Since we estimate a total of 1 individual will be killed annually by the proposed action, 1 turtle from each population is expected to be killed every 2 years. Both populations are increasing (see Section 5.6.1), hence neither population is expected to be affected by such a low level of mortality. Therefore, the risk to both populations from the proposed action is considered negligible. In addition, a beneficial market transfer effect from the proposed action may indirectly reduce overall green turtle mortality from the Eastern Pacific and possibly other populations.

7.6 Hawksbill Turtles

The stressors, exposure, response and risk steps of the effects analysis for hawksbill turtles with regard to implementation of the proposed action are described below. The following information was used to conduct these analyses of the proposed action on hawksbills: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2008 Hawaii bottomfish opinion, (NMFS 2008e), and other documents cited below.

7.6.1 Stressors

The 2005 BiOp on the Hawaii-based deep-set longline fishery concluded that the deep-set fishery is not likely to hook, entangle, or otherwise adversely affect hawksbill turtles (NMFS 2005). However, since then, a dead hawksbill that apparently was entangled and drowned in derelict fishing gear was retrieved by shallow-set gear in Hawaii, and an unconfirmed hawksbill interaction occurred in the American Samoa longline fishery, which fishes at intermediate depths for albacore. Longline fishing affects hawksbills primarily by hooking, but also by entanglement and trailing of gear (NMFS 2004a, Robins et al. 2002). Because hawksbills, like green turtles, recruit to nearshore habitat in the MHI, longline vessels traveling to and from port could strike hawksbills (NMFS 2008e).

While the primary direct effect of the proposed action on hawksbills will be the stressors of fishing gear interactions and vessel collisions, an indirect effect of the proposed action (one that is likely to occur later in time) may be a beneficial market transfer effect. The definition of "market transfer effect", and the market transfer effect that appears to have resulted from the 2001-2004 closure of this fishery, are described in the introduction to the effects section above. The 2001-2004 closure is estimated to have resulted in an additional 1 hawksbill mortality from the Western Pacific population, that would not have occurred if the fishery had stayed open, because of transferred swordfishing effort from Hawaii to Vietnam (Rausser et al. undated, Table 16).

The proposed action would considerably expand the Hawaii-based shallow-set swordfish fishery, i.e., the opposite action of the 2001-2004 closure. Therefore, the proposed action would likely result in a decrease in swordfish imports to the U.S., and a reduction in swordfishing effort by less turtle-friendly competing fleets. Such a market transfer effect would be the opposite of that which occurred due to the 2001-2004 closure, and may result in a reduction in interactions with hawksbills from the Central Pacific or other populations.

7.6.2 Exposure

Hawksbills interactions are very unlikely in either the shallow-set or deep-set components of the Hawaii-based longline fishery, as shown by zero reported hawksbill interactions in the fishery since the Observer Program began in 1994. However, the dead hawksbill retrieved by shallow-set gear described above suggests that pelagic juveniles likely sometimes forage in the action area. Hawksbills interactions have occurred in longline fisheries in the Atlantic (Yeung 1999) and Pacific (Robins et al. 2002). The proposed action will substantially increase fishing effort by the shallow-set fishery (WPFMC 2008), increasing the likelihood of hawksbill bycatch.

Like green turtles, hawksbills recruit as juveniles to nearshore habitat, where they remain except for breeding migrations. However, longline boat collisions with hawksbills is considered discountable because: (1) hawksbills are much less common in the MHI than green turtles; (2) within the MHI, hawksbills are most common around the Big Island, but least common around Oahu where most of the longline boat traffic is; and (3) even for green turtles, the proposed action is expected to only kill 1 turtle from boat collisions every few years at the most (see Section 7.6.2 above). Therefore the proposed action is not likely to result in boat collisions with hawksbills, lethal or otherwise.

A decrease in global hawksbill exposure to interactions with shallow-set gear deployed by other swordfishing fleets is expected to be indirectly caused by the proposed action, due to a market transfer effect. However, information is not available to quantify the reduction in exposure with any precision. Although Rausser et al. (2008) quantified the increased interactions resulting from the 2001-2004 closure (an additional 2,882 sea turtle interactions, all species combined over the 3 year period), uncertainty resulted in a very large 95 percent confidence interval (-59 to 30,680 additional sea turtle interactions). Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for hawksbills.

7.6.3 Response

Due to the rarity of hawksbill bycatch in this fishery, and the low post-hooking mortality rate (compared to deep-set longlining), the death of a hawksbill from the proposed action is considered very unlikely. We estimate that up to 1 hawksbill juvenile or adult will be injured by the proposed action due to hooking or entanglement every 5 years.

As described in the exposure section above, a market transfer effect resulting from the proposed action may reduce global hawksbill interactions. However, since the decrease in interactions (exposure) cannot be quantified, the resulting decrease in hawksbill mortalities (response) cannot be quantified. Thus, NMFS cannot quantify the market transfer effect that may result from the proposed action with any precision for hawksbills. The Central Pacific hawksbill population would likely be affected by the market transfer effect.

7.6.4 Risk

Hawksbills within the action area are thought to be from the Central Pacific population (Section 5). The proposed action is not expected to result in the mortality of any hawksbills, hence the risk to the Central Pacific population from the proposed action is considered insignificant. In addition, a beneficial market transfer effect from the proposed action may indirectly reduce overall hawksbill turtle mortality from the Central Pacific and possibly other populations.

8 Cumulative Effects

"Cumulative effects", as defined in the ESA implementing regulations, are limited to the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this opinion (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Because the action area is primarily a swath of the North Pacific Ocean (see Figure 1), and cumulative effects, as defined in the ESA, do not include the continuation of actions described under the Environmental Baseline, few actions within the action area are expected to result in cumulative effects.

Cumulative effects on the 6 species addressed by this opinion are likely to occur as a result of worsening climate change, and any increase in the fishing, ship traffic, and other actions described in the Environmental Baseline section. Such effects could include worsening of the climate change effects described in Sections 5 and 6, and could result in corresponding increases in fishing gear entanglements and ship strikes of humpback whales, and in fishing gear interactions of the 5 turtle species. In addition, any increases in marine debris could also increase entanglements of all 6 species. However, since the extent of climate change, and the extent of the increases in fishing, ship traffic, and marine debris, are unquantifiable, the corresponding effects are also unquantifiable.

9 Integration and Synthesis of Effects

The purpose of this biological opinion is to determine if the proposed action is likely to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination. This is done by considering the effects of the action within the context of the 'Status of Listed Species' and 'Environmental Baseline', as described in the *Approach* section (beginning of Section 7 Effects of the Action): We determine if mortality of individuals of listed species resulting from the proposed action are sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In order to make that determination, we use the population's base condition (established in the Status of Listed Species and Environmental Baseline sections of this opinion) as the context for the overall effects of the action on the affected populations. Finally, our opinion determines if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise. The following discussions summarize the probable risks the proposed action poses to the 6 listed species addressed by this opinion.

Humpback Whales. As described in the Effects of the Action (Section 7.1), if we assume that the proposed action will result in 5,550 sets annually, then that level of effort will result in 3 humpback interactions annually, which will result in 1 mortality every 1-2 years from the North Pacific population. As discussed in the humpback section of the Status of Listed Species (Section 5.1), there were an estimated 18,000 adults in the North Pacific population in 2007, and the population has grown at approximately 6 percent annually since 1965. As discussed in the humpback section of the Environmental Baseline (Section 6.1), up to 1 mortality annually is occurring within the action area due to fishery interactions. Viewed within the context of the Status of the Species and the Environmental Baseline, the estimated reductions in humpback numbers caused by the proposed action (Section 7.1) are insufficient to adversely affect the population dynamics of North Pacific humpback whales. That is, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of the North Pacific humpback population, or of the humpback species, as listed under the ESA (Table 1).

Loggerhead Turtles. As described in the loggerhead section of the Effects of the Action (Section 7.2), if we assume that the proposed action will result in 5,550 sets annually, then that level of effort will result in 46 loggerhead interactions annually, which will result in a maximum of 10 mostly juvenile mortalities annually (representing 3 adult females) from the North Pacific population. Also assuming an effort level of 5,550 sets annually (i.e., considerable expansion of the fishery), the market transfer effect may result in some reduction of loggerhead mortality from the North Pacific and possibly other loggerhead populations. However, as explained in the Effects section, it is not possible for NMFS to quantify the beneficial market transfer effect with any precision. Thus, the proposed action is likely to result in up to 3 adult female mortalities annually from the North Pacific loggerhead population. Is the loss of up to 3 adult females annually sufficient to reduce the viability of the North Pacific loggerhead population?

As discussed in the loggerhead section of the Status of Listed Species (Section 5.2), nesting of North Pacific loggerheads in Japan steadily increased from 1999 to 2005, before declining in 2006 and 2007 (Figure 3). However, in 2008, the number of nests was the highest since comprehensive counts were started in the 1980s. While nesting trends do not necessarily reflect population trends, the nesting trend data from Japan is currently the best available information on the status of the North Pacific population. The increase from approximately 2,000 nests (representing approximately 500 nesting females) in 1999, to 6,500 – 10,000 nests (representing approximately 2,000 nesting females) in 2008, suggests that efforts to decrease fishing interactions, along with other factors (described in Section 5.2), are having positive effects at the population level.

As discussed in the loggerhead section of the Environmental Baseline (Section 6.2), 50 to 600 juvenile and adult North Pacific loggerhead mortalities may be occurring annually due to longline fishery interactions within the action area alone. Thus, total fishery-related mortality of the North Pacific loggerhead population due to longline fishing, nearshore fishing in Japan, and other fisheries, is likely at least several hundred adults annually. The increase in nesting since 1999 while sustaining such high mortality suggests that the North Pacific loggerhead population consists of many thousands of adults. Viewed within the context of the Status of the Species and the Environmental Baseline, the annual loss of the equivalent of up to 3 adult females due to the proposed action (Section 7.2) is insufficient to adversely affect the population dynamics of North Pacific loggerhead turtles. That is, the mortality associated with the proposed action is so low relative to the total population size that its effects on the population cannot be distinguished from the effects of natural mortality, and hence does not adversely affect the population dynamics of North Pacific loggerheads. Therefore, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of the North Pacific loggerhead population.

To summarize for loggerhead turtles, we do not expect the combined direct (interactions) and indirect (market transfer effect) effects of the proposed action to reduce the reproduction, numbers, or distribution of the North Pacific loggerhead population. The market transfer effect of the proposed action may benefit this and other loggerhead populations. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of the loggerhead sea turtle species, as listed under the ESA (Table 1).

Leatherback Turtles. As described in the leatherback section of the Effects of the Action (Section 7.3), if we assume that the proposed action will result in 5,550 sets annually, then that level of effort will result in 19 leatherback interactions annually, which will result in a maximum of 5 mostly adult mortalities annually (representing 3 adult females) from the Western Pacific population. Also assuming an effort level of 5,550 sets annually (i.e., considerable expansion of the fishery), the market transfer effect may result in some reduction of leatherback mortality from the Western Pacific and possibly other leatherback populations. However, as explained in the Effects section, it is not possible for NMFS to quantify the beneficial market transfer effect with any precision. Thus, the proposed action is likely to result in up to 3 adult female mortalities annually from the Western Pacific leatherback population. Is the loss of up to 3 adult females annually sufficient to reduce the viability of the Western Pacific leatherback population?

As discussed in the leatherback section of the Status of Listed Species (Section 5.3), the total number of nests per year in the Western Pacific population was estimated at 5,067 – 9,176 for the period 1999-2006, leading to an estimate of 2,110 – 5,735 breeding females in the population during this time period (Dutton et al. 2007). As discussed in the leatherback section of the Environmental Baseline (Section 6.3), 20 to 320 juvenile and adult Western Pacific leatherback mortalities may be occurring annually due to longline fishery interactions within the action area alone. Thus, total fishery-related mortality of the Western Pacific leatherback population is likely at least a few hundred adults annually. The somewhat stable trend in nesting of the Jamursba-

Medi component of the population since 1999 (Figure 4) while sustaining such high mortality suggests that the Western Pacific leatherback population consists of many thousands of adults. Viewed within the context of the Status of the Species and the Environmental Baseline, the estimated reductions in leatherback numbers caused by the proposed action (Section 7.3) are insufficient to adversely affect the population dynamics of Western Pacific leatherback turtles. That is, the mortality associated with the proposed action is so low relative to the total population size that its effects on the population cannot be distinguished from the effects of natural mortality, and hence does not adversely affect the population dynamics of Western Pacific leatherbacks. Therefore, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of the Western Pacific leatherback population.

However, while the proposed action is not likely to reduce the reproduction, numbers, or distribution of the Western Pacific leatherback population, it would potentially increase the harm to the Western Pacific leatherback population by increasing the estimated maximum number of annual interactions from the currently-authorized 16 (NMFS 2004a) to 19. Baseline conditions for this population are already poor, and appear to be getting worse, as described above in this opinion, because: (1) While nesting for the Jamursba-Medi component (38 percent of total) of the Western Pacific leatherback appears stable since 1999, nesting levels in 1999-2007 were lower than in 1993-1997 (Figure 4); (2) the Jamursba-Medi nesting data upon which Figure 4 is based may over-state the number of nests (see Section 5.3.1); and (3) The trends of the nesting sites in the non-Jamursba-Medi component (62 percent of the Western Pacific leatherback population) are unknown, but the best available information suggests they may be declining more rapidly than Jamursba-Medi (described in Sections 5.3.1).

To summarize for leatherback turtles, despite the above concerns for the Western Pacific leatherback population, we do not expect that the effects of the proposed action (i.e., the annual mortality of a maximum of 3 adult female equivalents out of a population of many thousands of adults) will adversely affect the population. That is, we do not expect the combined direct (interactions) and indirect (market transfer effect) effects of the proposed action to reduce the reproduction, numbers, or distribution of the Western Pacific leatherback population. The market transfer effect of the proposed action may benefit this and other leatherback populations. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of the leatherback sea turtle species, as listed under the ESA (Table 1).

Olive Ridley Turtles. As described in the olive ridley section of the Effects of the Action (Section 7.4), if we assume that the proposed action will result in 5,550 sets annually, then that level of effort will result in 4 olive ridley interactions annually, which will result in a maximum of 1 juvenile or adult mortality annually, most likely from the Eastern Pacific population, but possibly from the Western Pacific population. Also assuming an effort level of 5,550 sets annually (i.e., considerable expansion of the fishery), the market transfer effect may result in some reduction of olive ridley mortality from the Eastern Pacific and possibly other olive ridley populations.

As discussed in the olive ridley section of the Status of Listed Species (Section 5.4), nesting of Eastern Pacific olive ridleys steadily increased from 1991 to 2006 up to over 1 million nests annually. The Western Pacific olive ridley population is a small, widely-scattered population with less than 1,000 nests annually. As discussed in the olive ridley section of the Environmental

Baseline (Section 6.4), hundreds of juvenile and adult Eastern Pacific olive ridley mortalities may be occurring annually due to longline fishery interactions within the action area alone. Thus, total fishery-related mortality of the Eastern Pacific olive ridley population is likely at least several hundred adults annually. Viewed within the context of the Status of the Species and the Environmental Baseline, the mortality of 1 individual olive ridley caused by the proposed action (Section 7.4) is insufficient to adversely affect the population dynamics of either Eastern Pacific or Western Pacific olive ridley turtles. That is, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of either population.

To summarize for olive ridley turtles, we do not expect the combined direct (interactions) and indirect (market transfer effect) effects of the proposed action to reduce the reproduction, numbers, or distribution of the Eastern Pacific or Western Pacific olive ridley populations. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of the olive ridley sea turtle species, as listed under the ESA (Table 1).

Green Turtles. As described in the green turtle section of the Effects of the Action (Section 7.5), if we assume that the proposed action will result in 5,550 sets annually, then that level of effort will result in 1 green turtle interactions annually, which will result in a maximum of 1 juvenile or adult mortality annually, from either the Eastern Pacific or the Hawaii component of the Central Pacific populations. Also assuming an effort level of 5,550 sets annually (i.e., considerable expansion of the fishery), the market transfer effect may result in some reduction of green turtle mortality, primarily from the Eastern Pacific population.

As discussed in the green turtle section of the Status of Listed Species (Section 5.5), nesting of Eastern Pacific population, and of the Hawaii component of the Central Pacific population, have increased in the last decade. As discussed in the green turtle section of the Environmental Baseline (Section 6.5), several dozen green turtles (approximately evenly-split between the two populations) are killed annually by longlining in the action area alone. Thus, total fishery-related mortality of green turtles from the two populations is likely a few hundred annually. In addition, up to several dozen green turtles from the Hawaii component of the Central Pacific population are killed annually by nearshore activities such as fishing and boat collisions within the action area. Viewed within the context of the Status of the Species and the Environmental Baseline, the mortality of 1 individual green turtle caused by the proposed action (Section 7.5) is insufficient to adversely affect the population dynamics of either the Eastern Pacific or Central Pacific green turtles. That is, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of either population.

To summarize for green turtles, we do not expect the combined direct (interactions and collisions) and indirect (market transfer effect) effects of the proposed action to reduce the reproduction, numbers, or distribution of the Eastern Pacific or Central Pacific green turtle populations. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of the green sea turtle species, as listed under the ESA (Table 1).

Hawksbill Turtles. As described in the hawksbill section of the Effects of the Action (Section 7.6), if we assume that the proposed action will result in 5,550 sets annually, then that level of effort will result in 1 hawksbill turtle interaction every 5 years from the Central Pacific population. Also assuming an effort level of 5,550 sets annually (i.e., considerable expansion of the fishery), the market transfer effect may result in some reduction of hawksbill turtle mortality from the Western Pacific population.

As discussed in the hawksbill turtle section of the Status of Listed Species (Section 5.6), nesting of Central Pacific population has continued to decline in the last decade. As discussed in the hawksbill turtle section of the Environmental Baseline (Section 6.6), up to 1 or 2 dozen hawksbill turtles are likely killed annually by longlining in the action area alone. Thus, total fishery-related mortality of Central Pacific hawksbills is likely at least several dozen annually. In addition, up to several hawksbills from the Hawaii component of the Central Pacific population are killed annually by nearshore activities such as fishing and boat collisions within the action area. However, since the proposed action is not likely to result in even 1 hawksbill mortality over a 5-year period (Section 7.6), the effects of the proposed action on hawksbill are insufficient to adversely affect the population dynamics of Central Pacific hawksbill turtles. That is, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of this population.

To summarize for hawksbill turtles, we do not expect the combined direct (interactions and collisions) and indirect (market transfer effect) effects of the proposed action to reduce the reproduction, numbers, or distribution of the Central Pacific hawksbill turtle population. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of the hawksbill sea turtle species, as listed under the ESA (Table 1).

10 Conclusion

The purpose of this biological opinion is to determine if the proposed action is likely to jeopardize the continued existence of listed species (i.e., jeopardy determination). "Jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). After reviewing the current status of ESA-listed humpback whales, loggerhead sea turtles, leatherback sea turtles, olive ridley sea turtles, green sea turtles, and hawksbill sea turtles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of these 6 species. Critical habitat has not been designated in the proposed action area, so no critical habitat would be affected by the proposed action.

While the proposed action is not likely to jeopardize leatherback sea turtles, it would potentially increase the harm to the Western Pacific leatherback population by increasing the estimated maximum number of annual interactions from the currently-authorized 16 (NMFS 2004a) to 19. Baseline conditions for this population are already poor, and appear to be getting worse, as described above in this opinion, because: (1) While nesting for the Jamursba-Medi component (38 percent of total) of the Western Pacific leatherback appears somewhat stable since 1999, nesting levels in 1999-2007 were lower than in 1993-1997 (Figure 4); (2) the Jamursba-Medi nesting data upon which Figure 4 is based may over-state the number of nests (see Section 5.3.1); and (3) The trends of the nesting sites in the non-Jamursba-Medi component (62 percent of the Western Pacific leatherback population) are unknown, but the best available information suggests they may be declining more rapidly than Jamursba-Medi (described in Sections 5.3.1).

11 Conservation Recommendations

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

The following conservation recommendations are provided pursuant to section 7(a)(1) of the ESA for developing management policies and regulations, and to encourage multilateral research efforts which would help in reducing adverse impacts to listed species in the Pacific Ocean.

1. HLA should encourage the use of TurtleWatch (Howell et al. 2008), a continuously-updated, on-line map showing the areas of highest potential loggerhead bycatch, in the shallow-set fishery. NMFS should encourage the use of TurtleWatch among other longline fleets that interact with loggerhead turtles in or near the action area.

2. NMFS should continue to research modifications to fishing gear (e.g., hook size, hook shape, hook offset, hook appendage, bait type, line type, depth configuration, float configuration, deterrents, decoys, etc.) and turtle handling methods (dehookers, lifting methods, etc) to reduce turtle bycatch and mortality in commercial longline fisheries.

3. NMFS should continue to promote reduction of turtle bycatch in Pacific fisheries by supporting:
   a. The Inter-American Convention for the Protection and Conservation of Sea Turtles;
   b. A binding Western and Central Pacific Fisheries Commission (WCPFC) sea turtle conservation and management measure for commercial longline fisheries operating in the western Pacific;
   c. Implementation of NMFS Sea Turtle Handling Guidelines that increase post-hooking turtle survivorship;
   d. Technical assistance workshops to assist other longlining nations;
   e. Observer programs on commercial vessels operating in the western Pacific;
   f. Continuation of ecological, habitat use, and genetics studies of loggerhead turtles occurring in nearshore foraging habitats in Central and South America, and gear mitigation studies for fisheries operating in these waters, and;
   g. A trans-Pacific international agreement that would include relevant Pacific Rim nations for the conservation and management of sea turtle populations, specifically a Japan-U.S.A.-Mexico agreement for North Pacific loggerhead turtles.

4. NMFS should continue to encourage, support and work with Regional partners to implement long-term sea turtle conservation and recovery programs at critical nesting, foraging and migratory habitats.

5. If recent post-hooking mortality studies (e.g. for loggerheads, Sasso and Epperly 2007, Swimmer et al. In press) so indicate, NMFS should update its guidelines (NMFS 2006b).

6. NMFS should conduct a study of the market transfer effect on sea turtles of the expansion of the Hawaii-based shallow-set longline fishery resulting from the proposed action.

12 Reinitiation Notice

This concludes formal consultation on management modifications for the Hawaii-based shallow-set longline swordfish fishery, as proposed in Amendment 18 (WPFMC 2008). As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of incidental take for any species is exceeded over a 3-year period, as specified in Table 10 below;
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 may affect listed species or critical habitat to an extent in a way not considered in this opinion (e.g., if >5,550 sets are made during one calendar year); or
4. A new species is listed or critical habitat designated that may be affected by the action.

13 Incidental Take Statement

Section 9 of the ESA and protective regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. "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 reasonable and prudent measures and terms and conditions of the Incidental Take Statement (ITS).

The measures described below are nondiscretionary, and must be undertaken by NMFS for the exemption in section 7(o)(2) to apply. NMFS has a continuing duty to regulate the activity covered by this ITS. If NMFS fails to assume and implement the terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NMFS must monitor the progress of the action and its impact on the species as specified in the ITS (50 CFR §402.14(I)(3)).

13.1 MMPA Authorization

A marine mammal species or population stock that is listed as threatened or endangered under the ESA is, by definition, also considered depleted under the MMPA. The ESA allows takings of threatened and endangered marine mammals only if authorized by section 101(a)(5) of the MMPA. The incidental taking of listed marine mammals must be authorized under section 101(a)(5)(E) of the MMPA, before incidental take of listed marine mammals may be exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA. Because MMPA 101(a)(5)(e) authorization has not been completed, incidental take of humpback whales is not authorized for the proposed action at this time.

13.2 Amount or Extent of Take

The annual numbers of interactions and mortalities expected to result from implementation of the proposed action are shown for 1-year and 3-year periods in Table 10 below (i.e., 1-year and 3-year ITSs). However, only the 3-year ITS will be used for purposes of reinitiation of consultation, as explained below. The interactions and mortalities in Table 10 have been calculated based on observed interaction rates since the re-opening of the fishery in 2004 (see Table 4 in Section 7) and estimated post-hooking mortality rates of loggerheads (see Section 7.2.3) and leatherbacks (see Section 7.3.3) in this fishery. Annual equivalent adult female mortalities (AFMs) are also shown for loggerheads and leatherbacks, because they were the basis for the population assessment (Snover 2008). AFMs are rounded from the estimates derived for loggerheads (2.51 AFMs, see Section 7.2.3) and leatherbacks (2.40 AFMs, Section 7.3.3).[7]

As shown in Table 4, the number of expected green and hawksbill turtle interactions annually is only 1 and 0, respectively. If 2 green turtle interactions, or 1 hawksbill interaction, unexpectedly occurred in the fishery during 1 calendar year, reinitiation of consultation would be required based on the 1-year ITS. Additionally, if the fishery is closed due to reaching a turtle interaction limit, as occurred in 2006 when the loggerhead limit was reached, an additional turtle interaction could occur during the fishery closure process. If that happens, reinitiation of consultation would be required because of exceedance of the turtle interaction limit in the 1-year ITS. NMFS does not believe that these instances merit reinitiation of consultation. In order to avoid unnecessary reinitiations of consultation, NMFS has developed a 3-year ITS (Table 10), similar to that developed for the 2005 deep-set biological opinion (NMFS 2005), that will not result in any more harm to the species than a 1-year ITS, as explained below.

Reasonable and Prudent Measure No. 1 below, and its implementing Terms and Conditions, were developed to provide annual loggerhead and leatherback turtle interaction limits to minimize the incidental take of those species associated with the proposed action. In conjunction with the interaction limits, Reasonable and Prudent Measure No. 2 below, and its implementing Terms and Conditions, were developed to restrict the 3-year ITS in a manner that would not affect the turtle populations any differently than limiting incidental take over a 1-year period for 3 consecutive years. The population assessment (Snover 2008) estimated the risk posed by the proposed action, assuming a consistent annual number of adult female mortalities, based on 46 loggerhead and 19 leatherback interactions, over 3 generations (100 years for loggerheads, 63 years for leatherbacks). The Reasonable and Prudent Measures below have been structured to restrict fluctuations in the maximum possible number of annual adult female mortalities, preventing the 3-year ITS from resulting in more harm to the species than a 1-year ITS.

[7] Snover (2008) used fractions for model inputs rather than rounded numbers. E.g., the effect of 2.51 adult female mortalities annually was tested in the model, rather than 3 adult female mortalities. Hence, fractions are used in this opinion when referring to inputs to the model. Otherwise, adult female mortalities are given in whole numbers, rounded up from one significant digit (e.g., 1.1 to 1.9 round to 2, but 1.01 to 1.04 round to 1).

Table 10. The number of turtle interactions expected from the proposed action during 1 calendar year, and **3 consecutive calendar years**. Also shown are the total mortalities (males and females, adults and juveniles) expected to result from this number of interactions, and the annual equivalent adult female mortalities (AFMs).

	1-year			**3-year**	
Species	Interactions	Total mortalities	Equivalent AFMs[a]	**Interactions**	**Total mortalities**
Loggerhead turtles	46	10	3	**138**	**29[b]**
Leatherback turtles[c]	19 (16)[c]	5 (4)[d]	3 (2)[e]	**57 (48)[c]**	**14 (11)[d]**
Olive ridley turtles	4	1	N/A	**12**	**3**
Green turtles	1	1	N/A	**3**	**1**
Hawksbill turtles	0	0	N/A	**1**	**0**

[a] Calculated AFMs are 2.51 North Pacific loggerheads and 2.40 Western Pacific leatherbacks for the proposed action, and rounded as described in footnote 7. AFMs were not calculated or used for the 3-year period. See Sections 7.2.3 and 7.3.3 for AFM calculation methodology. AFMs not calculated for olive ridley, green, or hawksbill turtles.

[b] 138 interactions x 0.205 (post-hooking mortality rate for loggerheads, Section 7.2.3) = 28.3, round to 29.

[c] The proposed action is expected to result in up to 19 and 57 leatherback interactions during 1-year and 3-year periods respectively, as proposed. However, Reasonable and Prudent Measure No. 1 below, as implemented by Term and Condition No. 1B, stipulates an annual (1-year) interaction limit of 16 interactions for this species, with a reinitiation trigger of 48 or more interactions during a period of 3 consecutive calendar years. The rationale for the reduced annual interaction limit is provided in Section 13.4 below.

[d] 16 interactions x 0.229 (post-hooking mortality rate for leatherbacks, Section 7.3.3) = 3.7, round to 4. Likewise, 57 interactions x 0.229 = 13.1, round to 14; 48 interactions x 0.220 = 11.0.

[e] With a reduced leatherback annual interaction limit (see footnote c above), AFMs decline to 2 for this species: (16 interactions)(0.229 mortalities/capture)(0.65 females)(0.85 adult equivalent) = 2.02 AFMs, round to 2. as described in Footnote 7.

13.3 Impact of the Take

In the accompanying biological opinion, NMFS determined that the level of incidental take anticipated from the proposed action is not likely to jeopardize the humpback whale, loggerhead turtle, leatherback turtle, green turtle, olive ridley turtle, or hawksbill turtle.

13.4 Reasonable and Prudent Measures

Section 7(b)(4) of the ESA requires that when an agency is found to comply with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement specifying the impact of any incidental taking. It also states that reasonable and prudent measures necessary to minimize impacts, and terms and conditions to implement those measures be provided and must be followed to minimize those impacts. Only incidental taking by the Federal agency or applicant that complies with the specified terms and conditions is authorized.

The incidental take expected to result from the proposed action is shown in Table 10 above for each sea turtle species. The full amount of incidental take expected from the proposed action is not authorized for leatherback turtles. For many Federal actions, it is not possible to stipulate Reasonable and Prudent Measures that reduce incidental take by a precise number of individuals in a manner that does not alter the basic design, location, scope, duration, and timing of the action. However, because the Hawaii-based shallow-set fishery has 100 percent observer coverage, NMFS is able to monitor the precise number of individual turtles that interact with the fishery. While this biological opinion has determined that incidentally taking 19 leatherback turtles annually will not jeopardize the continued existence of this species, NMFS believes that there are several reasons to be especially concerned about the conservation of Western Pacific leatherbacks, as explained below.

Baseline conditions for this population are already poor, and appear to be getting worse, as described above in this opinion, because: (1) While nesting for the Jamursba-Medi component (38 percent of total) of the Western Pacific leatherback appears somewhat stable since 1999, nesting levels in 1999-2007 were lower than in 1993-1997 (Figure 4); (2) the Jamursba-Medi nesting data upon which Figure 4 is based may over-state the number of nests (see Section 5.3.1); (3) The trends of the nesting sites in the non-Jamursba-Medi component (62 percent of the Western Pacific leatherback population) are unknown, but the best available information suggests they may be declining more rapidly than Jamursba-Medi (described in Sections 5.3.1); and (4) and the information available on the status and trends of the Western Pacific leatherback population is rather incomplete.

Thus, while the proposed action is not expected to jeopardize leatherback turtles, NMFS is concerned about the decline of the Western Pacific leatherback population. The lack of information on this population means that it could be worse off than it appears. For these reasons, NMFS believes that a cautionary approach is warranted, and is therefore setting the annual interaction limit for leatherback turtles at 16 in Reasonable and Prudent Measure No. 1 below, and its implementing Term and Condition No. 1B. An annual interaction limit of 16 reduces the estimated adult female mortalities resulting from the proposed action from 3 (rounded from 2.40) to 2 (rounded from 2.02), as shown in footnote e to Table 10. An annual interaction limit of 16 leatherbacks was set in the 2004 BiOp (NMFS 2004a).

NMFS has determined that the following reasonable and prudent measures, as implemented by the terms and conditions (identified in Section 13.5), are necessary and appropriate to minimize the impacts of the shallow-set longline fishery, as described in the proposed action, on sea turtles, and to monitor the level and nature of any incidental takes. These measures are non-discretionary--they must be undertaken by NMFS for the exemption in ESA section 7(o)(2) to apply.

1. NMFS shall establish appropriate annual interaction limits for loggerhead and leatherback turtles, such that the fishery is closed when either interaction limit is reached.

2. NMFS shall implement the annual interaction limits in conjunction with the 3-year ITS (Table 10), and to prevent excessive incidental take in any given year. The trigger to reinitiate consultation shall be based on the 3-year ITS limits, and not the annual limits.

3. NMFS shall collect data on the capture, injury, and mortality caused by the shallow-set longline fishery, and shall also collect basic life-history information, as available.

4. NMFS shall require that sea turtles captured alive be released from fishing gear in a manner that minimizes injury and the likelihood of further gear entanglement or entrapment, as practicable and in consideration of best practices for safe vessel and fishing operations.

5. NMFS shall require that comatose or lethargic sea turtles shall be retained on board, handled, resuscitated, and released according to the established procedures, as practicable and in consideration of best practices for safe vessel and fishing operations.

6. NMFS shall require sea turtles that are dead when brought on board a vessel or that do not resuscitate be disposed of at sea unless NMFS requests retention of the carcass for sea turtle research, as practicable and in consideration of best practices for safe vessel and fishing operations.

13.5 Terms and Conditions

NMFS shall undertake and comply with the following terms and conditions to implement the reasonable and prudent measures identified in Section 13.4 above. These terms and conditions are non-discretionary, and if NMFS fails to adhere to these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

1. The following terms and conditions implement Reasonable and Prudent Measure No. 1:

   1A. NMFS shall establish an annual interaction limit for loggerhead turtles of 46 interactions annually, and shall close the fishery if/when the annual interaction limit is reached.

   1B. NMFS shall establish an annual interaction limit for leatherback turtles of 16 interactions annually, and shall close the fishery if/when the annual interaction limit is reached.

   1C. If either of the two sea turtle interaction limits is *reached* during a given calendar year, the Regional Administrator shall file a Federal Register notice that the interaction limit was reached, and that the shallow-set component of the Hawaii-based longline fishery is closed north of the Equator beginning on a specified date until the end of the calendar year.

   1D. Coincidental with the filing of the fishery closure notice, the Regional Administrator will also provide actual notice of the fishery closure to all holders of Hawaii longline limited access permits via the appropriate methods (e.g., telephone, satellite telephone, radio, electronic mail, facsimile transmission, or post).

2. The following terms and conditions implement Reasonable and Prudent Measure No. 2:

   2A. In the event that either annual interaction limit specified in 1 above is exceeded, NMFS shall lower the following year's interaction limit by the amount it was exceeded, and include in the fishery closure notice the downward-adjusted annual interaction limit for the following calendar year.

   2B. When an annual interaction limit is not reached, NMFS shall <u>not</u> add the difference to the following year's interaction limit.

2C. NMFS shall reinitiate consultation under ESA section 7 if the amount of incidental take (either interactions or mortalities) as specified for 3 years in Table 10 is exceeded for loggerhead, olive ridley, green, or hawksbill turtles. For leatherback turtles, NMFS shall reinitiate consultation under ESA section 7 if the amount of incidental take during 3 consecutive calendar years exceeds 48 interactions or 11 mortalities (48 x 0.229 = 10.99).

3. The following terms and conditions implement Reasonable and Prudent Measure No. 3:

3A. *Observers*. NMFS shall continue 100 percent observer coverage aboard Hawaii-based shallow-set longline vessels.

3B. *Data Collection*. As practicable and in consideration of best practices for safe vessel and fishing operations, observers shall collect standardized information regarding the incidental capture, injury, and mortality of sea turtles for each interactions by species, gear, and set information, as well as the presence or absence of tags on the turtles. Observers shall also collect life-history information on sea turtles captured by the shallow-set fishery, including measurements, (including direct measure or visual estimates of tail length), condition, skin biopsy samples, and estimated length of gear left on the turtle at release. To the extent practicable, these data are intended to allow NMFS to assign these interactions into the categories developed through NMFS' most current post-hooking mortality guidelines..

3C. *Information Dissemination*. NMFS shall disseminate quarterly, summaries of the data collected by observers to the NMFS Assistant Regional Administrators of Protected Resources and Sustainable Fisheries in PIR, as well as the NMFS Sea Turtle Coordinators in PIR, SWR and HQ.

4. The following terms and conditions implement Reasonable and Prudent Measure No. 4:

4A. NMFS shall continue to require and conduct protected species workshops for owners and operators of vessels registered for use with Hawaii limited entry longline fishing permits, to educate vessel owners and operators in handling and resuscitation techniques to minimize injury and promote survival of hooked or entangled sea turtles, as specified in 50 CFR 665. The workshops shall include information on sea turtle biology and ways to avoid and minimize sea turtle impacts to promote sea turtle protection and conservation.

4B. NMFS shall continue to train observers about sea turtle biology and techniques for proper handling and resuscitation.

4C. NMFS shall require that shallow-set longline fishermen remove hooks from turtles as quickly and carefully as possible to avoid injuring or killing the turtle, as practicable and in consideration of best practices for safe vessel and fishing operations. NMFS shall require that each Hawaii-based shallow-set longline vessel carry a line clipper to cut the line as close to the hook as practicable and remove as much line as possible prior to releasing the turtle in the event a hook cannot be removed (e.g., the hook is deeply ingested or the animal is too large to bring aboard).

4D. NMFS shall require that each Hawaii-based shallow-set longline vessel carry a dip net to hoist a sea turtle onto the deck to facilitate hook removal. If the vessel is too small to carry a dipnet, sea turtles must be eased onto the deck by grasping its carapace or flippers, to facilitate the removal of the hook. Any sea turtle brought on board must not be dropped on to the deck. All requirements should consider practicality and best practices for safe vessel and fishing operations.

4E. NMFS shall require each shallow-set longline vessel to carry and use, as appropriate, a wire or bolt cutter that is capable of cutting through a hook that may be imbedded externally, including the head/beak area of a turtle.

5. The following terms and conditions implement Reasonable and Prudent Measure No. 5:

NMFS shall require that shallow-set longline vessel operators bring comatose sea turtles aboard and perform resuscitation techniques according to the procedures described at 50 CFR 665 and 50 CFR 223.206, as practicable and in consideration of best practices for safe vessel and fishing operations, except that the observer shall perform resuscitation techniques on comatose sea turtles if the observer is available.

6. The following terms and conditions implement Reasonable and Prudent Measure No. 6:

NMFS shall require that dead sea turtles may not be consumed, sold, landed, offloaded, transshipped, or kept below deck, but must be returned to the ocean after identification, unless NMFS requests the turtle be kept for further study.

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