Endangered Species Act – Section 7 Consultation

Biological Opinion

Action Agency:	National Marine Fisheries Service, Pacific Islands Region, Sustainable Fisheries Division
Activity:	Continued operation of the Hawaii-based Shallow-set Longline Swordfish Fishery – under 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:	*[signature]* Michael D. Tosatto Regional Administrator, Pacific Islands Region
Date Issued:	JAN 30 2012

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Acronyms

AFM	Adult female mortalities
AFR	Age at First Reproduction
BA	Biological Assessment
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
CMM	Conservation and Management Measure
DPS	Distinct population segment
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FAO	Food and Agriculture Organization of the United Nations
FEIS	Final Environmental Impact Statement
FEP	Fishery Ecosystem Plan
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
PBR	Potential Biological Removal
PDO	Pacific Decadal Oscillation
PIFSC	Pacific Islands Fisheries Science Center
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PIROP	Pacific Islands Region Observer Program
PNG	Papua New Guinea
PRD	Protected Resources Division, NMFS Pacific Islands Regional Office
PSW	Protected Species Workshop
PVA	Population Viability Assessment
QET	Quasi-extinction threshold
SCL	Standard carapace length
SEIS	Supplement Environmental Impact Statement
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 it authorizes, funds, or carries 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 is the continued operation of the Hawaii-based shallow-set longline fishery under the Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific Region (Pelagics FEP), as managed under the 2010 regulations implementing Amendment 18 (except the annual turtle interaction limit for loggerhead sea turtles). Accordingly, the federal action forecasts a gradual increase to a maximum of 5,500[1] sets (gear deployments) annually, which represents the approximate maximum annual number of sets that occurred during the period 1994-1999, prior to the fishery's closure due to sea turtle interactions. Amendment 18 to the Fishery Management Plan[2] for Pelagic Fisheries of the Western Pacific Region (Pelagics FMP) was developed by the Western Pacific Fishery Management Council (Council or WPFMC), and is described in the Amendment 18 Final Supplemental Environmental Impact Statement (WPFMC 2009). The purpose of Amendment 18 is to allow the Hawaii-based longline fishery to achieve optimum yield of North Pacific swordfish, consistent with National Standard 1 of Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), since the stock is currently under-exploited. NMFS has responsibility under the Magnuson-Stevens Act for implementing 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 and NMFS 1998).

The Hawaii-based shallow-set longline fishery is one of two Hawaii-based longline fisheries, which also includes a deep-set longline fishery. An overview of the Hawaii-based longline fisheries is given below to provide context for the shallow-set fishery.

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[1]Various documents associated with Amendment 18 to the Pelagic Fisheries FMP refer alternately to a proposed action consisting of 5,500 or 5,550 sets. Although our analysis of protected species impacts is based on 5,500 sets, our calculations and conclusions remain the same when the number of sets is changed to 5,550.

[2] In 2009, the Council developed and NMFS implemented five new archipelagic-based fishery ecosystem plans (FEPs). The FEPs incorporated and reorganized elements of the Councils' species-based FMPs, into spatially-oriented ecosystem plans (75 FR 2198; January 14, 2010). All applicable regulations were retained through the development and implementation of the five FEPs, and no substantive changes to the fisheries occurred, including around Hawaii.

1.1 The Hawaii-based Longline Fisheries

Domestic longline fishing around Hawaii consists of two separately managed fisheries: a deep-set fishery that targets primarily bigeye tuna, and a shallow-set fishery that targets swordfish. No regulatory distinction was made between the two fisheries in 1999, when the Court ordered the closure of an area north of Hawaii due to the bycatch of sea turtles by longline vessels targeting swordfish. Subsequent Court Orders led to regulations prohibiting swordfish-targeting vessels from fishing, while tuna-targeting vessels were allowed to continue operation, but with seasonal area and swordfish landing restrictions (NMFS 2001).

After the implementation of numerous measures to reduce the number and severity of turtle bycatch interactions, 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 fishery became an increasingly larger proportion of total Hawaii-based longline fishing effort until there was only deep-setting during the swordfish-targeting prohibition in 2001-2004. Since 2004, the shallow-set fishery has made up a small proportion of total longline fishing around Hawaii (see figure on PIFSC website The 2010 Hawaii-based Longline Annual Summary Report). The regulatory history of Hawaii-based longline fisheries is described in the 2001 Pelagics FEIS (NMFS 2001), the 2004 BiOp (NMFS 2004a), the 2004 Pelagics FSEIS (NMFS 2004b), and the 2008 BiOp (NMFS 2008a). For a comprehensive regulatory overview see the 2009 Pelagics FEP.

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 primarily 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, and WPFMC 2009). Some 124-129 vessels are typically active during any given year.

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. Longline fishing involves setting a mainline horizontally at a preferred depth in the water column using floats spaced at regular intervals. Three to five radio buoys are usually attached at fairly regular intervals along the mainline so the line may be easily located both for initial retrieval and in case the mainline breaks during fishing operations. Branchlines are clipped to the mainline at regular intervals, and each branchline has a single baited hook. Mainline lengths can be 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 one set is fished per day. Depending on the fishery, trips around Hawaii are typically three to five weeks long (NMFS 2001, NMFS 2005, WPFMC 2006a, Beverly and Chapman 2007, WPFMC 2009).

Longline fishing for swordfish is known as shallow-set longline fishing because the bait is set at depths of 30 to 90 m. The portion of the mainline with branchlines attached is suspended between floats at about 20 to 75 m of depth, and the branchlines hang off the mainline another 10 to 15 m. Only four to six branchlines are clipped to the mainline between floats, and a typical set for swordfish uses about 800 to 1,000 hooks. Shallow-set longline gear is set at night with luminescent light sticks attached to branchlines and hauled during the day. Formerly, J-hooks and squid bait were used, but since 2004, 18/0 or larger 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 to 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 at night. 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 floats. A typical deep-set consists of 2,000 to 2,500 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 vary seasonally around the Hawaiian Islands and there is some overlap with the shallow-set fishery. A comparison of shallow-set and deep-set longline fishing methods is provided in Bartram and Kaneko (2004).

Hawaii-based longline fisheries are managed by federal regulations pertaining to the Pelagics FEP, 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 Regulations (NMFS 2011e).

1.2 The Hawaii Shallow-set Longline Fishery

The Hawaii-based shallow-set longline fishery re-opened in late 2004 to test the effectiveness in the Pacific of a hook-and-bait combination that was found to dramatically reduce interactions[3] 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 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, annual limits were 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

[3] An interaction occurs when a sea turtle is 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.

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 requirements implemented by the April 2, 2004 (69 FR 17329) final rule, vessel operators in the Hawaii-based shallow-set fishery must use large (sized 18/0 or larger) circle hooks with a maximum of 10 degrees 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, NMFS places observers on all vessels 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, and once either limit is reached in a calendar year, the fishery would close for the remainder of the year. 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).

Under the requirements implemented by the final rule (December 10, 2009; 74 FR 65460) for Pelagics FMP Amendment 18, the annual limit on the number of fishing gear deployments (sets), which in 2004 had been capped at 2,120 annual sets following the reopening of the fishery, was removed. The set certificate program, used to monitor and control the number of sets, was also removed.

From January 11, 2010, to September 16, 2011, the fishery has operated unconstrained by effort limits and set certificates. In 2010, a total of 1,875 sets were made, 114 more than 2009, and 270 more than 2008 (NMFS consultation letter request from SFD).

In 2006 the shallow-set longline fishery reached the loggerhead sea turtle limit of 17 and was closed on March 20, 2006 for the remainder of the calendar year. On November 18, 2011 the shallow-set longline fishery reached their leatherback sea turtle limit of 16 and closed for the remainder of the calendar year.

2 Consultation History

The proposed federal action addressed by this biological opinion is the continued operation of the management program for the Hawaii-based shallow-set longline fishery, as recommended in Amendment 18 to the Pelagics FMP as described in section 1.0 above. The revised limit of 46 loggerhead interactions discussed in the 2008 biological opinion was based on the maximum expected fishing effort of about 5,500 annual sets and the Hawaii shallow-set fishery's interaction rates with loggerheads from 2004-2008. The limit for leatherback sea turtles remained unchanged at 16. These management changes were developed and implemented to allow the fishery to achieve optimum yield while minimizing bycatch and bycatch mortality, consistent with Magnuson-Stevens Act and other applicable laws.

As mentioned above, in 2008 an ESA section 7 consultation was conducted on proposed regulatory amendments to the Pelagics FMP (which included the Hawaii-based shallow-set longline fishery) and a biological opinion was issued on October 15, 2008 (2008 BiOp) (NMFS 2008a). On September 16, 2011, NMFS SFD requested reinitiation of formal consultation. Reinitiation of consultation is required if:

1. The amount or extent of incidental take for any species is exceeded;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;
3. The agency action is subsequently modified in a manner that may affect listed species or critical habitat to an extent in a way not considered in this opinion (e.g., if more than 5,500 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.

The reinitiation triggers for this consultation are as follows: This consultation requires consideration of all protected species that may be affected within the action area. In this regard, from January to September 16, 2011, there have been four observed green turtle interactions in the fishery. The ITS in the 2008 BiOp authorized the take of three green turtles over a three-year period, including one mortality. Since the ITS for green sea turtles has been exceeded, reinitiating consultation is required.

On December 16, 2009, plaintiffs Turtle Island Restoration Network (TIRN), Center for Biological Diversity (CBD), and KAHEA: the Hawaiian Environmental Alliance, filed a lawsuit in the U.S. District Court for the District of Hawaii (Court) to challenge the NMFS 2008 BiOp and December 10, 2009, final rule (2009 rule) implementing Amendment 18. Plaintiffs and NMFS eventually agreed to settlement terms that on January 31, 2011 were approved under a stipulated injunction and order entered by the Court. Under the terms of settlement, that portion of the 2009 rule increasing the maximum annual incidental take of loggerhead sea turtles by the fishery to 46 was vacated and remanded to the agency. On March 11, 2011, consistent with the requirements of the stipulated injunction, the previous annual limit of 17 was reinstated through agency rulemaking (76 Fed.Reg. 13297). In addition, that portion of the 2008 BiOp addressing loggerhead and leatherback sea turtles was vacated and remanded to the agency. All remaining provisions of the 2009 rule remain in effect, including the removal of the annual set limits.

Under the stipulated injunction and order, NMFS must issue a new biological opinion and incidental take statement (ITS) for the fishery within 135 days of taking final action on a joint NMFS and U.S. Fish and Wildlife Service (USFWS) proposed rulemaking to designate nine distinct population segments (DPS) of loggerhead sea turtles and to change the listing status of loggerhead sea turtles under the ESA. On September 16, 2011, NMFS and the USFWS filed a final rule with the Office of the *Federal Register* to list the North Pacific loggerhead DPS, the population affected by the operation of the fishery, as endangered. As required under the terms of the consent decree, and consistent with ESA regulations in 50 CFR 402.16, NMFS is required to reinitiate consultation on the continued operation of the fishery.
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. On October

28, 2011 and November 21, 2011, conference calls were conducted between NMFS PRD, SFD, and the applicant, the Hawaii Longline Association (HLA), in order to provide an update on where NMFS PRD was in the process. PIRO/PRD provided a draft biological opinion to PIRO/SFD, and PIFSC with a request for comments, on December 7, 2011. Comments were received from PIRO/SFD on December 20, 2011 and from PIFSC on December 21, 2011. On January 2, 2011, the draft biological opinion was provided to the Applicant, HLA, for the proposed action. A conference call was conducted with HLA on January 6, 2012. Comments were received from HLA on January 17, 2012.

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 FEP and applicable regulations[4]. Accordingly, the federal action forecasts a gradual increase to a maximum of 5,500 sets annually, which represents the approximate maximum annual number of sets that occurred during the period 1994-1999, prior to the fishery's closure due to sea turtle interactions. The effects of the proposed action are evaluated over the next 25 years, which corresponds to the forecast limitations of the climate-based model discussed in Section 7.

A synopsis of the current shallow-set regulations that are part of the proposed action is provided below. 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 on board the vessel:
  - Hawaii Longline Limited Entry Permit.
  - Marine Mammal Authorization Program Certificate.
  - High Seas Fishing Compliance Act Permit, for fishing on the high seas.
  - Western and Central Pacific Convention (WCPFC) Area Endorsement, for fishing on the high seas in the convention area.
  - Protected Species Workshop (PSW) Certificate.
  - Western Pacific Receiving Vessel Permit, if applicable.
  - State of Hawaii Commercial Marine License.

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

[4] Under regulations implementing Amendment 18, the shallow-set longline fishery is subject to closure upon reaching annual interaction limits ("hard caps") for leatherback and loggerhead sea turtles, as established by NMFS through consultation under the ESA section 7. Under Amendment 18, annual "hard caps" requiring closure of the fishery were initially set for 46 loggerheads and 16 leatherback sea turtles. As a result of litigation, discussed *infra*, NMFS reinstated a hard cap of 17 loggerheads. 76 Fed. Reg. 13297 (March 11, 2011).

- ❖ Notification Requirement and Observer Placement:
  - ➢ Notify NMFS 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 fishery observer on board if requested by NMFS; NMFS places 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 Longline Fishing Prohibited Area.

- ❖ Protected Species Workshop:
  - ➢ Each year, longline vessel owners and operators must attend a PSW, and receive a 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 regulations for safe handling and release of sea turtles and seabirds.
  - ➢ Longline vessel owners/operators must have on board the vessel all required turtle handling/dehooking gear specified in regulations.
  - ➢ Longline vessel owners/operators can choose between side-setting or stern-setting longline gear with additional regulatory specifications to reduce seabird interactions.
  - ➢ When shallow-set longline fishing north of the Equator:
    - ▪ Use 18/0 or larger circle hooks with no more than 10° offset.
    - ▪ Use mackerel-type bait.

- ❖ 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 NMFS to report injuries or mortalities of marine mammals.

The above regulations can be found at 50 CFR Part 665, and are also included in Appendix 2. A summary of regulations for Hawaii-based longline fisheries (shallow-set and deep-set combined) is provided by the Summary of Hawaii Longline Fishing Regulations (NMFS 2011e).

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 from 2008-2011 occurred between 180° - 128° W longitude and 17° N - 45° N latitude (Figure 1). In addition, in some years, shallow-set longline vessels started and/or completed fishing trips at ports along the California coast, although no longline fishing occurred within the U.S Exclusive Economic Zone (EEZ) around the continental U.S. Therefore, the action area includes part of the EEZ around Hawaii and off the U.S. west coast. Longline fishing is prohibited within approximately 25 to 75 nm from the Main Hawaiian Islands, depending on the location and season, which is described in regulations at 50 CFR Part 665. In addition portions of the EEZ around the U.S. west coast are closed to longlining and are described in regulations at 50 CFR Part 660. However, these longline fishing prohibited areas are included in the action area, because longline vessels travel through them while on shallow-set fishing trips.

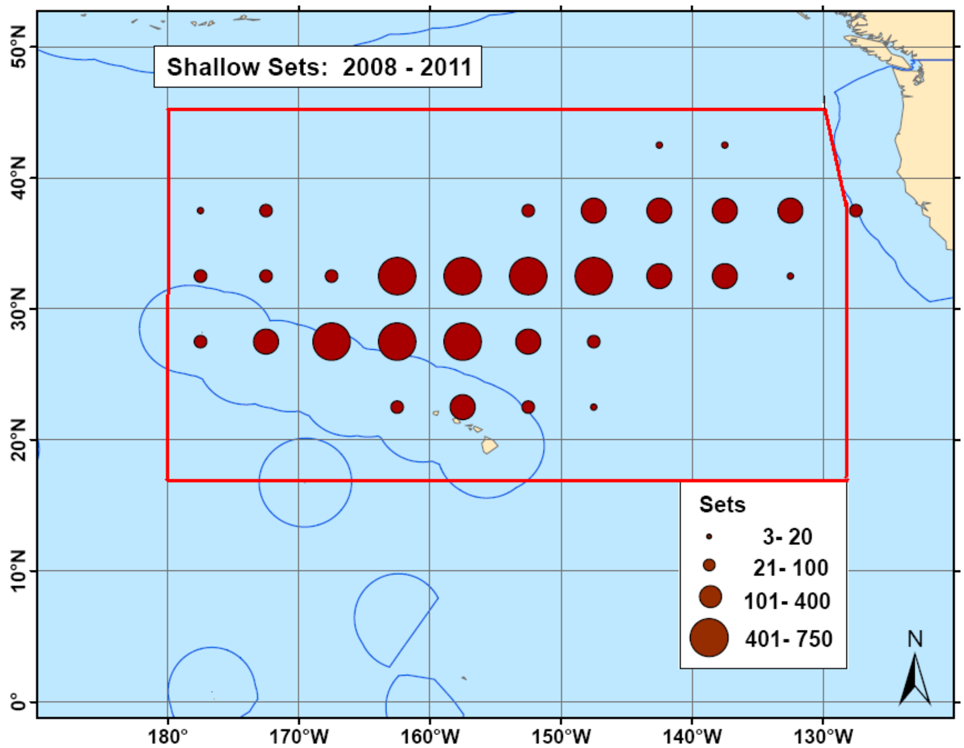

Figure 1. Location of shallow sets made by the Hawaii shallow-set longline fishery from 2008-2011. Some sets do not appear on the map due to confidentiality rules. Action Area is in the red polygon. No sets were made in the California EEZ; circle appears there due to the application of the data confidentiality rules (Map provided by Lesley Jantz, of the Pacific Islands Region Observer Program (PIROP), 12/15/2011).

There is spatial overlap between the Hawaii-based shallow-set and deep-set longline fisheries. The proposed action addressed by this biological opinion is the continued operation of the shallow-set fishery only. The shallow-set fishery operates almost entirely north of Hawaii. In some years, depending on seawater temperature, this fishery may operate mostly north of 30° N. The deep-set fishery operates primarily to the south of Hawaii between the Equator and 35° N. In some years there may be considerable fishing north of Hawaii also. Thus, the fisheries overlap spatially near Hawaii between 20° N and 30° N (NMFS 2008a).

5 Status of Listed Species

The memo of September 16, 2011, from SFD to PRD requesting reinitiation of consultation on the shallow-set longline fishery determined that the proposed action may adversely affect the five ESA-listed marine species shown in Table 1b and hawksbill sea turtles. The memo further determined that the six marine mammal species shown in Table 1a below were consulted on in 2008. On August 27, 2008, PRD responded with a letter concurring with these determinations. SFD stated that there have not been any changes in the proposed action that were not previously considered, therefore no reinitiation triggers are met for the species in Table 1a. Therefore these six species (Hawaiian monk seal and five whale species) are not addressed further in this biological opinion. Upon further analysis it has been determined that hawksbill sea turtles may be affected by the proposed action but they are not likely to be adversely affected (see analysis below). After the hawksbill analysis, the remainder of this biological opinion deals exclusively with the five species likely to be adversely affected by the proposed action (humpback whale and the four sea turtle species) listed in Table 1b.

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

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
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	7/28/1978	43 FR 32800
Table 1b. Species likely to be adversely affected by the proposed action.				
Humpback Whale	*Megaptera novaeangliae*	Endangered	12/02/1970	35 FR 18319
North Pacific DPS Loggerhead Sea Turtle	*Caretta caretta*	Endangered	9/22/2011	76 FR 58868
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
Olive Ridley Sea Turtle	*Lepidochelys olivacea*			
Nesting aggregations on Pacific 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, Pacific coast Mexico, Florida		Endangered	7/28/1978	43 FR 32800
All other Green turtles		Threatened	7/28/1978	43 FR 32800

Critical Habitat

Federal agencies are directed under section 7(a)(2) to ensure that any activities or programs they authorize, fund, or carry out do not destroy or adversely modify critical habitat. Destruction or adverse modification of critical habitat means a direct or indirect alternation that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical. On January 20, 2012 critical habitat was designated for leatherback sea turtles off the west coast of the U.S. including areas off of Washington, Oregon, and California. This is the only critical habitat designation that occurs in the Action Area. All of the designated area is contained within the exclusive economic zone off the U.S. west coast. The primary constituent element of the critical habitat is the quantity and quality of leatherback prey, which is primarily scyphomedusae of the order Semaeostomeae (e.g., Chrysaora, Aurelia, Phacellophora, and Cyanea), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks (NMFS 2011g). Activities that are listed in the designation that may impact the primary constituent element includes point source pollution, pesticide application, oil spill response, power plants, desalination plants, wave and wind energy projects, and Liquid Nitrogen Gas projects. As described previously the shallow-set fishery is prohibited from fishing in the exclusive economic zone of the U.S. west coast and therefore would not be conducting any fishing operations inside the designated critical habitat. The shallow-set vessels would occasionally transit through designated areas on their way to ports in California. Given the limited number of vessels that participate in the fishery and the even lower number that travel to California ports we do not anticipate that the vessels will adversely modify the primary constituent element, which is the quantity and quality of the prey. These vessels would have an insignificant effect on the level of pollution occurring in the designated area since they are required to follow Marpol regulations. Additionally, no leatherback prey (e.g., jellyfish) would be fished or removed from the habitat. No aspects of the proposed action would be expected to affect the condition, distribution, diversity, abundance and density of leatherback prey. Therefore we conclude that the proposed action will not destroy or adversely modify the designated critical habitat.

Not Likely to Adversely Affect Analysis for the Hawksbill Sea Turtle

Hawksbill life history is characterized by early development in the pelagic zone followed by later development in nearshore habitats. Hawksbills recruit to coastal habitats of the neritic zone at greater than 40 cm carapace length. Sub-adults and adults forage on coral reefs, primarily on sponges. Detailed information about the biology, habitat, and conservation status of the hawksbill sea turtle can be found in its recovery plan and other sources at http://www.nmfs.noaa.gov/pr/species/turtles/.

Like other sea turtles, if large enough, hawksbill sea turtles can potentially be hooked or entangled by longline gear if they come in contact with it. However, unlike other species of sea turtles, the density of hawksbills is extremely low in the action area. In Hawaii, tracking of post-nesting hawksbills from the Big Island of Hawaii and Maui suggest that primary adult foraging habitat occurs along the Hamakua coast of the Big Island (Parker et al. 2009), and adults are very rarely expected to enter waters fished by Hawaii-based longline vessels (approximately 25 to 75 nautical miles from the MHI). There has been no recorded bycatch of hawksbill sea turtles in Pacific U.S. longline fisheries. In the entire central north Pacific, only a few dozen females are thought to nest annually, thus it appears that there is low hawksbill sea turtle abundance with very few pelagic juveniles foraging in the action area. Based on very low densities of hawksbill sea turtles in the action area, and the lack of any interactions between the Hawaii-based shallow-set and deep-set fisheries since observer coverage began in 1994 (with 100% observer coverage since 2004 in the shallow-set fishery), we consider the probability of hawksbill interactions with gear of the proposed action extremely unlikely, and discountable.

NMFS also considered the potential for vessel collisions with hawksbill sea turtles that could be associated with the proposed action. Since the shallow-set fishery re-opened in 2004, fewer than 50 boats have participated in the fishery each year, thus the fishery makes up well under 1 percent of the total boat traffic in the main islands. In addition there are very low densities of hawksbill turtles around the main Hawaiian Islands. Thus, we consider it discountable that this species will be struck by vessels associated with the proposed action.

Based on the above, hawksbill sea turtles are not likely to be adversely affected by the proposed action.

Species Likely to be Adversely Affected
This section presents the biological and 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 and 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 five species addressed by this biological opinion (humpback whale and four sea turtle species).

The five species addressed by this biological opinion have global distributions and all but one 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)[5].

However, as shown above in Figure 1, the action area is relatively small compared to the distributions of the five species. Since the proposed action can only affect 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 absence of DPSs or other formally-recognized populations for four of the five species, affected populations must first be identified. For the purposes of this opinion, the five species addressed by this biological opinion (humpback whale and four sea turtle species) occur in the Pacific Ocean as the following:

1. Humpback whales: North Pacific and South Pacific populations. NMFS has identified three 'stocks' in the north Pacific that overlap (see humpback whale Stock Assessment Reports), and due to the complexity it is likely that there is not just one population in the north Pacific (SPLASH report, Calambokidis et al. 2008; Global Review of Humpback Whales, NMFS 2011f). 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 DPS and South Pacific DPS. The 2011 Loggerhead DPS listing describes the two distinct population segments in the Pacific.
3. Leatherback turtles: Eastern Pacific and Western Pacific populations. The leatherback 5-year status review (NMFS and 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 olive ridley 5-year status review (NMFS and USFWS 2007c) describes the status of olive ridley

[5] 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.

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 green turtle 5-year status review (NMFS and 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.

Not all Pacific populations identified above occur within the action area (Figure 1). All humpbacks in the action area are thought to be from the central North Pacific stock (NMFS 1991, Calambokidis et al. 2008; NMFS 2010, NMFS 2011f). For turtles, genetic work has been done to determine the source populations of individuals that have interacted with the Hawaii-based longline fisheries (shallow-set and deep-set; Table 2). Almost 200 loggerhead samples have been analyzed so far from the shallow-set fishery, and all were from the North Pacific DPS. The few loggerhead samples from the deep-set fishery were also from the North Pacific DPS. The 35 leatherbacks sampled from the shallow-set fishery were all from the western Pacific population. One of the 15 leatherback samples from the deep-set fishery 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 turtle interactions are very rare in the shallow-set fishery. Seven of the 13 olive ridleys caught in the shallow-set fishery were from the eastern Pacific and the remaining six were from the western Pacific. Additionally, olive ridleys are the most common turtle species in the deep-set fishery, and about three-fourths are from the eastern Pacific population. Green turtle bycatch in the shallow-set is about evenly split between the central and eastern Pacific populations and for the deep-set fishery about three-fourths are from the eastern Pacific (Table 2).

Table 2. Genetics results for turtle bycatch, shallow-set vs. deep-set, 1995-2011 (P. Dutton, personal communication, January 2012).

Species	Shallow-Set		Deep-set	
	Samples	**Source Pop^n (%)**	**Samples**	**Source Pop^n (%)**
Loggerhead	186	186 Japan (100%)	11	11 Japan (100%)
Leatherback	35	35 W. Pacific (100%)	15	14 W. Pacific (93%) 1 E. Pacific (7%)
Olive Ridley	13	7 E. Pacific 6 W. Pacific	92	67 E. Pacific (74%) 23 W. Pacific (26%)
Green	8	4 C. Pacific 4 E. Pacific	17	12 E. Pacific (71%) 2 W. Pacific (12%) 2 C. Pacific (12%) 1 C or E. Pacific(5%)

Table 3 shows sea turtle interactions since the Hawaii-based shallow-set longline fishery re-opened in April 2004 (samples for which genetics results are available were taken from turtles caught between October 2004 and December 2011). During this period, 67 loggerhead, 51 leatherback, 3 olive ridley, and 6 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. Genetics results for turtle bycatch in shallow-set since re-opening in 2004 (P. Dutton, personal communication, January 2012).

Species	Total caught	Genetics Samples Taken	Genetics Samples Analyzed	Source Pop (%)
Loggerhead	67	61	60	60 Japan (100%)
Leatherback	51	29	22	22 W. Pacific (100%)
Olive Ridley	3	2	2	2 E. Pacific (100%)
Green	6	6	6	3 C. Pacific (50%) 3 E. Pacific (50%)

Based on the genetics results shown in Tables 2 and 3 above (i.e., all samples available from the shallow-set fishery since 1995), for the purposes of this opinion, the affected populations of the five species addressed by this biological opinion (humpback whale and four sea turtle species) are defined as follows:

1. Humpback whales: Central North Pacific population.
2. Loggerhead turtles: North Pacific DPS.
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.

"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.

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), biological opinion on the effects of activities associated with the Navy's Hawaii Range Complex (NMFS 2008b), the humpback whale Stock Assessment Reports (e.g., Allen and Angliss 2010), the SPLASH report (Calambokidis et al. 2008), the 2008 BiOp (NMFS 2008a), the Global Review of Humpback Whales (NMFS 2011f), and other sources cited below.

5.1.1. Population Characteristics

Humpback whales are distributed worldwide in all ocean basins, from subtropical to subpolar waters. Humpback whales in the north Pacific 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. Breeding areas in the north Pacific are more geographically separated than the feeding areas and include regions offshore of mainland Central America; mainland Baja California, and the Revillagigedos Islands, Mexico; Hawaii; and Asia, including Ogasawara and Okinawa Islands, and the Philippines. About half of the humpback whales in the north Pacific Ocean breed and calve in the U.S. territorial waters off Hawaii, and more than half feed in U.S. territorial waters (NMFS 2011f). In the north Pacific, population structure is complex with mixing between feeding grounds and breeding grounds. Stock structure of humpback whales is defined based on feeding areas (NMFS 2010e).

Within the north Pacific Ocean, at least three stocks make up the north Pacific population(s): 1) the California/Oregon/Washington and Mexico stock, consisting of winter/spring populations in coastal Central America and Mexico which migrate to California and British Columbia; 2) the central north pacific (CNP) stock that migrates between the Hawaiian Islands and northern British Columbia/Southeast Alaska, Gulf of Alaska, and the Bering Sea/Aleutian Islands; and 3) the western north Pacific stock, consisting of winter/spring populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands (Allen and Angliss 2010). Until recently, the North Pacific was considered to be one population but based on complexities observed

through the Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific (SPLASH) study, which analyzed genetics and photographs, it appears that there is likely more than one (NMFS 2011f).

Based on whaling statistics, before 1905 the north Pacific population(s) was estimated to be 15,000 and 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 21,000 individuals by 2010 (NMFS 2011f). About half of the population(s) winters in Hawaii (the CNP stock). The 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 CNP 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 less than 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 Main Hawaiian Islands (MHI) Longline Fishing Prohibited Area, which varies from approximately 25 to 75 nm from shore, depending on the location and season, as described above in the Action Area section. 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 less than 60 m. Since shallow-set longline gear is typically set so hooks are less than100 m deep, humpback dives largely overlap with this gear depth.

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., Allen and Angliss 2010), the SPLASH report (Calambokidis et al. 2008), and the Global review of Humpbacks (NMFS 2011f). From 1900 - 1965, nearly 30,000 whales were taken in modern whaling operations on the Pacific Ocean. Hunting humpback whales has been prohibited since 1966. Current threats include hookings and entanglement in fishing gear, ship strikes, tourism, noise, and potentially the effects of anthropogenic 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 95 confirmed entanglement reports in Hawaii from 2002 to 2011, with the highest number of confirmed reports during the 2008-2009 and 2009-2010 field seasons in which there were 38 (Lyman 2011). 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 entanglement. Available evidence from entangled humpback 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. A study in southeast Alaska on the CNP stock of humpback whales estimated that the number which showed evidence of entanglement from some point in their life and survived is about 71% which is a much higher number than reported disentanglements (Neilson et al. 2009).

The total of all known serious injury and mortalities to the CNP stock as a result of commercial fishing operations for the time period from 2003 through 2007 is 17 whales (16 in Alaska, 1 in Hawaii), resulting in an annual average take of 3.6 animals. In addition, nine whales were observed entangled in Hawaiian waters with injuries that could be serious, which is an annual mean of 1.8 over the 5-year period. The gear entangling these whales did not originate in Hawaiian waters; therefore, some of these whales may be included among the entangled humpback whales seen and documented in Alaska. Based on this information it is estimated that there were 5.6 commercial fishery-caused mortalities or serious injuries of CNP humpback whales per year over the period 2003-2007 (NMFS 2010a). Interactions with humpback whales in the shallow-set fishery accounted for 0.2 of the 5.6 mortalities during that time period (Allen and Angliss 2010).

Many humpback whales are killed by ship strikes throughout the world, including along both coasts of the U.S. On the Pacific coast, one 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 five whales struck per year in Alaska, whereas in Hawaii three to four vessel collisions with humpback whales were reported per year in 2001 through 2006. Between 2007 and 2011, reports of vessel collisions with humpback whales indicate an average of 6.8 whales struck per year in Hawaii. During the 2009 humpback whale season in Hawaii, there were 13 humpbacks reported with ship-strikes; ten of these reports were confirmed (Lyman 2011). Several other threats affect humpback whales throughout their range. For example, the CNP 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 noise occurs. Anthropogenic sound has increased in all oceans over the last 50 years and it is thought to have doubled each decade in some areas of the ocean over the last 30 years. Low-frequency sound comprises a significant portion of this and stems from a variety of sources including shipping, hydrographic research, naval activities, and oil and gas exploration (NMFS 2006a; NMFS 2008b; NMFS 2011f).

Highly mobile species, such as marine mammals, can respond to effects of climate change more rapidly than their terrestrial counterparts (Harwood 2001). No significant climate change-related impacts to humpback whale populations have been reported to date (NMFS 2011f). The most likely impact of climate change on cetaceans will be changes in range related to migration, expansion, or contraction of the geographic thermal niche populations currently occupy, or changes in the distribution of prey species with particular thermal requirements. The ranges of 88% of cetaceans may be affected by changes in water temperature resulting from global anthropogenic climate change, however the humpback whale is a cosmopolitan species ranging throughout the world's oceans and thermal and prey limitations related to anthropogenic climate change are unlikely to impact the range of this species (MacLeod 2009). Whilst oceanic cetaceans are unlikely to be directly affected by rises in sea level, important habitats for coastal species and species that require coastal bays and lagoons for breeding, such as humpback whales, could be adversely affected in the future (Simmonds and Elliot 2009). Humpback whales that feed in Polar Regions may also encounter reduced prey. Current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species. Due to a lack of scientific data, specific effects climate change will have on this species in the future are not predictable or quantifiable to any degree such as would allow for more detailed analysis in this consultation. Because of this uncertainty, climate change-related impacts are not considered significant within the context of the temporal scale of this action which is 25 years.

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 prohibit approaching humpback whales within 100 yards (90 m) when on the water or operating 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 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 whale and its habitat. The Sanctuary works collaboratively to conserve, enhance and protect humpback whales and their habitat by promoting and coordinating research, enhancing public awareness, and fostering traditional uses by native Hawaiians. It 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 five 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 is delineated around Maui, Lanai, and Molokai. The four 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). From 2002-2011, the network received over 356 reports of animals in distress; approximately 186 of those represented entangled animals including humpback whales. The network and partnering agencies have mounted at least 63 (on-the-water or in-the-air) responses to these reports. To date, ten humpbacks reported entangled in Hawaii have been confirmed to have gear from Alaska; nine of these represent commercial pot gear. The mean distance traveled with this gear is at least 2150nm. The greatest known straight line distance a whale may have carried gear is 2450nm (between North shore of Etolin Island, approx 9nm SW of Wrangell Alaska, where the gear was lost and the island of Maui where the animal was first reported) (Lyman 2011).

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 2008 BiOp (NMFS 2008a), 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 loggerhead 5-year status review (NMFS and USFWS 2007a), the SEIS for Amendment 18 (WPFMC 2009), the 2009 Status Review (Conant et al. 2009), the 2011 Loggerhead DPS listing, and other sources cited below.

The Services (NMFS and USFWS) determined that the loggerhead turtle (*Caretta caretta*) is composed of nine distinct population segments (DPSs) that constitute ''species'' that may be listed as threatened or endangered under the ESA. These loggerhead DPSs are the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Southeast Indo-Pacific Ocean, Southwest Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, South Atlantic Ocean, and Mediterranean Sea. In the Pacific, the two loggerhead turtle DPSs, North Pacific and South Pacific, have been listed as endangered (76 FR 58868; September 22, 2011).

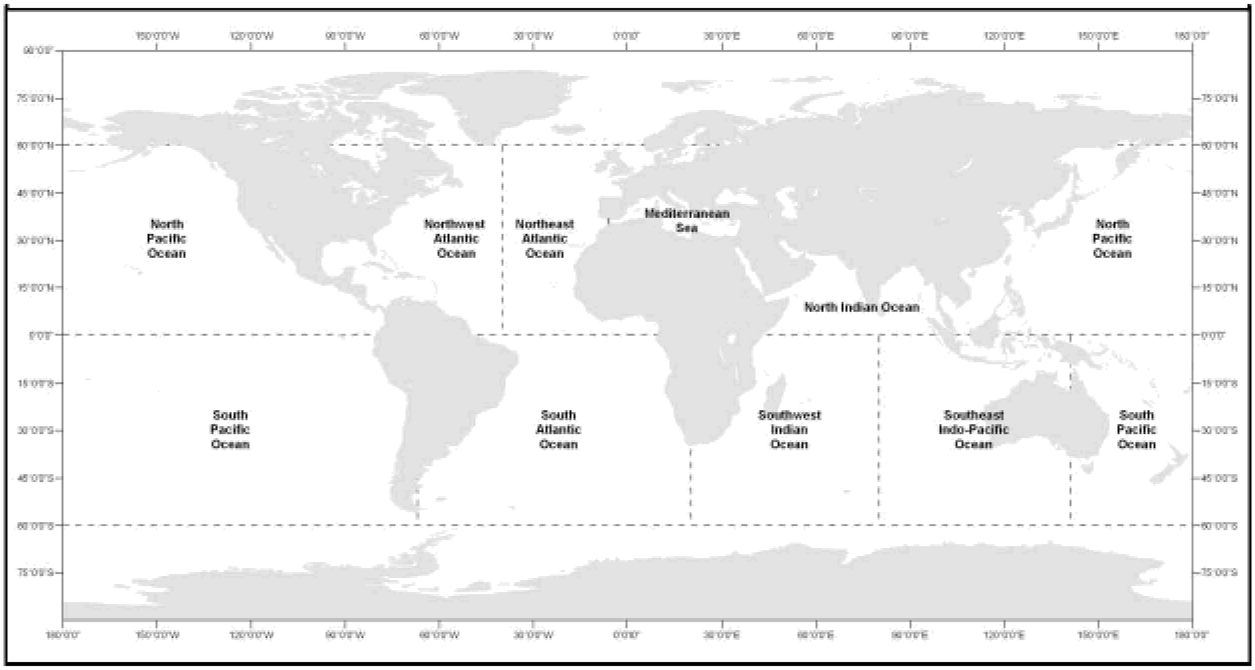

Figure 2. Map of Loggerhead Sea Turtle DPS boundaries (76 FR 58868; September 22, 2011).

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. The North Pacific loggerhead DPS nests primarily in Japan (Kamezaki et al., 2003), although low level nesting may occur outside of Japan in areas surrounding the South China Sea (Chan et al., 2007; Conant et al. 2009). Nesting beach monitoring in Japan began in the 1950s on some beaches, and grew to encompass all known nesting beaches starting in 1990 (Kamezaki et al. 2003). Along the Japanese coast, nine major nesting beaches (greater than 100 nests per season) and six "submajor" beaches (10–100 nests per season) exist, including Yakushima Island where 40% of nesting occurs (Kamezaki et al. 2003). Census data from 12 of these 15 beaches provide composite information on longer-term trends in the Japanese nesting assemblage. As a result, Kamezaki et al. (2003) concluded a substantial decline (50–90 percent) in the size of the annual loggerhead nesting population in Japan since the 1950s. As discussed in the 2011 final ESA listing determination, current nesting in Japan represents a fraction of historical nesting levels (Conant et al. 2009; 76 FR 58868, September 22, 2011). Nesting declined steeply from an initial peak of approximately 6,638 nests in 1990–1991, to a low of 2,064 nests in 1997. During the past decade, nesting increased gradually to 5,167 nests in 2005 (Conant et al., 2009), declined and then rose again to a record high of 11,082 nests in 2008, and then 7,495 and 10,121 nests in 2009 and 2010, respectively (STAJ 2008, 2009, 2010). As per the recent November 2011 Sea Turtle Association of Japan annual sea turtle symposium, the 2011 nesting numbers are slightly lower at 9,011 (Asuka Ishizaki, pers comm… November 2011).

For the 20-year period 1990-2010, the total number of nests per year for the North Pacific DPS ranged between 2,064 – 11,082 nests. Assuming a clutch frequency of four per female per year

(Van Houtan 2011), the number of nesting females per year between 1990 and 2010 ranged between 516 – 2771. The total number of adult females in the population was estimated at 7138 for the period 2008-2010 by Van Houtan (2011).

Population estimates for sea turtles are problematic due to lack of demographic information (NRC 2010). Lewison et al. (2004) made several assumptions regarding demographic parameters in order to estimate bycatch in Pacific longline fisheries and obtained 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). As a result, they estimated that approximately 20 percent of the population (67,000) was in size classes susceptible to longline fishing (Lewison et al. 2004). However, due to the uncertainty in assumptions used to derive these population estimates, NMFS will use nesting or nesting female data as population indices in this opinion.

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 of older age classes where maturation is likely reached. Based on tag-recapture studies, the East China Sea has been identified as a major habitat for post-nesting adult females (Iwamoto et al. 1985; Kamezaki et al. 1997, 2003; Kobayashi et al. 2008, 2011). Satellite tracking of juvenile loggerheads indicates the Kuroshio Extension Bifurcation Region to be an important pelagic foraging area for juvenile loggerheads (Polovina et al. 2006; Kobayashi et al. 2008; Howell et al. 2008). Other important juvenile turtle foraging areas have been identified off the coast of Baja California Sur, Mexico (Peckham and Nichols 2006; Peckham et al. 2007; Conant et al. 2009). After spending years foraging in the central and eastern Pacific, loggerheads return to their natal beaches for reproduction (Resendiz et al.,1998; Nichols et al., 2000) and remain in the western Pacific for the remainder of their life cycle (Iwamoto et al., 1985; Kamezaki et al., 1997; Conant et al. 2009; Hatase et al., 2002).

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 juveniles foraging and migrating across the oceanic zone, as discussed below. The Hawaii-based shallow-set fishery primarily interacts with juvenile loggerhead turtles, typically 50 – 80 cm carapace length, 96% (214/223) of the total loggerhead interactions have been with juveniles (i.e., <80 cm SCL) (PIRO Observer Program, unpublished data). 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 Kuroshio Extension Bifurcation Region (or Transition Zone Chlorophyll Front), and is favored foraging habitat for both juvenile loggerhead turtles (Polovina et al. 2006; Kobayashi et al. 2008; Howell 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, it is the most susceptible of the Pacific sea turtle species to interactions with shallow-set gear.

Loggerheads are a slow-growing species that reach sexual maturity at 25 to 37 years of age, depending on the DPS (NMFS and USFWS 2007a). Conant et al. (2009) estimate age to maturity to be 30 years +/- 5 yrs. Van Houtan and Hailey (2011) estimated age at first reproduction to be 25 years. The 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, 2008a).

5.2.3 Threats to the Species

Global threats to loggerhead turtles are spelled out in the 5-year review (NMFS and USFWS 2007a), and threats to the North Pacific loggerhead DPS are described in more detail in the proceedings of the 2005 and 2007 workshops (WPFMC 2005, WPFMC 2009), Conant et al. (2009), and Van Houtan (2010). Major threats to the species, according to these sources, are fisheries bycatch, alteration of nesting habitat, and direct harvest and predation, which are briefly described below. In addition, anthropogenic climate change and marine debris appear to be a growing threat to this species, and are discussed briefly below.

Sources of mortality for North Pacific loggerheads in addition to U.S. western Pacific commercial longline fisheries include: human encroachment and egg harvest/predation on nesting beaches, nesting beach alteration (armament and habitat degradation), incidental capture in coastal and pelagic fisheries (including longline, drift gillnet, set-net, bottom trawling, dredge, and trap net) throughout the species' range (Conant et al. 2009; Dutton and Squires, 2008; Peckham et al. 2007, 2008; Kudo et al. 2003; Ishihara et al. 2009, 2011; Koch et al. 2006; Van Houtan and Halley 2011). Interactions and mortality with coastal and artisanal fisheries in Mexico and the Asian region likely represent the most serious threats to North Pacific loggerheads (Peckham et al. 2007, 2008; Ishihara et al 2009; Conant et al. 2009). Bycatch and fisheries-related standings' numbering in the thousands annually have been reported from gillnet and longline fisheries operating in loggerhead 'hotspots' off of Baja Mexico where intense coastal fishing pressure overlaps with high densities of loggerheads foraging in nearshore habitats, producing among the highest bycatch rates reported worldwide (Peckham et al. 2007, 2008; Conant et al. 2009). More work is necessary to understand and quantify the impact of these Baja fisheries and to develop measures to reduce bycatch mortality. Between 2003 and 2010, annual stranding surveys to assess mortality have documented 3,096 dead loggerhead turtles (with a mean of 420 ± 274/yr) along 45 km stretch of beach of Playa San Lazaro in Baja California SUR, Mexico (Peckham 2010). For comparison purposes, along this same beach during same time period, 144 olive ridley and 279 green turtles were documented. (Peckham et al., 2007, 2008).

Preliminary research of coastal pound net fisheries in Japan also suggests high mortality to loggerheads and that these fisheries may pose a major threat to mature stage classes of loggerheads due to pound net operations offshore of nesting beaches in coastal foraging areas (Ishihara et al. 2007, 2009). Pound nets in Japan operate nearshore in depths up to 100m and range in size measuring up to 10,000m^3. Nets consists of a leader set perpendicular to the coast that directs fish into standing nets that entrain fish into an enclosed trap mounted either at the surface or midwater. Fish are retrieved at regular intervals (usually daily) from poundnets, enabling live release of turtles and other bycatch from surface traps. However, pound nets with midwater traps prevent sea turtles from reaching the surface to breathe and thus can result in high mortality rates. Hence coastal pound net fisheries off Japan may pose a significant threat to the North Pacific DPS population (76 FR 58868; September 22, 2011).

Before 2001 in the north Pacific, longline fisheries operating out of Hawaii were estimated to capture an average of about 417 loggerheads a year (McCracken 2000). If we apply the old mortality rate of 40% (Gilman 2007), this would give us an estimated mortality of 167 (417*40%= 166.8) annually before the shallow-set portion of the fishery was closed in 2001. The Hawaii longline fishery subsequently reopened in 2004 and was subject to a number of management measures that were designed to minimize bycatch and post-hooking mortality. The 2004 management measures have proven to reduce loggerhead interaction rates by 90% (Gilman et al. 2007a, WPFMC 2008). Since the shallow-set fishery re-opened in 2004, 13 (round up from 12.46) is the estimated number of loggerhead mortalities for the last 7 years (NMFS 2011a). The Hawaii-deep set fishery occasionally interacts with loggerheads and has an incidental take statement for up to 18 anticipated loggerhead interactions and 9 anticipated mortalities over a three year period (NMFS 2005). From 2005-2010, an estimate of 8.15 loggerhead mortalities occurred, which is less than two per year, in the deep-set fishery (NMFS 2011c). Since 2004, the Hawaii-based longline fisheries have reduced their estimated mortality to four annually (NMFS 2011a, b, and c). 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 and USFWS 2007a). Other U.S. fisheries that operate in the Pacific and interact with loggerhead sea turtles are the California/Oregon (CA/OR) drift gillnet fishery that targets swordfish and thresher shark off the west coast and the California longline experimental fishery. From July 1990 to January 2000, the CA/OR drift gillnet fishery was observed to incidentally capture 17 loggerheads (12 released alive, 1 injured, and 4 mortalities). Since 2000, restrictions have been in place to close areas to drift gillnet fishing off Southern California when loggerheads are expected to be in the area. The California Oregon drift gillnet fishery has an incidental take statement for up to five anticipated loggerhead interactions and two anticipated mortalities annually (NMFS 2004c). Since 2001, two loggerheads have been observed caught and released alive in the drift-gillnet fishery.

Destruction and alteration of loggerhead nesting habitats are occurring throughout the species' 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 coastal development from erosion during storms, but armoring blocks turtles from accessing nesting areas and often leads to beach loss (NMFS and USFWS 2007a). In Japan, where the North Pacific loggerhead DPS nests, many nesting beaches are lined with concrete armoring, causing turtles to nest below the high tide line where most eggs are washed away unless they 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 and 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). Overall, the Services have concluded that coastal development and coastal armoring on nesting beaches in Japan are significant threats to the persistence of this DPS (76 FR 58868; September 22, 2011).

Deliberate hunting of loggerheads for their meat, shells, and eggs is reduced from previous levels, but still exists. The North Pacific loggerhead DPS nests almost 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 2011, given that loggerheads mature in about 25 years (Ohmuta 2006). Predation of eggs also occurs, for example by raccoons and feral animals in Japan (NMFS and USFWS 2007a, and STAJ 2011). While sea turtles have been protected in Mexico since 1990 (Conant et al. 2009), studies have shown that loggerheads continue to be caught, both indirectly in fisheries and by a directed harvest of juvenile turtles (Gardner and Nichols 2001; Koch et al. 2006; Peckham et al. 2007).

Sea walls and beach armoring are common along coastal Japan, where North Pacific loggerheads predominantly nest, as precautions against tsunamis and sea level rise. Beach hardening structures limit access for nesting females and reduce the potential for natural beach migration with future sea level rise. Increasing temperatures at nesting beaches may impact sex ratios of hatchlings and/or increase embryonic mortality (Matsuzawa et al. 2002). The North Pacific DPS is estimated to have a 1:1 male to female ratio (NMFS and FWS 2007), and while nest temperatures in Japan may be within survival thresholds, high beach incubation temperatures have also occurred resulting in mortality of pre-emergent hatchlings in Japan (Matsuzawa 2006). This population may be less vulnerable to increases in sand temperature than those already highly skewed toward female or at the high end of thermal tolerance, but limited data are available on past trends and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species.

Marine debris is also a source of mortality to all species of sea turtles because small debris can be ingested and larger debris can entangle animals leading to death. Marine debris is defined by NOAA as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment. Manmade materials like plastics, micro plastics, and derelict fishing gear (e.g., ghost nets) that may impact turtles via ingestion or entanglement can reduce food intake and digestive capacity, cause distress and/or drowning, expose turtles to contaminants, and in some cases cause direct mortality (Arthur et al. 2009; Balazs 1985; Bjorndal et al. 1994; Bugoni et al. 2001; Doyle et al. 2011; Keller et al. 2004; Parker et al. 2011; Wabnitz and Nichols 2010). All marine turtles have pelagic stages; including when they leave the nesting habitat as hatchlings and enter a period known as the "lost years" that can last for years or decades (Lutz and Musick 1997; Zug 2002). While the impact of marine debris to Pacific turtles during pelagic life stages is currently unquantified, it is quite likely that impacts may be severe given the increase of plastics and other debris and pollution entering the marine environment over the past 20-30 years (Arthur et al. 2009; Doyle et al. 2011; Stewart et al. 2011; NMFS and USFWS 2007a-e; Hutchison and Simmonds 1992; Law et al. 2010; Mrosovsky et al. 2009; Wabnitz and Nichols 2010). The addition of debris from the earthquake and tsunami that hit Japan in March 2011 increases concern due to the large amount of debris that entered the water in a short time. The Japanese government estimated that 25 million tons of debris was generated but there is no confirmed estimate of how much entered the water, and little information as to the type of debris that entered the water. It is believed that it is highly unlikely that the debris is radioactive for several reasons; the vast majority of the debris was many miles away from the reactor that leaked, the leak of contaminated water from the reactor into the sea started days to weeks after the debris was washed out to sea, and vessels coming into the U.S. from Japan were monitored for radiation, and readings were below the level of concern. The large debris field that was initially generated has broken up so it is no longer visible by satellite, which means that it can no longer be monitored so the location of the debris is unknown and projections of when it will reach shore can only be predicted using models that take into account oceanic and wind conditions (NOAA Marine Debris Program). For loggerheads the greatest risk is in the pelagic environment but there is no information to quantify what the impact will be.

As highly migratory, wide-ranging organisms that are biologically tied to temperature regimes, sea turtles are vulnerable to effects of climate change in aspects of their physiology and behavior (Van Houtan 2011). Climate refers to average weather conditions, as well as associated variability. The term climate change refers to any distinct change in measures of climate lasting a long period of time, which means major changes in temperature, rainfall, snow, or wind patterns lasting for decades or longer. Climate change may result from: natural factors, such as changes in the Sun's energy or slow changes in the Earth's orbit around the Sun; natural processes within the climate system (e.g., changes in ocean circulation); and human activities that change the atmosphere's makeup (e.g., burning fossil fuels) and the land surface (e.g., cutting down forests, planting trees, building developments in cities and suburbs, etc.), also known as anthropogenic climate change (U.S. Environmental protection Agency). Impacts to marine turtle populations resulting from climate change may occur at different rates or at different levels between marine turtle species based on a number of factors. In the future, increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storm events are expected as a result of climate change and are all potential threats for loggerheads.

A final factor when considering the effects of future anthropogenic climate change is the role the Pacific Decadal Oscillation (PDO) plays in influencing turtle populations. Recent studies combined two factors of climate variability mentioned above, changes in ocean circulation and sea surface temperatures (SST) on two different life stages of loggerhead sea turtles, (neonates[6] and adult females) to see how they influence population trends (Van Houtan and Halley 2011). This study found that changes in loggerhead nesting over at least the last several decades are strongly correlated with ocean oscillations due to environmental influences on juvenile recruitment (Van Houtan and Halley 2011). Juvenile recruitment appears to be strongly correlated with the Pacific Decadal Oscillation (PDO) in the Kuroshio Bifurcation Extension Region where juveniles congregate (Polovina et al. 2006) as they are most susceptible to oceanographic variability given their limited ability to exploit their environment for food (Van Houtan and Halley 2011). SST in the months preceding nesting has been demonstrated to influence whether females nest due to the need for sufficient nutrients for yolk production (Van Houtan and Halley 2011). Using this same type of information, forecasts were then made into the future for several populations. For loggerheads in the north Pacific, nesting trend data were combined with current PDO data and future winter SST temperature, which were based on the IPCC A2 projections, to project the population trend out to 25 years, which is the maximum lag time for the PDO. The PDO cannot be predicted beyond what information we have now. Twenty-five years is the calculated age to first reproduction (AFR) for loggerheads, which means that we are predicting how many adult females there will be based on the number of juveniles that recruit today, which is influenced by current ocean conditions. Future winter SSTs influence adult breeding remigrations, which is the second component of the study. In this study the model contributions of each climate factor plus the error were calculated and for the North Pacific DPS, the PDO accounted for 37% of the results and the winter SST accounted for 26% (Van Houtan and Halley 2011). In the next 25 years, the model predicts that the North Pacific loggerhead nesting population will decline below a Quasi Extinction Threshold (QET) set at 50% of the current population size (Figure 6a; Van Houtan 2011). Beyond 25 years we do not have information to predict what the population will do. Additional studies that simulated changes in physical ocean properties in northern hemisphere westerlies in response to various future CO^2 emission scenarios predict that the area and primary production of the temperate oceanic biome in the north Pacific is anticipated to decrease by 34% over the next century (Polovina et al. 2011). The extent of the impact on species in the region, such as loggerheads, is unknown because we do not know how species may or may not adapt to changes over the long-term (Chaloupka et al. 2009).

5.2.4 Conservation of the Species

Considerable effort has been made since the 1980s to document and reduce loggerhead bycatch in Pacific Ocean fisheries, as this is the highest conservation priority for the species. NMFS has formalized conservation actions to protect foraging loggerheads in the north Pacific Ocean which were implemented to reduce loggerhead bycatch in U.S. fisheries. Observer programs have been implemented in 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, modifying existing gear, and developing and promoting Sea Turtle Handling Guidelines (NMFS and USFWS 2007a). For example, switching

[6] Neonates are defined as hatchlings up to six months of age for the purpose of this study (Van Houtan, pers. Comm.).

to large circle hooks and mackerel bait in 2004 reduced the interaction rate by approximately 90% in the Hawaii shallow-set longline fishery (Gilman et al. 2007a, WPFMC 2009). In 2003, NMFS implemented a time/area closure in southern California during forecasted or existing El Niño-like conditions to reduce the take of loggerheads in the California/Oregon drift gillnet fishery (68 FR 69962; December 16, 2003). NMFS has also developed a mapping product known as TurtleWatch that provides a near real time product that recommends areas where the deployment of pelagic longline shallow sets should be avoided to help reduce interactions between Hawaii-based pelagic longline fishing vessels and loggerhead sea turtles (Howell et al. 2008).

Since loggerhead interactions and mortalities with coastal fisheries in Mexico and Japan are of concern and are considered a major threat to North Pacific loggerhead recovery, NMFS and U.S. non-governmental organizations have worked with international entities to: (1) assess bycatch mortality through systematic stranding surveys in Baja California Sur, Mexico; (2) reduce interactions and mortalities in bottom-set fisheries in Mexico; (3) conduct gear mitigation trials to reduce bycatch in Japanese pound nets; and (4) convey information to fishers and other stakeholders through participatory activities, events and outreach. In 2003, Grupo Tortuguero's ProCaguama (Operation Loggerhead) was initiated to partner directly with fishermen to assess and mitigate their bycatch while maintaining fisheries sustainability in Baja California, Mexico. ProCaguama's fisher-scientist team discovered the highest turtle bycatch rates documented worldwide and has made considerable progress in mitigating anthropogenic mortality in Mexican waters (Peckham et al. 2007, 2008). As a result of the 2006 and 2007 tri-national fishermen's exchanges run by ProCaguama, Sea Turtle Association of Japan (STAJ), and the Western Pacific Fisheries Management Council, in 2007 a prominent Baja California Sur fleet retired its bottom-set longlines (Peckham et al. 2008; Peckham and Maldonado-Diaz, in press). Prior to this closure, the longline fleet interacted with an estimated 1,160-2,174 loggerheads annually, with nearly all (89 percent) of the takes resulting in mortalities (Peckham et. al. 2008). Because this fleet no longer interacts with loggerheads, conservation efforts have resulted in the continued protection of approximately 1,160-2,174 juvenile loggerheads annually (76 FR 58868; September 22, 2011). Additionally, stranding data collected since 2003 at Playa San Lazaro indicates a 60% reduction in standings' during 2010 compared to previous 2003-2009 averages (Peckham 2010). To date, 90% of the gillnet fleet has retired their gear (a total of 140 gillnets), 18 crews have converted to hook and line fishing (a more sustainable practice in the 'hotspot' area), and local government enforcement has increased to ensure compliance with local laws (Peckham pers.comm.). In Japan, due to concerns of high adult loggerhead mortality in mid-water pound nets, researchers with the STAJ, ProCaguama, and NMFS have begun collaborations, together with local fishermen throughout several Japanese prefectures, to investigate and test pound net mitigation options to reduce the impact and mortality of sea turtle bycatch. This work is ongoing as of 2011, and has received high media attention both within Japan and internationally that has helped to raise public awareness and maintain momentum (Ishihara et al. in prep).

Led by the Mexican Wildlife Service, a federal loggerhead bycatch reduction task force, comprised of federal and state agencies and non-governmental organizations, was organized in 2008 to ensure loggerheads receive the protection they are afforded by Mexican law. In 2009, while testing a variety of potential solutions, ProCaguama's fisher-scientist team demonstrated the commercial viability of substituting bycatch-free hook fishing for gillnet fishing. ProCaguama, in coordination with the task force, is working to develop a market-based bycatch solution consisting of hook substitution, training to augment ex-vessel fish value, development of fisheries infrastructure, linkage of local fleets with regional and international markets, and concurrent strengthening of local fisheries management (Conant et al. 2009).

Conservation efforts have also focused on protecting nesting beaches, nests, and hatchlings. Much of Japan's coastline is "armored" using concrete structures to prevent and minimize impacts to coastal communities from natural disasters. These structures have resulted in a number of nesting beaches losing sand suitable for sea turtle nesting, and nests often need relocating to protect them from erosion and inundation. In recent years, a portion of the concrete structures at a beach in Toyohashi City, Aichi Prefecture, was experimentally removed to create better nesting habitat (76 FR 58868; September 22, 2011). The STAJ along with various other organizations in Japan, are carrying out discussions with local and Federal Government agencies to develop further solutions to the beach erosion issue and to maintain viable nesting sites. Recently, the Ministry of Environment has supported the local NGO conducting turtle surveys and conservation on Yakushima in establishing guidelines for tourism to minimize impacts by humans on nesting beaches (Y. Matsuzawa, STAJ, personal communication; Conant et al. 2009). Yet, beach erosion and armament still remain one of the most significant threats to nesting beaches in Japan (Conant et al. 2009). Since 2003, WPFMC has been contracting with STAJ to protect loggerhead nests and increase hatchling survivorship at several nesting beaches in southern Japan, including at the two primary beaches on Yakushima Island. Beach management activities include conducting nightly patrols during the summer nesting season to relocate nests from erosion prone areas, protecting nests from predators and people with mesh and fences, and cooling nests with water and shading 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 2004-08 resulted in an estimated 160,000 hatchlings being released that otherwise may have been lost (76 FR 58868; September 22, 2011).

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. In 2008 the Western and Central Pacific Fisheries Commission (WCPFC) adopted a Conservation and Management Measure (CMM 2008-03) to mitigate the impacts on turtles from longline swordfish fisheries in the western central Pacific Ocean. The measure includes the adoption of FAO guidelines to reduce sea turtle mortality through safe handling practices and to reduce bycatch by implementing one of three methods by January 2010. The three methods to choose from are: 1) use only large circle hooks, or 2) use whole finfish bait, or 3) use any other mitigation plan or activity that has been approved by the Commission. 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, Japan, 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 and USFWS 2007a; Ishihara et. al. in prep).

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 leatherback 5-year status review (NMFS and 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 SEIS for Amendment 18 (WPFMC 2009a), the 2008 BiOp (NMFS 2008a), and other sources cited below.

Although this species is listed globally (Table 1), it is difficult to characterize the global status and trend of leatherbacks on a global scale because the species consists of many discrete populations (see Section 5.3.1 below) that may increase or decrease independently of one another. The leatherback 5-year status review (NMFS and 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 and USFWS 2007b, 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).

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. Leatherbacks can forage in the cold temperate regions of the oceans, occurring at latitudes as high as 71° N and 47° S (Benson et al. 2011; Shillinger et al. 2008); however, nesting is confined to tropical and subtropical latitudes. 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 leatherback 5-year review (NMFS and USFWS 2007b) and the Turtle Expert Working Group's report on Atlantic leatherback (TEWG 2007). There are three demographic populations in the Pacific identified through genetic studies (Dutton et al. 1999, 2007): 1) a western Pacific population that nests in Papua Barat Indonesia, Papua New Guinea (PNG), Solomon Islands and Vanuatu, 2) an Eastern Pacific population that nests in Mexico and Costa Rica, and 3) a Malaysian population (Benson et al. 2011). All leatherback interactions with the Hawaii-based shallow-set longline fishery have been of western Pacific stock origin (Dutton unpublished).

The western Pacific leatherback metapopulation that nests in Papua Barat, Indonesia (formerly known as Irian Jaya), Papua New Guinea (PNG), Solomon Islands, and Vanuatu harbors the last remaining nesting aggregation of significant size in the Pacific with approximately 2700–4500 breeding females (Dutton et al. 2007; Hitipeuw et al. 2007). This metapopulation is made up of small nesting aggregations scattered throughout the region, with a dense focal point on the northwest coast of Papua Barat, Indonesia; this region is also known as the Bird's Head Peninsula where approximately 75% of regional nesting occurs (Hitipieuw et al. 2007). Genetic results to date have found that nesting aggregations that comprise the western Pacific population all belong to a single stock (Dutton et al 2007). The Bird's Head region consists of four main beaches, three that make up the Jamursba-Medi (JM) beach complex and a fourth which is Wermon beach (Dutton et al. 2007). Due to seasonal patterns of beach erosion, nesting occurs primarily at Wermon during the winter months (November to February) when the three beaches at Jamursba-Medi are gone. During the summer months (May to September)), the three beaches of JM are built up again and leatherbacks nest there at that time (Hitipieuw et al. 2007). Satellite tagging studies of leatherbacks from this metapopulation indicate that turtles that nest during different times of the year have different migration patterns. Summer nesting turtles (July through September) have tropical and temperate northern hemisphere foraging regions, while winter (November through February) nesters traverse to tropical waters and temperate regions of the southern hemisphere (Benson et al. 2011). Turtles nesting in Papua Barat, Indonesia during the summer months migrate through waters of Malaysia, Philippines, and Japan, across the Pacific past Hawaii to foraging grounds in temperate waters off North America (Benson et al. 2007a, b; Benson et al. 2011). This Papua Barat, Jamursba-Medi nesting population exhibits strong site fidelity to the central California foraging area (Benson et al. 2011) which puts them at risk of interacting with Hawaii-based longline fisheries during migrations. Primary impacts to this population in addition to U.S. commercial longline fisheries include: fishery interactions with international fleets within the Sulu Sulawesi and South China Seas and north Pacific Ocean, direct harvest of eggs and turtles, nest predation by feral animals (e.g., pigs and dogs), coastal development and village sprawl, coastal fishery impacts, beach erosion, low hatch success, marine debris entanglement and ingestion, and climate change (Benson et al. 2011; NMFS and USFWS 2007b; Bellagio Steering Committee 2008).

All 35 leatherbacks sampled so far as bycatch in the Hawaii-based shallow-set longline fishery are from the western Pacific population, based on genetic analyses. One of the 15 leatherbacks sampled so far as bycatch in the deep-set fishery 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 Barat (Benson et al. 2007a, b; Benson et al. 2011). 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 (3535/35) were of western Pacific origin (Table 2); (2) the one 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).

Western Pacific leatherbacks nest primarily in Papua Barat, Indonesia, 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 approximately 75% of nesting is concentrated at sites along the northwest coast of the Bird's Head Peninsula of Papua Barat Indonesia which includes Jamursba-Medi and Wermon beaches. The remainder of nesting 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 four countries, nesting data for more than 10 years are only available for the Jamursba-Medi site (hereafter referred to as the 'Jamursba-Medi component' of the western Pacific population). Jamursba-Medi is the only component of the metapopulation of sufficient monitoring duration that was modeled for analysis applied in this document (see section 7, Effects of the Action). The status and trends at Jamursba-Medi are described below, followed by a description based on the 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 laid annually between 1999 and 2006, making up approximately 38 percent of total estimated nesting for the western Pacific population during this time period (Dutton et al. 2007). Jamursba-Medi is comprised of three beaches that are monitored together as an index beaches. The other main beach on the north coast of the Bird's Head peninsula is Wermon. A number of other beaches are also known to support nesting activity such as the Manokwari region, but the most consistently monitored beaches of significant size are Jamursba-Medi and Wermon (Benson et al. 2007a; 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. 2007; Hitipeuw et al. 2007).

Nesting data from Jamursba-Medi are highly variable from year to year, and no data are available from 1998 due to a lack of survey effort that year. For the 17-year period 1993-2010, nesting fluctuated annually, with the overall trend slightly declining. The total number of nests per year for the Jamursba-Medi leatherback nesting population ranged between a high of 6,373 nests in 1996 and a low of 1,537 nests in 2010 (Hitipeuw et al. 2007; Tapilatu et al. unpublished). The average number of nests per female is unknown for western Pacific leatherback turtles; however, clutch frequency ranges from 4.3 to 7.9 (mean of 6.1) nests per female in Costa Rica (Reina et al. 2002). Assuming an average clutch size of 6.1, the number of nesting females per year between the 1996 high and 2010 low ranged between 1044–252 nesting annually. For the period from 2007-2010 the average number of nesters each year is 308 (Tapilatu et al. unpublished data). The total number of adult females in the Jamursba-Medi component was estimated at 1233 for the period 2007-2010 by Van Houtan (2011) (from

Tapilatu et al. unpublished data). Nest count methods and effort have been inconsistent, so there is an unknown level of error associated with nest counts. Independent nest counts made by a second research group from the same beaches during similar seasons between 2001 and 2007 were 31-38 percent lower than the data reported by Hitipeuw et. al. (2007) (NMFS 2008a).

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 Barat, 10 in PNG, 8 in the Solomon Islands, and 3 in Vanuatu). Approximately 62 percent of leatherbacks nesting in 1999-2006 occurred at these 27 sites, while the remaining 38 percent occurred at Jamursba-Medi, the largest nesting site.

Wermon beach of the Birds Head peninsula in Papua Barat, Indonesia produced approximately 30 percent of all western Pacific nests from 1999-2006 (Dutton et al. 2007). Peak leatherback nesting at Wermon occurs between November and March, with some variable levels of nesting in the summer, although significantly lower than Jamursba-Medi (Wurlianty and Hitipeuw 2007; Hitipeuw et al. 2007). Winter post-nesting females from Wermon migrated westward around Bird's Head Peninsula and then south into the Halmahera, Ceram or Banda Seas, or moved along the north side of New Guinea and then southeast into waters of the western south Pacific Ocean and Tasman Sea, whereas summer post-nesting females from Jamursba-Medi headed to the temperate north Pacific Ocean or into tropical waters of the South China Sea (Benson et al. 2011). Anecdotal information indicates that there may be a small number of animals that utilize both Wermon and Jamursba-Medi beaches during a nesting season (Tapilatu, pers. comm.; Benson, pers. comm.. 2011). Nesting beach monitoring at Wermon began in November 2002 and ran through June 2003 with 1,788 nests recorded (Hitipeuw et al. 2007). Monitoring was conducted again from November 2003 through September 2004 which resulted in the highest number of nests recorded for 2003-04 totaling 2,881 nests (Hitipeuw et al. 2007). Monitoring resumed in November 2004 and continued year round thereafter. Nesting declined during 2005 to approximately 1,300 nests (Wurlianty and Hitipeuw 2007) and has remained somewhat stable since then (NMFS 2011d). It is possible there may have been a learning curve to overcome by the community-based rangers. Hence it is unknown if the apparent decline in nesting activity is due to such a learning curve, is an actual decline in nesting activity, or is representative of typical annual sea turtle nesting variability. Long-term standardized monitoring at Wermon is needed to adequately assess trends. Impacts from threats to the Wermon nesting aggregation are consistent with those occurring at Jamursba-Medi, although the mean hatching success rates are higher (e.g., Jamursba-Medi at 25.5 percent and Wermon at 47.1 percent) (Bellagio Steering Committee, 2008).

The Huon Coast of PNG hosts an estimated 50 percent of leatherback nesting in that country which occurs primarily between November and March (Benson et al. 2007). Nesting also occurs on Bougainville, the south coast of West New Britain Province and the north coast of the Madang Province (Benson et al. 2007). Benson et al. (2007) aerial surveys recorded 58 nests on Bougainville. In January 2009, an expedition to Bougainville Island to survey beaches identified 46 leatherback nests during the peak nesting period with a high level (83-100%) of nest harvest and relatively frequent harvest of adult leatherback turtles (Kinch 2009). Post-nesting females satellite tagged in PNG migrated into the southern hemisphere, southward through the Coral Sea, into waters of the western south Pacific Ocean (Benson et al. 2011).

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 (Hirth et al. 1993). The average remigration interval (period since last nesting season along the Huon coast) is 3 years, with substantial variation ranging from 1 to 7 years (Pilcher 2010a). During the 2010-11 nesting season, 79 leatherback turtles nested laying a total of 527 nests (Pilcher 2011). Of these females, 30 were remigrants (turtles from previous seasons), 15 were new turtles never tagged before, and 34 were renesting events for turtles already identified previously in the season (Pilcher 2011). Between 2003 and 2006 the Huon Coast Leatherback Turtle Conservation Program (HCLTCP) expanded to incorporate more nesting habitat at the Kamiali nesting area and six additional communities. As a result, nesting trends are reflective of increased monitoring effort. The most reliable trend information begins from the 2006 - 07 nesting season, and since then nesting activity has been stable or slightly increasing (Pilcher 2011). However, total nest counts for these years reflect a decline of approximately 93% in nesting activity since 1980 estimates (Pilcher 2009).

The Solomon Islands support leatherback nesting (Bellagio Steering Committee 2008) that 30 years ago was widely distributed across at least 15 beaches (Vaughan 1981). Dutton et al. (2007) estimated that approximately 640 - 700 nests were laid annually in the Solomon Islands in 1999 – 2006. Important nesting areas remain on Isabel Island at two principal beaches, Sasakolo and Litogarhira, with additional nesting occurring on Rendova and Tetepare in the Western Province (Dutton et al. 2007). Nesting activities in these primary locations occur during November to March, although there are reports of nesting from May to August both within the Solomon Islands and PNG that warrant further investigation. Additionally, one of 37 foraging leatherbacks outfitted with a satellite transmitter in California waters migrated to the Solomon Islands and nested at Santa Isabel Island in May providing additional evidence of a summer breeding population linkage between the western Pacific region and California foraging habitats (Benson et al. 2011).

Nesting beach monitoring began in 1993 at Sasokolo by the Department of Fisheries where an average of 25 nesting females deposit approximately 100 nests per season (Ramohia et al. 2001; Pita 2005). The Tetepare Descendants' Association (TDA) turtle monitoring program has operated since 2002 supporting beach rangers to monitor nesting activity at Tetapare and Rendova and has permanently closed a 13 km beach to harvest. At Tetapare, approximately 30-50 leatherback turtle nests are laid seasonally (Mckay 2005; Goby et al. 2010; Pilcher 2010b). At Rendova, 79 nests were laid during the 2009-10 winter nesting season of which only three hatched (Goby et al. 2010), and during the 2003-04 winter nesting season, 235 leatherback turtle nests were recorded of which only 14 hatched (Pilcher 2010b), strongly suggesting that low hatch success poses significant impact to the current nesting population in the Solomons. 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 (Bellagio Steering Committee 2008, NMFS 2008a).

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 four or five beaches with a total of approximately 50 nests laid per year (Dutton et al. 2007).

5.3.1.3 Summary for Western Pacific Population

Population estimates for sea turtles are problematic due to a lack of demographic information. Few population estimates are available, especially for the Pacific. 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 population was estimated to be within the range of 2,110 – 5,735 adult females (Dutton et al. 2007). Due to the uncertainty of the assumptions used to derive sea turtle population estimates, in this opinion NMFS uses nesting or nesting female data for population indices, as recommended by Dutton et al.(2007). NMFS estimates that there are approximately 1233 nesting females in the Jamursba – Medi component, which represents approximately 38% of the Western Pacific population, which means that there are approximately 3245 nesting females in the Western Pacific population (Van Houtan 2011, Dutton et al. 2007; Tapilatu unpublished data).

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 and USFWS 2007b, 2008a). 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; Benson et al. 2011). Given that the action area is oceanic, the main aspects of western Pacific leatherback 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 (Van Houtan 2011). In recent years, nesting females of the western and eastern Pacific populations have been tagged with satellite-linked transmitters, allowing tracking of their post-nesting migration routes. A portion of western Pacific leatherbacks nesting during June through August in Papua Barat go northeast, passing through the action area on their way to productive temperate waters off the west coast of the U.S. (Benson et al. 2007a; Benson et al. 2011). In contrast, leatherbacks nesting during November through March in Papua Barat, PNG, and Solomon Islands migrated southeast after nesting, towards Australian and New Zealand waters (Benson et al. 2007b; Benson et al. 2011). Additionally, seven of the 25 turtles with tracks of sufficient duration (28%) sampled in California waters migrated westward, presumably towards western Pacific nesting beaches (Benson et al. 2011). Eastern Pacific leatherbacks are not known to migrate through the action area after nesting; rather, they migrate south to foraging areas off 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 less understood for western and eastern Pacific leatherbacks, although 10 males were tagged with satellite-linked transmitters at California foraging grounds. Movements were similar to those of female leatherbacks tagged off California (Benson et al. 2011).

Adult leatherbacks typically feed on pelagic soft-bodied animals, especially sea jellies, 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 less than 80 m, thus primary foraging depth overlaps with fishing depth of the Hawaii-based shallow-set fishery (Shillinger et al. 2011). 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 5-year review (NMFS and 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), and the Proceedings of the Bellagio Sea Turtle Conservation Initiative (Bellagio Steering Committee, 2008). Major threats to the species, according to these documents, are fisheries bycatch, alteration of nesting habitat, and direct harvest and predation, which are briefly described below. In addition, climate change and marine debris may be a growing threat to this species, and is described 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. Before 2001 in the north Pacific, the Hawaii-based longline fishery was estimated to capture about 110 leatherbacks annually (McCracken 2000). If we apply the old mortality rate of 32% (Gilman 2007), this would give us an estimated mortality of 36 (110*32%= 35.2) annually before the shallow-set portion of the fishery was closed in 2001. The Hawaii longline fishery subsequently reopened in 2004 and was subject to a number of management measures that were designed to minimize bycatch and post-hooking mortality. The 2004 management measures have proven to reduce leatherback interaction rates by 83% (Gilman et al. 2007a, WPFMC 2008). Since the shallow-set fishery re-opened in 2004, 12 (rounded up from 11.21) estimated leatherback mortalities occurred in the shallow-set fishery (NMFS 2011a). All of the leatherbacks caught were released alive; mortality estimates come from applying the NMFS post-hooking mortality criteria (NMFS 2006b) to interactions. The Hawaii-deep set fishery occasionally interacts with leatherbacks and has an incidental take statement for up to 39 anticipated leatherback interactions and 18 anticipated mortalities over a three year period (NMFS 2005). In the deep-set fishery from 2005-2010, 17 (rounded up from 16.57) mortalities are estimated to have occurred (NMFS 2011c). Since 2004, the Hawaii-based longline fisheries combined have reduced their estimated mortality to five annually (NMFS 2011a, b, and c). 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. The California Oregon drift gillnet fishery has an incidental take statement for up to 3 anticipated leatherback interactions and 2 anticipated estimated mortalities annually (NMFS 2004c). Since 2001, one leatherback was observed taken and released unharmed in October, 2009 in the drift gillnet fishery. In addition, coastal fisheries using gillnets or trap nets are also resulting in high mortality (NMFS and 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 reduce suitability of nesting beaches for nesting by reducing beach size. Beach armoring is typically done to protect coastal development from erosion during storms, but armoring blocks turtles from accessing nesting areas and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards 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 reducing emergence success. Fortunately, some major nesting beaches for leatherback turtles, including those for the western Pacific population, occur in remote areas where development as described above is less prevalent (NMFS and USFWS 2007b).

Harvest of leatherbacks for their meat and eggs has resulted in the extirpation of major nesting aggregations, such as what 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 primary nesting beaches. Predation of eggs is a major problem for western and eastern Pacific leatherbacks, for example by feral pigs in Papua Barat and feral dogs in PNG (NMFS and USFWS 2007b). Impacts and threats to leatherback turtle conservation and recovery in Papua Barat include: exploitation of turtles and eggs, chronically low hatchling production as a result of predation (pigs, dogs, and monitor lizards), inundation, beach erosion, and lethal incubation temperatures (Starbird and Suarez 1996; Hitipeuw et al. 2007; Tapilatu and Tiwari 2007; Bellagio Steering Committee, 2008). While efforts are underway to coordinate and standardize conservation and monitoring work, there is a need to establish an advisory committee consisting of local stakeholders and to encourage local management authorities to become actively engaged in oversight of nesting beach programs (Bellagio Steering Committee, 2008). Despite successes achieved through the HCLTCP described above, information indicates continuing impacts to leatherbacks from egg and adult harvest and domestic dog predation in Huon coast communities not part of the project, along with continuing broad-scale impacts from beach erosion, wave inundation, and village sprawl (Bellagio Steering Committee, 2008; Pilcher 2009). Adult leatherbacks are opportunistically hunted for meat in some areas of Vanuatu. In addition, leatherback eggs are occasionally collected from these beaches (Bellagio Steering Committee 2008, NMFS 2008a).

Marine debris is also a source of concern for leatherbacks due to the reasons described for loggerheads. Leatherbacks can ingest small debris and larger debris can entangle animals leading to death. For leatherbacks the greatest risk is in the pelagic environment but there is no information to quantify what the impacts are.

Although leatherbacks are probably already beginning to be affected by impacts associated with anthropogenic climate change in several ways, no significant climate change-related impacts to leatherback turtle populations have been observed to date. However, over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Paremsan and Yohe 2003). In the same study described above for loggerheads, leatherbacks show an increasing trend in the population over the next 25 years. The PDO was used to provide insight into neonate survival which was the same for loggerheads but instead of SST being used as a breeding cue for adult females, the ocean coastal upwelling index that describes the California Current dynamics was used (Van Houtan 2011). This study found that changes in leatherback nesting populations over the last approximately 20 years are correlated with ocean oscillations (PDO) due to environmental influences on juvenile recruitment. In the next 25 years, leatherbacks in the western Pacific are projected to increase by 82% due to favorable conditions in the PDO in recent years. Beyond 25 years we do not have information to predict what the population will do. The study discussed above by Polovina *et al.* (2011), indicates that primary production in the southern biome and in the California current ecosystem are expected to increase by the end of the century (Rykaczewski and Dunne 2010) which may benefit leatherbacks. Increases in their primary prey source, sea jellies, due to ocean warming and other factors (Brodeur et al. 1999; Attrill et al. 2007; Richardson et al. 2009) may occur which may or may not impact leatherbacks as there is no evidence that any leatherback populations are currently food-limited. Even though there may be a benefit to leatherbacks due to climate change influence on productivity we do not know what impact other climate-related changes may have such as increasing sand temperatures, sea level rise, and increased storm events.

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, modifying existing gear (e.g., reducing mesh size of gillnets), and developing and promoting Sea Turtle Handling Guidelines (NMFS and USFWS 2007b). For example, switching to large circle hooks and mackerel bait in 2004 resulted in an approximately 83 percent reduction in the leatherback interaction rate in the Hawaii shallow-set longline fishery (Gilman et al. 2007a, WPFMC 2009). PIR offices in particular, have supported a significant number of international fishery-based projects to identify and promote effective sea turtle bycatch mitigation measures (e.g., circle hooks) or other gear modifications. In the Pacific, such projects have occurred in: Indonesia, Vietnam, Papua New Guinea, Solomon Islands, Malaysia, Palau, Marshall Islands, Federated States of Micronesia, and throughout Latin America in association with the IATTC. Much of this work has been coupled with capacity-building, training, and implementation of regional observer programs aimed to improve the quality of catch and bycatch information from international fleets to better address the requirements of RFMO Conservation and Management Measures (CMMs) (of the WCPFC and IATTC). NMFS together with other regional partners will continue working within the context of RFMOs and U.S. laws to modify and improve international sea turtle bycatch mitigation requirements.

NMFS and partners (including the WPFMC) have been involved in leatherback turtle research and conservation activities in the western Pacific for nearly a decade supporting projects to understand and bolster survivorship, reduce harvest or predation, and to address other priority actions identified in the U.S. Pacific Leatherback Turtle Recovery Plan (NMFS and USFWS 1998d). Efforts to recover leatherbacks have been hampered by naturally occurring phenomena, including seasonal spring tide inundation of nests and large earthquakes. A myriad of land ownership, beach access, and local village politics have also hampered monitoring and conservation efforts in all countries. The NMFS continues to work toward achieving support and developing fruitful partnerships for leatherback conservation throughout the region and has made substantial progress toward understanding population structure and threats. Progress has been achieved by building capacity among international colleagues, implementing studies on the economics of conservation, engaging and supporting nesting beach conservation activities and mitigation measures that include hatching success studies, implementing and encouraging PIT (Passive Integrated Transponder) tagging as a necessary tool to determine annual nesting estimates, undertaking aerial surveys and satellite telemetry research to assess habitat use, and utilizing innovative molecular techniques (genetics and stable isotopes) to assess stock structure and connectivity.

Community-based village rangers at Wermon and Jamursba-Medi in Papua Barat have been hired over the past decade to collect population demographic data (tag turtles and record nesting activity). Through their presence on the beach, projects have been able to guard leatherback nests from predation by feral pigs and egg collectors. In Wermon, for example, during the 2006-07 nesting season the project used a few bamboo grids over nests as protection from dog predation (Bellagio Steering Committee 2008), however alternative protection measures are being investigated. Bamboo grids have been an effective conservation measure for the PNG project (Pilcher 2006). Prior to 2002, 100% of nests laid at Wermon beach were lost as a result of harvest (60%) or predation (40%) (Starbird and Suarez 1996). Therefore, as a result of monitoring efforts the Wermon project may have protected over 12,000 nests that have been laid since the project's inception (NMFS 2011d). Community support in the form of scholarships and church repairs has been provided to encourage local participation in leatherback conservation. Other community-based initiatives are currently being developed and coordinated among the groups working in Papua. From 2003 to 2007, the WPFMC supported a project at the Kei Kecil Islands of Papua Barat Indonesia to assess and help reduce traditional harvest of adult leatherbacks in coastal foraging habitats. Suarez and Starbird (1995) estimated that this traditional fishery captured at least 100 leatherbacks per year, however, the Kei Islands project acquired a more accurate harvest estimate of less than 50 turtles per year with the majority being juveniles or subadults (Lawalata and Hitipeuw 2006).

In PNG, the community-based HCLTCP has monitored nesting activity, implemented conservation measures to protect nests from dog predation (e.g., bamboo grids), and has worked to reduce localized harvest through community development incentives (CDI) since its inception in 2003. Through CDI, communities at large experience the benefits of the leatherback turtle project over time even if they themselves have not personally gained (financially or otherwise) from the project's existence, but in many cases may have relinquished resource utilization by agreeing to participate in conservation efforts (i.e. no harvest). CDI projects to date have included repairing or improving fresh water supplies, building or expanding school facilities, repairing traditional village meeting houses, and developing or improving church and aid outpost facilities (Pilcher 2011). As a result, nest predation and harvest of eggs has been reduced and hatchling production has increased over time in associated communities from close to 0% to approximately 70% as a result of the CDI program and concurrent efforts to implement nest protection measures (Pilcher 2009). During the 2010-11 nesting season, the average hatching success rate was quantified to be 44.0%, resulting in an overall conservative estimate of 80,000 hatchlings released since the project's inception (Pilcher 2011; NMFS 2011d).

In the Solomon Islands, a program has been initiated at Sasakolo and Litogarhira to relocate nests that would otherwise be destroyed by beach erosion, high sand temperatures, illegal harvest and predation in order to increase hatchling production (a collaborative project between SWFSC and The Nature Conservancy, with additional funding support from the International Sustainable Seafood Foundation and the Ocean Foundation). Additionally, the Tetepare Descendents Association (TDA) has closed 13 km of beach to harvest, continues to protect and monitor nests, and is obtaining training, guidance and encouragement through collaborations with relevant NMFS staff. Further, efforts are currently underway to launch assessment and monitoring activities with communities that have summer nesting activities.

In Vanuatu, while leatherback turtle nesting is limited or unknown, especially on more remote islands, NMFS has supported a local NGO, Wan Smolbag, to train local villagers to monitor nesting activity, conserve leatherback nesting beaches, and educate local communities to protect leatherbacks and their nests from direct harvest of nesting females and their eggs.

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. In 2008 the Western and Central Pacific Fisheries Commission (WCPFC) adopted a Conservation and Management Measure (CMM 2008-03) to mitigate the impacts on turtles from longline swordfish fisheries in the Western Central Pacific Ocean. The measure includes the adoption of FAO guidelines to reduce sea turtle mortality through safe handling practices and to reduce bycatch by implementing one of three methods by January 2010. The three methods to choose from are: 1) use only large circle hooks, 2) use whole finfish bait, or 3) use any other mitigation plan or activity that has been approved by the Commission. As a result of these designations and agreements, many intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been reduced at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to reduce the take of turtles in foraging areas (Gilman et al. 2007b; NMFS and 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 2008 BiOp (NMFS 2008a), the olive ridley 5-year status review (NMFS and USFWS 2007c), the SEIS for Amendment 18 (WPFMC 2009), 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. Population structure and genetics are poorly understood for this species, but populations occur in at least the eastern Pacific, western Pacific, eastern Indian Ocean, central Indian Ocean, western Indian Ocean, West Africa, and the western Atlantic (NMFS and USFWS 2007c). The eastern Pacific population includes nesting aggregations on the coast of Mexico, which are listed under the ESA as endangered. All other olive ridleys are listed as threatened (Table 1). The Hawaii-based deep-set longline fishery interacts with olive ridley turtles, but interactions in the shallow-set fishery are rare. Of the interactions in the shallow-set fishery since 2004, 100% of analyzed olive ridley genetic samples are from the eastern Pacific population. However, given historic interactions (Table 2) a proportion of interactions may also occur with the western Pacific population which is genetically similar to haplotypes identified in Sri Lanka, Malaysia and India (Dutton pers.comm..).

The eastern Pacific population is thought to be increasing, while there is inadequate information to suggest trends for other populations. The global status of olive ridleys is described in the 5-year status review (NMFS and USFWS 2007c). While olive ridleys are the most common turtle species that interacts with the Hawaii-based deep-set longline fishery, they are very uncommon in the shallow-set fishery. Thirteen genetic samples have been collected and analyzed from individuals caught in the shallow-set fishery since 1995; seven were from the eastern Pacific population and six were from the western Pacific population (Table 2).

Eastern Pacific olive ridleys nest primarily in large *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 and 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. The 5-year status review (NMFS and USFWS 2007c) describes arribadas occurring in northeastern India at Gahirmatha and Ryshikulya, with 1,000 to 100,000 turtles and 10,000 to 200,000 turtles, respectively, occurring per arribada. A number of other locations in western and eastern India are also described as sites of potential solitary nesting activity, but nesting activity is unquantified at these locations (NMFS and USFWS 2007c). Survey effort on India beaches has fluctuated over the years and methods used to census nesting populations have also changed. As a result, reported trends and abundance numbers may be somewhat speculative and potentially unreliable. The most reliable abundance estimate for Gahirmatha during the 1999 arribada was approximately 180,000 nesting females, with long-term data indicating the population may be in decline (NMFS and USFWS 2007c). 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 (Limpus and Miller 2008). Data are not available to analyze trends (NMFS 2005; NMFS and USFWS 2007c).

The once large nesting populations of olive ridleys that occurred in peninsular Malaysia and Thailand have been decimated through long term over-harvest of eggs (Limpus and Miller 2008). The species nests in low numbers at many sites in Indonesia and is only rarely encountered nesting in the Republic of the Philippines or Papua New Guinea (Limpus et al. 2008). While the Australian olive ridley nesting distribution and population size remains to be fully evaluated, a few thousand females may nest annually in the Northern Territory (Limpus and Miller 2008). There is no evidence to suggest that the current nesting numbers in Australia are the remnant of a population that has declined substantially within historical times (Limpus and Miller 2008).

5.4.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Life history of eastern Pacific olive ridleys is characterized by juvenile and adult stages occurring in the oceanic zone. Along with leatherbacks, olive ridleys are the most pelagic of all sea turtle species (NMFS 2004a, 2005, 2006a; 2008a, NMFS and 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 reduce the likelihood of olive ridleys interacting with this fishery, as discussed below.

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, 2004, NMFS 2006a). Therefore, in contrast to loggerheads, foraging in deep water and a distribution generally to the south of the action area provide some spatial separation of olive ridleys from the Hawaii-based shallow-set fishery, resulting in very low olive ridley bycatch rates.

5.4.3 Threats to the Species

Global threats to olive ridley turtles are spelled out in the 5-year status review (NMFS and USFWS 2007c). Major threats to the species, according to this document, are direct harvest and fishing bycatch, which are briefly described below. Climate change and marine debris may also be a growing threat to this species, as it is for other sea turtle species and is discussed below.

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. Unsustainable harvest led to extirpation of major *arribadas*, such as at Mismaloya and Chacahua in Mexico by the 1970s, prompting listing of these nesting aggregations as endangered under the ESA and their protection in Mexico since 1990. Globally, 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 India (NMFS and USFWS 2007c).

A major threat to olive ridley 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 of dead adults wash up on the coast annually (NMFS and USFWS 2007c). In the eastern Pacific, fishery interactions are a major threat to the species, primarily because of development of a shrimp trawl fishery along the Pacific coasts of Central America starting in the 1950s, which is thought to kill tens of thousands of olive ridleys annually. In addition, the growth in longline fisheries in the region over 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). Threats to olive ridleys in Australia include high bycatch in gillnet and trawl fisheries, ghost net entanglement, egg loss due to pig and dog predation, and significant egg harvest as a result of Indigenous practices (Limpus and Miller 2008).

The Hawaii shallow-set fishery rarely interacts with olive ridleys and since 2004, only three have been incidentally caught. All three were released alive. The Hawaii-deep set fishery interacts with olive ridleys and has an incidental take statement for up to 121 anticipated olive ridley interactions and 117 anticipated mortalities over a three year period (NMFS 2005). However the interactions that have occurred in the fishery since 2005 are lower. Between 2005 and 2010 there were 142 olive ridley interactions in the deep-set fishery and from this the estimated mortality is 136 (McCracken 2006-2010; NMFS 2011b). The California Oregon drift gillnet fishery has an incidental take statement for up to 4 anticipated olive ridley interactions and 1 anticipated estimated mortality annually (NMFS 2004c). Since 2001 no olive ridleys have been captured in the California Oregon drift gillnet fishery.

As with the other species discussed above, no significant climate change-related impacts to olive ridley turtle populations have been observed to date. However, over the long-term, climate change-related impacts will likely influence biological trajectories in the future on a century scale (Paremsan and Yohe 2003). Only limited data are available on past trends and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species.

Marine debris is also a source of concern for olive ridleys due to the same reasons described for loggerheads. Olive ridleys can ingest small debris and larger debris can entangle animals leading to death. For olive ridleys the greatest risk is when they are in the pelagic environment but there is no data to quantify what the impacts are.

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 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). However, enforcement is reported to be lacking in both areas (Frazier et al. 2007, Shankar et al. 2004).

Between 2004 and 2007, the 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 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 (Largacha et al. 2005; Hall et al. 2006). This project ended in 2007 and no follow up study has been initiated to assess continued use of circle hooks or dehooking and safe handling methods.

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. Within the WCPFC, NMFS has worked to modify and improve international bycatch mitigation requirements and aided in establishing a binding Sea Turtle Conservation Measure implementing the FAO Guidelines (e.g., circle hooks and safe handling measures) which has likely helped reduce interactions and improve survivorship in international longline fisheries. As a result of these designations and agreements, many of the intentional impacts on olive ridleys have been reduced: harvest of eggs and adults have been reduced at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to reduce the take of turtles in foraging areas (Gilman et al. 2007b; NMFS and 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 2008 BiOp (NMFS 2008a), the 2010 BiOp (NMFS 2010d), the green turtle 5-year status review (NMFS and USFWS 2007d), and the SEIS for Amendment 18 (WPFMC 2009), and other sources cited below.

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 5-year review (NMFS and 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 and 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; Maison et al. 2010). The eastern Pacific population includes turtles that nest on the 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 (Table 1).

The Hawaii-based shallow-set longline fishery occasionally interacts with green turtles. Eight turtles have been sampled so far as bycatch in this fishery; four were from the Hawaii component of the central Pacific population, while the other four were 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 17 turtles that have been sampled from this fishery, 12 were from the eastern Pacific population, two were from the western Pacific population, two were from the Hawaii component of the central Pacific, and one was of indeterminate origin (from either Hawaii or eastern Pacific populations) (Table 2).

The Hawaii component nests exclusively in the Hawaiian Archipelago, with over 90 percent of nesting at French Frigate Shoals (FFS) in the Northwestern Hawaiian Islands. Adults migrate greater than 1,000 km between foraging areas in the Main Hawaiian Islands (MHI) and the FFS nesting area. Since initial nesting surveys at the FFS index beach in 1973, there has been a marked increase in annual green turtle nesting (Balazs and Chaloupka 2004). The increase over the last 30+ years corresponds to an underlying near-linear increase of about 5.7 percent per year (Chaloupka et al. 2007). Between 1973 and 2011, nesting activity has been variable – as is typical of green turtle nesting dynamics, ranging between a low of 67 in 1973 and an all time high of 808 nesting females observed during the 2011 six week sampling period at East Island, FFS (with a total estimate of 843 nesters for the season) (NMFS-PIFSC unpublished). In-water abundance of green turtles is consistent with the increase in nesting trends (Balazs 1996; Balazs and Chaloupka 2004; Chaloupka et al. 2007). In addition, there has been a dramatic increase in the number of basking turtles in the MHI and throughout the Northwestern Hawaiian Islands (Balazs 1996; Balazs and Whittow 1982; Parker and Balazs 2011). Long-term monitoring of the population indicates a strong degree of island fidelity exists 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; Dutton et al. 2008). This linkage has been firmly established through genetics, satellite telemetry, flipper tagging and direct observation (Balazs 1983, 1994; Leroux et al. 2003; Dutton et al. 2008). More information is available on green turtle population and trends in the 5-year review (NMFS and USFWS 2007d). The increase of the long-term nester trend can be attributed to increased survivorship (since harvesting of turtles in foraging grounds was prohibited in the mid-1970s) and cessation of habitat damage at the FFS rookery since the early 1950s (Balazs and Chaloupka, 2004).

Eastern Pacific green turtles nest on at least the 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 (NMFS and USFWS 2007d), and nesting has been steadily increasing at the primary nesting sites in Michoacan, Mexico, and in the Galapagos Islands since the 1990s (Delgado and Nichols 2005; Senko et al. 2011). Recent information suggests that up to 10,000 nesting females may nest annually at Michoacan (SWOT 2011). Colola beach is the most important green turtle nesting area in the eastern Pacific; it accounts for 75% of total nesting in Michoacan and has the longest time series of monitoring data since 1981. Nesting trends at Colola have continued to increase since 2000 with the overall eastern Pacific green turtle population also increasing at other nesting beaches in the Galapagos and Costa Rica (Wallace et al. 2010; NMFS and USFWS 2007d).

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. After hatching, juveniles spend at least several years in pelagic areas where they feed primarily on small invertebrates. Between 6 to 10 years of age, at approximately 40 cm curved carapace length, most green turtles recruit to coastal habitats. However one recent study has shown that some green sea turtles don't recruit to nearshore areas until they are around 70 cm; curved carapace length they move between open ocean areas and nearshore regions. This appears to be most prevalent with eastern Pacific greens (Parker et al. 2011).

Adults forage in shallow coastal areas, primarily on algae and seagrass. Unlike other sea turtle species, 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 (NMFS 2004a, 2005, 2006a; NMFS and USFWS 2007d). However, as described above in Section 4 (Description of Action Area), the proposed action includes waters of the Hawaiian Islands although longline fishing does not occur within approximately 25 to 75 nm from the Main Hawaiian Islands, depending on the location and season. Adults migrate directly between the MHI and FFS (Balazs 1994), but the proposed action is unlikely to encounter many migrating adult green turtles from the Hawaii component of the central Pacific population. Green turtles from this region are expected to reach maturity at approximately 80 cm straight carapace length (SCL) (Zug et al. 2002). In 2011, one 88.5 cm SCL green turtle (PIRO Observer program, unpublished data) from the Hawaii population (Dutton, personal communication) was incidentally caught. The other two turtles incidentally caught from this population were both less than 40 cm SCL. The adult that was incidentally caught was north of French Frigate Shoals, in the southern portion of the action area and generally an area with less effort. All three turtles from the eastern Pacific population that were incidentally caught were less than 70 cm SCL (PIRO Observer Program, unpublished data). Therefore we expect that the main aspect of green turtle life history affecting their vulnerability to Hawaii-based shallow-set longline fishing is juveniles utilizing oceanic habitats.

Although foraging juvenile green turtles are more likely to interact with the Hawaii-based shallow-set fishery than adults, green turtle interactions are rare compared to the Hawaii-based deep-set fishery. Because very little is known of juvenile green turtle pelagic habitat use or foraging behavior, reasons for fewer incidents of green turtle bycatch in the shallow-set fishery versus the deep-set fishery are unknown. 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), if juvenile green turtles are simply scarce in the action area, or if some other 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 and USFWS 2007d). 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 and marine debris may also be a growing threat to this species, as it is for other sea turtle species and is discussed below. The 5-year review also identifies boat collisions as threats to green turtles in Hawaii.

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 coastal development from erosion during storms, but armoring blocks turtles from accessing nesting areas and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards 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 reducing emergence success. Sea level rise threatens to erode coastal habitat, including nesting habitats. In Hawaii, the majority of nesting occurs on FFS, a low-lying atoll vulnerable to increases in sea level (Baker et al. 2006). 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 and USFWS 2007d).

Another threat to green turtles in Hawaii is fibropapillomatosis (FP), which causes debilitating tumors of the skin and internal organs. FP is the most significant cause of stranding and mortality in green turtles in Hawaii, accounting for 28% of standings', and has an 88% mortality rate in stranded afflicted turtles (Chaloupka et al. 2008). While the disease appears to have regressed over time (Chaloupka et al. 2009) it persists in the population at varying spatial scales (Van Houtan et al. 2010). Van Houtan et al. (2010) suggest a potential relationship exists between the expression of FP and the State's land use, waste-water management practices and invasive macroalgae.

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 and recreational fisheries gear (Nitta and Henderson 1993; Chaloupka et al. 2008). 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 and USFWS 2007d). Industrial fisheries also interact with green turtles, especially juveniles, like in the Hawaii-based deep-set and American Samoa longline fisheries. The Hawaii shallow-set fishery rarely interacts with green turtles and since 2004, only six have been incidentally caught. All six were released alive. The Hawaii-deep set fishery occasionally interacts with green turtles and has an incidental take statement for up to 21 anticipated green interactions and 18 anticipated mortalities over a three year period (NMFS 2005). However the interactions that have occurred in the fishery since 2005 are lower. Between 2005 and 2010 there were 7 green interactions in the deep-set fishery and from this the estimated mortality is 7 (rounded from 6.34) (McCracken 2006-2010; NMFS 2011b). The California Oregon drift gillnet fishery has an incidental take statement for up to 4 anticipated green interactions and 1 anticipated estimated mortality annually (NMFS 2004c). Since 2001 no green turtles have been captured in the California Oregon drift gillnet fishery.

Harvest of green turtles for their meat, shells, and eggs has been a major factor in past declines of green turtles, and continues to be a major threat in some areas, for example a legal fishery operating 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, illegal adult harvest continues but at lower rates today than in the past (Gardner and Nichols 2001; Koch et al. 2006; Senko et al. 2011). The curio trade in Southeast Asia also harvests a large but unknown number of green turtles annually (NMFS and USFWS 2007d).

Green turtles forage in shallow areas, surface to breath, and often occur just below the surface. The majority of turtles in coastal areas spend their time at depths less than 5 m below the surface (Schofield et al. 2007, Hazel et al. 2009), and hence are vulnerable to being struck by vessels. A study completed in Australia found the proportion of green turtles that fled to avoid an approaching vessel increased significantly as vessel speed decreased (Hazel et al. 2007). Sixty percent of observed turtles encountered during low speed trials (2.2 knots) fled the approaching vessel. Flight response dropped to 22 percent and 4 percent at moderate (5.9 knots) and fast (10.3 knots) vessel speeds, respectively. Those that fled at higher vessel speeds did so at significantly shorter distances. The results implied that sea turtles can not be expected to actively avoid a vessel traveling faster than 2.2 knots. The authors suggested that visual rather than auditory cues were more likely to provoke a flight response and that vessels transiting at slower speeds can assure a "turtle-safe" transit so both turtles and vessels have time to evade collisions (Hazel et al. 2007).

Although green turtles are probably already beginning to be affected by impacts associated with anthropogenic climate change in several ways no significant climate change-related impacts to green turtle populations have been observed to date. However, impacts from climate change are likely to influence biological trajectories in the future over the long-term, on a century scale (Paremsan and Yohe 2003). For example, increasing temperatures at nesting beaches may impact sex ratios of hatchlings (many rookeries already exhibit strong female bias (Binckley et al. 1998; Chan and Liew 1995; Godfrey et al. 1996; Godfrey et al. 1999; Godley et al. 2001; Kaska et al. 2006; Marcovaldi et al. 1997; Oz et al. 2004) and/or increase embryonic mortality (Matsuzawa et al. 2002). Increased nest mortality has also been linked to erosion due to increased typhoon frequency (Van Houtan and Bass 2007) and intensity, a predicted consequence of climate change (Webster et al. 2005). Seagrasses are a major food source for green turtles worldwide. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise and salinity and temperature changes (Short and Neckles 1999; Duarte 2002). Climate change induced shifts in ocean productivity linked to temperature changes (Harwood 2001; Edwards and Richardson 2004; Hays et al. 2005) may affect foraging strategies and therefore reproductive capacity for green turtles (Solow et al. 2002) similar to what has been observed during El Nino events in the western Pacific (Limpus and Nicholls 1994; Chaloupka 2001). While there are some available data on past trends, these data are limited, and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species.

Marine debris is also a source of concern for greens due to the same reasons described for loggerheads. Green sea turtles can ingest small debris and larger debris can entangle animals leading to death. For greens the greatest risk is most likely when the debris is closer to the Northwest and main Hawaiian Islands where there are large numbers of turtles.

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 improvements made in the Hawaii-based longline fisheries since 2004 (NMFS and USFWS 2007d).

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. Within the WCPFC, NMFS has worked to modify and improve international bycatch mitigation requirements and aided in establishing a binding Sea Turtle Conservation Measure implementing the FAO Guidelines which has likely helped to reduce interactions and improve survivorship in international longline fisheries. As a result of these designations and agreements, many intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been reduced at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to reduce the take of turtles in foraging areas (Gilman et al. 2007b; NMFS and USFWS 2007d).

6 Environmental Baseline

The environmental baseline for a biological opinion includes past and present impacts of all state, federal or private actions and other human activities in the action area, 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 and NMFS 1998). The purpose of describing the environmental baseline in this manner in a biological opinion is to provide context for effects of the proposed action on listed species.

The past and present impacts of human and natural factors leading to the status of the five species addressed by this opinion within the action area include fishery interactions, vessel strikes, climate change, pollution, marine debris, and entanglement. The environmental baselines for the five ESA-listed marine species addressed by this opinion (humpback whale and the four sea turtles) are described below.

6.1 Humpback Whales

Information in this section is summarized from the humpback whale Stock Assessment Reports (e.g., Allen and Angliss 2010), the humpback whale recovery plan (NMFS 1991), the SPLASH report (Calambokidis et al. 2008), the MMPA Section 101 (a)(5)(E)-Negligible Impact Determination, the Global Review of Humpback Whales (NMFS 2011f), and other sources cited below. The primary past and present impacts of human activities within the action area on the Central North Pacific (CNP) humpback stock are fishery interactions and ship strikes. Estimated annual minimum mortality rates from fishery interactions and ship strikes on this stock is 4.0 and 1.6 whales per year, respectively, for a total 5.6 whales per year. Of the 4.0 killed by fishing interactions, 0.2 are estimated to be caused by U.S. recreational fisheries, while the remaining 3.8 are from U.S. commercial fisheries. Of the 3.8 killed by commercial fishing interactions 0.2 are estimated to be from the Hawaii shallow-set fishery (Allen and Angliss 2010).

Because the CNP stock inhabit 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 (Allen and Angliss 2010), the combined impact of past and present fishing interactions and ship strikes within the action area is likely to be less than one whale per year. In addition, impacts from anthropogenic sound such as military sonar and shipping (Ellison et al. 2011) 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 via 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 number 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 2008 BiOp (NMFS 2008a), the SEIS for Amendment 18 (WPFMC 2009), the 2009 Status Review, the 2011 Loggerhead DPS listing, and the other sources cited below. Past and present fisheries interactions have been, and continue to be, a threat to loggerhead turtles within the action area. Currently, primary fishing activity in the action area is longline fishing, except for nearshore fisheries that operate within 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, instituting a global prohibition in 1992. Other types of fishing may occur in the action area outside of longline prohibited areas (e.g., MHI offshore handline mixed gear), but on such a small scale and with assumed low mortality rates as to be insignificant with regard to the loggerhead environmental baseline. Within longline prohibited areas around the Hawaiian Islands, numerous fisheries operate, but these do not affect loggerheads. Therefore, fisheries impacts on loggerheads in the action area are limited to longline fishing, past and present impacts of which are described below.

6.2.1 Longline Fishing

The action area lies entirely within the central north Pacific[7]. Longline fishing is done by many countries in this region, and there are two 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 about one month (like the Hawaii longline fleet). The total annual number of longline vessels in the western central Pacific region has fluctuated between 3,500 and 6,000 for the last 30 years, this includes the 100-125 vessels in the Hawaii longline fisheries (a minority of which are involved in the shallow-set fishery). The four main target species are yellowfin, bigeye, albacore tuna, and swordfish. The distribution of longline effort between 2000-2010 is shown in Figure 3 below. The action area is shown by the red rectangle, and consists mostly of international waters.

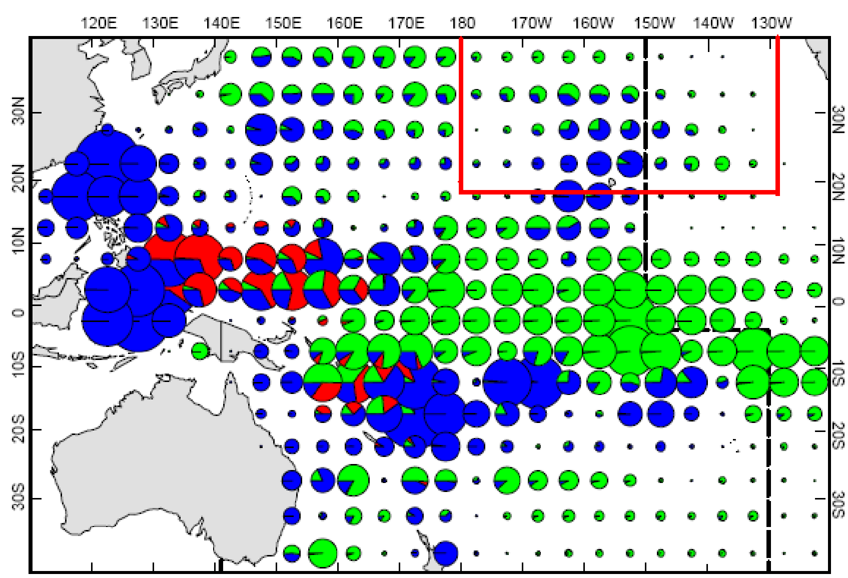

Figure 3. Distribution of longline effort of distant-water fleets (green), foreign-offshore fleets (red) and domestic fleets (blue) for the period 2000-2010 (Williams and Terawasi 2011). Action area for Hawaii Shallow-set longline fishery highlighted by red rectangle.

[7] For purposes of this Biological Opinion the central and north Pacific corresponds to the Northeast Pacific, Northwest Pacific, Eastern Central Pacific, and the Western Central Pacific defined by the FAO statistical areas (Appendix A). It does not directly correspond to the Action Area, however the action area overlaps with all four of these areas.

Because of low observer coverage and inconsistent reporting from international fleets, the total number of sea turtle interactions in all Pacific longline fisheries (domestic and international) must be estimated. 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 (Kaneko and Bartram 2008, Chan and Pan 2012). 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 2,600 – 6,000 loggerhead juvenile and adult mortalities from 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. Chan and Pan (2012) estimated that there were approximately 1866 total turtle interactions in 2009 in the central and north Pacific by comparing swordfish production and turtle bycatch rates from fleets fishing in the central and north Pacific area. From this we estimate that approximately 989[8] were loggerhead interactions. Since the area that Chan and Pan analyzed does not directly correlate with the action area we must estimate the number that occurred in the action area. The action area occurs in approximately 50% of the four FAO statistical areas used by Chan and Pan, therefore we estimate that approximately 495 loggerhead interactions occurred in the action area in 2009.

For purposes of providing the environmental baseline for loggerheads in this opinion, NMFS estimates that longlining from 2000-2009 in the action area has killed 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. Using Chan and Pan's estimate, NMFS estimates that there were 92-198[9] loggerhead mortalities in the action area in 2009.

The shallow-set fishery has traditionally interacted with more loggerhead turtles than the deep-set fishery, although mortality rates of turtles in shallow-set gear is lower than in deep-set gear. The reason for the lower mortality rates in the shallow-set fishery is due to the gear being at shallower depths, which allows turtles to reach the surface to breath. Loggerheads are particularly susceptible to shallow-set gear and in the 1990s the Hawaii-based shallow-set fishery interacted with several hundred loggerheads annually in the action area (see section 5.2.3). However, the shallow-set fishery was closed in 2001 and only re-opened in 2004 after instituting measures for reducing turtle interactions. This reformation of the Hawaii-based shallow-set fishery, including gear modifications and reduced effort, has resulted in an approximately 97

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[8] Chan and Pan 2012 calculated that there were 1866 total turtle interactions in the Central and North Pacific in 2009. Approximately 53% of turtle interactions in the Hawaii shallow-set fishery are with loggerheads; this percent was applied to the total number in order to estimate loggerhead interactions (1866 * 53%=989).

[9] This is calculated by applying mortality rates of 18.6% and 40% to the 495 interactions estimated to have occurred in the action area.

percent reduction in the average number of loggerhead interactions in this fishery since the 1990s (McCracken 2000, NMFS 2011a). In 2005-10, turtle bycatch in Hawaii longline fisheries (shallow-set and deep-set combined[10]) within the action area is estimated to have resulted in mean annual mortality of two to 3 three loggerheads per year (NMFS 2011c).

6.2.2 Other Impacts

As mentioned in Section 5.2.3, and described in further detail below, climate change and marine debris 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 (Chaloupka et al. 2008a). In addition, marine debris may entangle or 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), the 2008 BiOp (NMFS 2008a), the SEIS for Amendment 18 (WPFMC 2009), and other sources cited below. Like other sea turtle species addressed by this opinion, past and present fisheries interactions have been, and continue to be, a threat to leatherback 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., MHI offshore handline mixed gear), but on such a small scale and with assumed low mortality rates as to be insignificant with regard to the leatherback environmental baseline. Within the longline prohibited areas around the Hawaiian Islands, numerous fisheries operate, but these do not affect leatherbacks. Therefore, the fisheries impact on leatherbacks in the action area is limited to longline fishing, the past and present impacts of which are described below.

6.3.1 Longline Fishing

Longline fishing from domestic and international fleets within the action area is described in Section 6.2.1 and represented in Figure 3 above. Estimating the total number of sea turtle interactions in Pacific-wide longline fisheries is difficult because of low observer coverage and inconsistent reporting from international fleets. 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,

[10] The deep-set fishery does not occur entirely in the action area. For purposes of this biological opinion the two fisheries are considered to have an overlap of approximately 25%; therefore 25% of the mortalities from the deep-set fishery are added to the environmental baseline. The total number of mortalities resulting from the deep-set fishery are discussed in the status of the species sections for all turtles.

they estimated 1,000 – 3,200 leatherback mortalities from 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. In a more recent study it was estimated that the number of interactions for all species operating in the central and north Pacific was approximately 1866 (Chan and Pan 2012). Approximately 40.2%, or 750 can be expected to be leatherbacks if we assume a similar proportion of sea turtle bycatch to that of the U.S. shallow-set fishery in the area. Since the area that Chan and Pan analyzed does not directly correlate with the action area we must estimate the number that occurred in the action area. The action area occurs in approximately 50% of the four FAO statistical areas used by Chan and Pan, therefore we estimate that approximately 375 leatherback interactions occurred in the action area in 2009.

For purposes of providing the environmental baseline for leatherbacks in this opinion, NMFS estimates that longlining from 2000-2008 in the action area has killed 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. 2004 estimate), or 20 - 320 western Pacific leatherback juveniles and adults annually (10 percent of Kaplan's 2005 estimate = 63). Using Chan and Pan's estimate, NMFS estimates that there were 83-120[11] leatherback mortalities in the action area in 2009.

The shallow-set fishery has traditionally interacted with more turtles than the deep-set fishery, although mortality of turtles in shallow-set gear is lower than in deep-set gear because the turtles can reach the surface. Leatherbacks are not as susceptible to shallow-set gear as loggerheads, but in the 1990s the Hawaii-based shallow-set fishery was estimated to have interacted with about a hundred leatherbacks annually in the action area (McCracken 2000). The shallow-set fishery was closed in 2001, and only re-opened in 2004 after instituting measures for reducing turtle interactions. This reformation of the Hawaii-based shallow-set fishery, including gear modifications and reduced effort, has resulted in an approximately 90 percent reduction in the average number of leatherback interactions annually in this fishery since the 1990s (McCracken 2000; NMFS 2011a). 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 Taiwan and China tuna fisheries, are thought to have bycatch rates several times higher than the Hawaii-based shallow-set fishery (NMFS 2008a, Chan and Pan 2012). In 2005-10, turtle bycatch in the Hawaii longline fleet (shallow-set and deep-set fisheries combined) within the action area is estimated to have resulted in mean annual mortality of two to three leatherbacks per year (NMFS 2011c).

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[11] This is calculated by applying mortality rates of 22.0% and 32.0% to the 375 interactions estimated to have occurred in the action area.

6.3.2 Other Impacts

As mentioned in Section 5.3.3, and described in further detail below, climate change and marine debris may be affecting pelagic leatherback habitat within the action area. Leatherbacks may be particularly susceptible to ingesting of marine debris because plastic bags resemble sea jellies, their primary prey. Derelict fishing gear may cause entanglement and 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 2008 BiOp (NMFS 2008a), the most recent olive ridley 5-year status review (NMFS and USFWS 2007c), the SEIS for Amendment 18 (WPFMC 2009), and other sources cited below. Past and present fisheries interactions have been, and continue to be, a threat to olive ridley turtles within the action area. Longline fishing as described above is the most important past and present impact on olive ridleys. Much less attention has been paid to the effects of longline fishing on this species than has been given to similar impacts on loggerheads and leatherbacks, hence no estimates are available for olive ridley mortality from longline fishing in the Pacific. Olive ridleys are 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, the bycatch rate of olive ridleys is higher than other species (McCracken 2006-2011). In addition, mortality of bycaught olive ridleys is higher than the other sea turtle species (Beverly and 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, and constitute much more fishing effort than the Hawaii-based fishery. Thus it is likely that thousands of olive ridley mortalities occur annually in the Pacific via longlining.

However, the action area for the proposed action is 17° N - 45° N latitude (Figure 1 in Section 4), and olive ridleys are primarily limited to tropical waters (NMFS and USFWS 2007c). While a substantial amount of longlining occurs in the action area the bycatch rate of olive ridleys is much lower than in tropical waters. Nevertheless, because of the abundance of this species and the amount of longlining occurring within the action area by all fleets combined, at least several hundred olive ridley mortalities are thought to have occurred annually, and are still occurring annually via longlining (most from the eastern Pacific population, but some from the western Pacific population). Chan and Pan (2012) estimated that there were approximately 1866 total turtle interactions in 2009 in the central and north Pacific by comparing swordfish production and turtle bycatch rates from fleets fishing in the central and north Pacific area. From this we estimate that approximately 37[12] were olive ridley interactions. Since the area that Chan and Pan analyzed does not directly correlate with the action area we must estimate the number that occurred in the action area. The action area occurs in approximately 50% of the four FAO

[12] Chan and Pan 2012 calculated that there were 1866 total turtle interactions in the Central and North Pacific in 2009. Approximately 2% of turtle interactions in the Hawaii shallow-set fishery are with olive ridleys; this percent was applied to the total number in order to estimate olive ridley interactions (1866 * 2%=37).

statistical areas used by Chan and Pan, therefore we estimate that approximately 19 olive ridley interactions occurred in the action area in 2009. This number however only represents the number of interactions that resulted from swordfish targeted effort and does not consider tuna longlining effort that also occurs in the area and has a higher rate of olive ridley bycatch.

The vast majority of olive ridley bycatch in the Hawaii-based longline fishery occurs in the deep-set fishery, which operates primarily to the south of the action area. In 2005-10, turtle bycatch in Hawaii longline fisheries (shallow-set and deep-set combined) within the action area is estimated to have resulted in mean annual mortality of seven to eight olive ridleys per year (NMFS 2011c).

As mentioned in Section 5.4.3, and described in further detail below, 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 2008 BiOp (NMFS 2008a), the green turtle 5-year status review (NMFS and USFWS 2007d), the SEIS for Amendment 18 (WPFMC 2009), and the other sources cited below. Past and present fisheries interactions have been, and continue to be a threat to green turtles within the action area. However, unlike loggerheads, leatherbacks, and olive ridleys, green turtles are affected by both longline fishing and nearshore fishing, and other anthropogenic threats 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. In addition, climate change and marine debris may be affecting this species in the action area.

Much less attention has been paid to the effects of longline fishing on green turtles than has been given to similar impacts on loggerheads and leatherbacks, thus no estimates are available for green turtle mortality due to longline fishing in the Pacific. While few green turtle interactions occur in Hawaii-based fisheries, general turtle bycatch rates in foreign deep-set fisheries (for tuna) are >10 times higher than in the Hawaii-based fisheries (Bartram and Kaneko), and constitute much more fishing effort than the Hawaii-based fisheries. Therefore it is likely that within the action area, up to several hundred juvenile green turtle mortalities occur annually by longlining (about equally split between the Hawaiian and eastern Pacific populations). Chan and Pan (2012) estimated that there were approximately 1866 total turtle interactions in 2009 in the central and north Pacific by comparing swordfish production and turtle bycatch rates from fleets fishing in the central and north Pacific area. From this we estimate that approximately 93[13] were green turtle interactions. Since the area that Chan and Pan analyzed does not directly correlate

[13] Chan and Pan 2012 calculated that there were 1866 total turtle interactions in the Central and North Pacific in 2009. Approximately 5% of turtle interactions in the Hawaii shallow-set fishery are with greens; this percent was applied to the total number in order to estimate green turtle interactions (1866 * 5%=93).

with the action area we must estimate the number that occurred in the action area. The action area occurs in approximately 50% of the four FAO statistical areas used by Chan and Pan, therefore we estimate that approximately 47 green interactions occurred in the action area in 2009. This number however only represents the number of interactions that resulted from swordfish targeted effort and does not consider tuna longlining effort that also occurs in the area and has a different rate of green turtle bycatch.

In 2005-10, turtle bycatch in Hawaii longline fisheries (shallow-set and deep-set combined) within the action area is estimated to have resulted in mean annual mortality of zero to one green turtle per year (NMFS 2011c). In the first two quarters of 2011 the shallow-set fishery interacted with four green turtles with an estimated mortality of 0.21 animals (round up to 1 green mortality) based on NMFS post-hooking mortality criteria (NMFS 2006b; NMFS 2011a).

Interactions in nearshore fisheries in the MHI (e.g. lay gillnets, hook-and-line, etc.) sometimes result in entanglement and drowning of green turtles. Of many kinds of nets used in Hawaii, gillnets are most problematic for turtles, because they are left untended, and entangled animals usually drown. Revised State of Hawaii regulations governing lay gillnets began in March 2007; they can be legally left untended in ½ hour increments, must be inspected completely every two hours, and may not be used for more than four hours during any set, but the likelihood of turtle entanglement and drowning still persists. Hook-and-line fishing from shore or boats also hook or entangles green turtles, although the chance of survival is higher than if caught in a gillnet (Chaloupka et al. 2008b). 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 turtle mortalities that occur annually from fishing interactions (NMFS 2008c). Between 1982 and 2003 the most common known cause of green turtle standings' was 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). Since 2002, there has been a steady increase in the rate of hook and line fishing induced standings' from 20 turtles per year to over 40, ranging from 10% to 20% of reported standings' (PIFSC MTRP unpublished quarterly stranding report to PIRO).

Fibropapillomatosis (FP) is the most significant cause of stranding and mortality in green turtles in Hawaii, accounting for 28% of standings' with an 88% mortality rate of stranded afflicted turtles (Chaloupka et al. 2008b). While the disease appears to have regressed over time (Chaloupka et al. 2009), it persists in the population at levels of spatial variability (Van Houtan et al. 2010). Van Houtan et al. (2010) also suggest a potential relationship exists between the expression of FP and the State's land use, waste-water management practices, and invasive macroalgae. Current research suggests that green turtles, through proliferation of FP, may be considered indicators of near shore ecosystem condition as significant correlations exist between hotspot areas of turtles with FP and watersheds of high anthropogenic induced eutrophication, specifically high nitrogen levels (Van Houtan et al. 2010; Smith et al. 2010).

Total annual green sea turtle mortalities in recent years (1998-2007) in the MHI by boat collisions was estimated by NMFS (2008e) based stranded turtle mortalities determined to have been caused by boat collisions (Chaloupka et al. 2008b, PIFSC MTRP Hawaii Sea Turtle Stranding Database 2007). An estimate of 10 stranded turtle mortalities from boat collisions in the MHI (see Figure 3, p. 25, NMFS 2008c) was determined to represent 20 – 40% of all annual green turtle mortalities in the MHI by boat collisions, resulting in a range of 25 – 50 turtle mortalities per year. Thus the average number of green turtle mortalities per year by boat collisions was estimated at 37.5 (NMFS 2008c). Between 1982 and 2010, fifty records of turtle standings' exist from Ala Moana Regional Park to Kaka'ako Waterfront Park and Kewalo Basin, which is a busy area for boaters and an area with a high abundance of green sea turtles. Of these cases, only one stranding involved a boat collision as the determined cause of stranding (PIFSC MTRP Hawaii Sea Turtle Stranding Database 2010), which may mean that earlier estimates are exaggerated.

As mentioned in Section 5.5.3 and described in further detail below, 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 All species: impacts associated with climate change

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 (Solomon et al. 2007). Climate change is a global phenomenon so resultant impacts have likely been occurring in the action area, although scientific data describing any impacts that have occurred from climate change in the action area are lacking. As described in section 5.2.3, climate variability and climate change are not the same and should not be confused. While we have evidence that climate variability, as shown with the PDO in the climate forcing study, influences sea turtle populations this does not mean that we can predict the impacts of climate change on species in the biological opinion at this time. The effects of climate variability will be described in greater detail in section 7. As discussed in the Threats Section, no significant climate change-related impacts to humpback whale populations have been reported to date. As also discussed in the Threats Section, climate change is likely beginning to affect sea turtles found in the action area through the impacts of rising sand temperatures, rising sea level, increased typhoon frequency, and changes in ocean temperature and chemistry.

While sea turtle hatchling sex ratios vary naturally within and among seasons and nesting locations, several species already exhibit female bias throughout their major rookeries worldwide, in many cases producing anywhere from 60 – 99% females (Chan and Liew 1995; Godfrey et al. 1996; Marcovaldi et al. 1997; Binckley et al. 1998; Godfrey et al. 1999; Godley et al. 2001; Oz et al. 2004; Kaska et al. 2006). Monitoring data over a long enough timescale to discern climate change related trends in sea turtle sex ratio have not been collected in the action area. Sea level rose approximately 17 cm during the 20th century (Solomon et al.2007) and further increases are expected. There are several predictions for potential future sea turtle nesting habitat loss due to sea level rise (Fish et al. 2005; Baker et al. 2006; Fuentes et al. 2009), however available data are insufficient to determine an existing correlation between past sea level rise and sea turtle population dynamics (Van Houtan 2010).

Global climate change-induced elevated temperatures, altered oceanic chemistry, and rising sea level may be contributing to changes to coral reef and seagrass ecosystems (as described above in Status of the Species) which provide resting and foraging habitat for some sea turtles, although it is difficult to distinguish impacts of climate-related stresses from other stresses that produce more prominent short term effects (Parry et al. 2007). Climate change-induced shifts in ocean productivity linked to temperature changes (Harwood 2001; Edwards and Richardson 2004; Hays et al. 2005) may affect foraging strategies and therefore reproductive capacity for sea turtles (Solow et al. 2002; Chaloupka et al. 2008, Van Houtan and Halley 2011; Van Houtan 2011), similar to what has been observed during El Nino events in the Pacific (Limpus and Nicholls 1994; Chaloupka 2001; Saba et al. 2007; Reina et al. 2008). These shifts in abundance of foraging resources are also directly linked to observed modifications in phenology for sea turtles such as longer re-migration intervals and temporal shifts in nesting activity (Weishampel et al. 2004; Hawkes et al. 2007). However, at this time it is only possible to speculate as to the implications of such impacts, as findings raise numerous follow up questions (listed by Weishampel et al. 2004) including whether earlier nesting will affect overall fecundity, clutch size, incubation length, hatch success, mating synchrony, and sex ratio. Recent studies have demonstrated that unfavorable climate conditions influence juvenile recruitment and impact future population trends in the North Pacific loggerhead DPS, Northwest Atlantic loggerhead DPS, western pacific leatherbacks, and gulf of Mexico hawksbills (Van Houtan and Halley 2011, Van Houtan 2011; del Monte-Luna et al. 2011). Changes in reproductive capacity and temporal shifts of nesting activity associated with changing environmental conditions have not been studied specifically in the action area.

Additional potential effects of climate change on sea turtles include range expansion and changes in migration routes (Robinson et al. 2008). Leatherbacks have extended their range in the Atlantic north by 330 km in the last 17 years as warming has caused the northerly migration of the 15°C SST isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays 2006). Similar studies on changes in migration routes for loggerheads, leatherbacks, olive ridleys, and greens have not been done in the Pacific. Therefore, it is not possible to say with any degree of certainty whether or how their migration routes and ranges have been or are currently affected.

The ranges of 88% of cetaceans may be affected by changes in water temperature resulting from global climate change, however the humpback whale is a cosmopolitan species ranging throughout the world's oceans and thermal and prey limitations related to climate change are unlikely to impact the range of this species (MacLeod 2009). Whilst oceanic cetaceans are unlikely to be directly affected by rising in sea level, important habitats for coastal species and species that require coastal bays and lagoons for breeding, such as humpback whales, could be adversely affected in the future (Simmonds and Elliot 2009). Humpback whales that feed in polar regions may also encounter reduced prey.

Attempting to determine whether recent biological trends are causally related to anthropogenic climate change is complicated because non-climatic influences dominate local, short-term biological changes. However, the meta-analyses of 334 species and the global analyses of 1,570 species show highly significant, nonrandom patterns of change in accord with observed climate warming in the twentieth century. In other words, it appears that these trends are being influenced by climate change-related phenomena, rather than being explained by natural variability or other factors (Parmesan and Yohe 2003). The details discussed previously in this section support the probability that recently observed changes in sea turtle phenology, sex ratio, and foraging characteristics in studied populations may be influenced by climate change-related phenomena. However, the implications of these changes are not clear in terms of population level impacts, and data specific to the action area are lacking.

In summary, several factors of climate change are impacting turtle populations or may impact populations in the future. Climate variability from year to year influences juvenile recruitment and influences nesting for several populations of turtles; turtles have encountered this type of climate variability throughout their entire existence but changes in climate variability due to anthropogenic climate change is a less understood issue. There are different life stages that will be affected by different aspects of climate change, some may be positive and others negative. Since it is anticipated that changes due to increasing temperatures are expected to occur slowly over the next century, species may adapt as they have done with a variable climate throughout their existence.

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 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. "Direct effects" are those affects that are caused directly by the action. "Indirect effects" are those that are reasonably certain 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 together with the 'Environmental Baseline' sections of this opinion, along with 'Cumulative Effects' 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. 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 populations that comprise them, viability (probability of extinction or probability of persistence) of listed species depends on viability of their populations. Similarly, the continued existence of populations are determined by the fate of individuals that comprise them; populations grow or decline as 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. We begin by identifying the probable risks the action poses to listed individuals that are likely to be exposed to an action's direct and indirect 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', 'Environmental Baseline', and 'Cumulative Effects' 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.

Introduction to Direct Effects
This introduction summarizes stressors and interactions resulting from the proposed action. It is included here to set the stage for following sections. Table 4 will be referenced throughout Section 7.

Potential Stressors. Potential stressors associated with the proposed action are listed here, and 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 with a forecast of a gradual increase up to 5,500 sets annually. The greatest stressor associated with this action on the five listed species considered in this opinion is interactions (defined in footnote 1 in Section 1) with fishing gear. 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 where green turtles occur. 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.

Exposure
The shallow-set fishery re-opened in April 2004 and fishermen resumed operations in October, thus the fishery has been operating for approximately seven years. Interactions in the fishery during that seven year period with the five species likely to be adversely affected by the action are shown in Table 4 below. Exposure for each species will be explained in greater detail below.

Table 4. Fishing effort (sets), interactions, and interaction rates in the Hawaii-based shallow-set longline fishery for the 5 species considered in this opinion over a 7-year period (4th quarter 2004 – 2011).

Year	Sets [a]	Interactions				
		Humpbacks	Loggerheads	Leatherbacks	Olive Ridleys	Greens
2004	135	0	1	1	0	0
2005	1,645	0	12	8	0	0
2006	850	1	17	2	0	0
2007	1,570	1	15	5	1	0
2008	1,605	0	0	2	2	1
2009	1,761	0	3	9	0	1
2010	1,875	0	7	8	0	0
2011	1,463	0	12	16	0	4
Total	10,904	2	67	51	3	6
Interaction Rate[b]		.00018	0.00614	0.00468	0.00028	0.00055
Estimated Annual Interactions from Proposed Action		1 (1.01)[c]	34 (33.79)[c]	26(25.72)[c]	2 (1.5)[c]	3 (3.03)[c]

[a] PIRO observer program, unpublished data. Number of sets is based on begin set date.
[b] 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.
[c] 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, 0.00018 x 5,500 = 1.01, round to 1. For loggerheads, 0.00614 x 5,500 = 33.79, round to 34. For leatherbacks, 0.00468 x 5,500 = 25.72, round to 26. For olive ridleys, 0.00028 x 5,500 = 1.5, round to 2. For greens, 0.00055 x 5,500 = 3.03, round to 3.

Introduction to Indirect Effects
This introduction discusses the indirect, spillover effects of the proposed action. "Indirect effects" are defined as those that are reasonably certain to occur later in time (50 CFR 402.02). This discussion provides background important to understanding these effects as presented in the sea turtle sections that follow.

"Spillover Effect". We analyze the spillover effect because it has been identified as a potential indirect effect of the proposed action. As discussed in more detail below, the proposed action is expected to result in a beneficial spillover effect for turtles, because the Hawaii-based shallow-set longline fishery operates under more stringent turtle conservation measures than do foreign fleets that would otherwise provide fresh swordfish to U.S. consumers. This spillover effect could stem from two sources: 1) U.S. consumption of swordfish shifting toward domestically produced swordfish and away from imported swordfish from countries with higher bycatch rates, termed market transfer in a paper by Rausser, et al. (2008), and 2) U.S. production displacing the fishing activities of foreign fleets that have higher turtle bycatch rates in the same general area (Chan and Pan 2012). In this analysis we briefly describe the consumption source, but our focus is on the spillover effect from the second source or the production displacement because it captures the swordfish production and turtle interactions in the same area that the U.S shallow-set fishery operates in.

Swordfish and most sea turtle species have global distributions, and swordfish landings can be traded among countries. Hence, regulation of a swordfish fleet in one country may affect swordfish fishing by other countries and therefore global sea turtle bycatch, resulting in a net change in mortalities of the affected sea turtle species. Studies by Sarmiento (2006) and Rausser et al. (2008) demonstrated that the 2001-2004 closure of the Hawaii-based shallow-set fishery led to increased import demand for fresh swordfish, since the Hawaii-based fishery primarily supplies the U.S. market. The swordfish consumption pattern in the U.S. is similar to its production pattern. U.S. consumption is composed of domestic production plus imports (almost all U.S. production is consumed in the U.S.). The highest U.S. swordfish consumption was recorded in 1998 with over 23,000 mt, of which 37% was fresh imports and 30% was fresh domestic product (the remaining 33% consumed was frozen swordfish). U.S. consumption trended downward beginning in 2000 and fell by over 50% to 11,000 mt by 2009. There are several factors that could have contributed to this decline but the two most often referred to are the FDA warning about the level of mercury in swordfish (Chan and Pan 2012), and the "Give Swordfish a Break" campaign that was initiated in 1998 due to concerns about swordfish stocks in the Atlantic. Even with this overall decline in consumption, U.S. production has not been able to meet domestic demand. Because swordfish imports were supplied by countries with higher turtle bycatch rates than the Hawaii-based swordfish fishery, these swordfish imports were associated with greater overall sea turtle bycatch (Chan and Pan 2012). Since the Hawaii-based swordfish fishery is required to comply with conservation measures that are more effective in reducing turtle bycatch and bycatch mortality rates than their foreign counterparts, Rausser argued that the shift in swordfish production for the U.S. market from the Hawaii-based fleet to foreign fleets resulted in an estimated increase of 2,882 sea turtle interactions associated with swordfish consumed in the U.S. over the 3-year closure (Rausser et al. 2008).

Chan and Pan (2012) conducted an updated evaluation of Rausser's consumption analysis and, based on the additional data, affirmed his conclusion. In addition, Chan and Pan examined historic data for swordfish markets and resulting sea turtle bycatch from 2005 to 2008[14], after the Hawaii-based shallow-set fishery had reopened with circle hook and fish bait regulatory measures. During this time period, U.S. fishermen supplied a greater share of the U.S. swordfish market, and the U.S. relied less on imports to meet demand, relative to the period 2001-2004 when the Hawaii-based shallow-set fishery was closed. After controlling for recent declines in U.S. swordfish consumption, Chan and Pan examined sea turtle bycatch rates and catch per unit effort rates (CPUE) of swordfish among individual countries and identified a reduction in sea turtle interactions associated with U.S consumption following the reopening of the Hawaii swordfish fishery, which was between 842 to 1,826 fewer interactions with all species of sea turtles (Chan and Pan 2012).

Considering the demonstrated effectiveness of existing regulatory measures in reducing the frequency and severity of sea turtle interactions, the expansion of the Hawaii-based shallow-set fishery under the proposed action is expected to result in a beneficial spillover effect for turtles. Based on the Chan and Pan's study, we expect this beneficial effect to occur when the Hawaii shallow-set longline swordfish production at the effort level of 5,500 set produces 5,461 mt of swordfish and there is a one-to-one displacement for the increased swordfish production, which is proportionally deducted from foreign fleets (Chan and Pan 2012). This spillover effect is also influenced by the lower catch per unit effort (use of more hooks for same amount of fish) of some foreign fisheries relative to their U.S.-counterparts, which translates into an increase in overall fishing effort and a corresponding increase in sea turtle bycatch (Chan and Pan 2012). Chan and Pan further conclude that the expansion of the Hawaii-based shallow-set fishery to 5500 sets, with its historical contribution to the U.S. market, is likely to cause a reduction in imports from less turtle-friendly swordfish fisheries, thereby decreasing the sea turtle bycatch associated with U.S. consumption of swordfish (Chan and Pan 2012). Accordingly, the proposed action is expected to result in a spillover effect that is beneficial to sea turtles by decreasing interactions associated with swordfish consumed in the U.S. (Chan and Pan 2012).

A key finding of Chan and Pan (2012) is that, based on historic swordfish production data to supply U.S markets, U.S. production offsets non-U.S. production of swordfish in the central and north Pacific by nearly one-for-one. The study suggests that any increase in U.S. swordfish production would lead to lower foreign swordfish production as was demonstrated in 2005-2008, rather than simply shifting the amount of swordfish sold to other countries. Accordingly, the proposed action of up to 5,500 annual sets would amount to an estimated increase from the 1,761 mt of swordfish caught in 2009 to 5,461 mt, and the displacement of 3,700 mt of foreign swordfish production in the central and north Pacific. Due to differences in the bycatch rate of turtles per amount of swordfish caught, and the differences in turtle mitigation requirements in the central and north Pacific, Chan and Pan project a decrease in turtle interactions by 12%, or 221 individual turtles of all species combined (Chan and Pan 2012). Due to limited reporting of sea turtle bycatch in foreign fisheries within the area, Chan and Pan were not able to make precise estimates of the bycatch numbers of individual species that would be beneficially affected. Based on the similarities of fishing styles and the area of operation, we can estimate the bycatch numbers by species by comparing data from the Hawaii fishery. We note, however, that

[14] As described previously, the fishery re-opened in late 2004 but the authors of the study made their comparisons starting in 2005 because there was limited fishing activity that occurred in 2004 (Chan and Pan 2012).

because the data on foreign fisheries is likely incomplete or inaccurate, foreign fishery bycatch rate estimation is imprecise. In addition, the expected number of sea turtle interactions with foreign fisheries that would have occurred but for the proposed action cannot be confirmed by direct observation. Therefore, for purposes of our spillover effects analysis, we do not believe the projected reduction in mortality numbers based on interactions avoided by foreign fisheries are at a level of precision as those data we analyzed for the direct effects of the proposed action (i.e., interactions observed with 100% observer coverage in the Hawaii shallow-set fishery). For these reasons we do not incorporate the numerical determination of sea turtle mortalities that will be avoided as a result of the spillover effect in our quantitative PVA models.

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), 2008 BiOp (NMFS 2008a), the humpback whale Stock Assessment Reports (e.g., Allen and Angliss 2010), the humpback whale recovery plan (NMFS 1991), the SPLASH report (Calambokidis et al. 2008), the Global Review of Humpback Whales (NMFS 2011f), 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. 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 five observed interactions between humpbacks and the entire Hawaii-based longline fleet, two of which were with the shallow-set fishery (Table 5).

Table 5. Summary of observed interactions between humpback whales and the Hawaii-based longline fisheries from 1995-2011 (NMFS 2010a). Seriousness of injuries was assessed under MMPA serious injury guidelines (Angliss and DeMaster 1998).

Hawaii Longline Fishery	Date	EEZ	NMFS-Determined Severity
Deep Set	2/11/2001	Hawaii	Not serious
Deep Set	10/12/2002	Outside	Not serious
Deep Set	2/16/2004	Outside	Not serious
Shallow Set	2/19/2006	Outside	Serious
Shallow Set	12/29/2007	Outside	Not serious

According to descriptions of these interactions by NMFS 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 humpback whales indicates that while it is not possible to predict whether an animal will free itself of gear, a large proportion of them are believed to extricate themselves based on scarring observed among apparently healthy animals. A study in southeast Alaska on the central north Pacific stock of humpback whales estimated that about 71% had been entangled at some point in their life and survived (Neilson et al. 2009).

7.1.2 Exposure

Since the shallow-set fishery re-opened in 2004, there have been two interactions with humpback whales in 10,904 sets, giving an interaction rate of 0.00018 humpbacks per set (Table 4). The proposed action is defined as up to 5,500 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 one annually (Table 4).

The beneficial spillover 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 mainlines is 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.

7.1.3 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 five interactions of humpbacks with the Hawaii-based longline fishery since 2001 (3 in deep-set, 2 in shallow-set), four were ‘not serious’, one was ‘serious’ (Table 5) (NMFS 2010b).

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. Because the effects of deep-set vs. shallow-set gear on humpbacks are likely indistinguishable, the three humpback interactions with deep-set gear are considered applicable to this response analysis, along with the two shallow-set interactions. Due to the fact that all three deep-set interactions resulted in ‘not serious’ injuries, one of the shallow-set interactions resulted in a ‘not serious’ injury, the one shallow-set interaction considered ‘serious’ is deemed 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 one entanglement annually. Of the five interactions that have occurred since 2001 in the Hawaii-based longline fishery, one resulted in serious injury. Thus, if 20 percent of the one entanglement resulted in serious injury, one humpback may be seriously injured by the proposed action every 1 – 5 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 one humpback whale every 1 – 5 years from the Central North Pacific stock.

7.1.4 Risk

The increase in mortality and serious injury of CNP humpback whales due to the proposed action is estimated to be one whale every five years. This increase would not approach the stock's Potential Biological Removal (PBR), which is 20.4 animals. The stock size is relatively large (about 7,500 to 10,000, depending upon which model is used for the abundance estimate) and is growing at a rate that is nearly double the maximum rate of growth for cetaceans (4%). Thus, the mortality of up to one individual humpback whale every five years from the central north Pacific stock is not expected to increase the risk of extinction for this population. That is, NMFS does not expect the proposed action to result in an appreciable reduction in the numbers, distribution, or reproduction of the north Pacific population of humpback whales (NMFS 2011f).

7.2 Loggerhead Turtles

Stressors, exposure, response and risk steps of the effects analysis for loggerhead turtles with regard to implementation of the proposed action are described below. Loggerhead turtles directly affected by interactions resulting from the proposed action are from the North Pacific Ocean Distinct Population Segment (DPS). Direct and indirect effects of the action on this DPS are related to the base condition of the DPS 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), 2008 BiOp (NMFS 2008a), the SEIS for Amendment 18 (WPFMC 2009), the population assessment conducted by PIFSC for the proposed action (Van Houtan 2011), the 2011 Loggerhead DPS listing 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 that remains attached to an animal. 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 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 organs from their connective tissue. Once the hook is set and pierces an organ, infection may ensue, which may result in 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, 2008a).

Loggerheads also become entangled in fishing gear but not as frequently as becoming hooked (NMFS 2011a). 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 incidentally caught and released, particularly line trailing from a hook. Turtles may swallow line trailing from a hook, which may block the gastrointestinal tract and cause other serious injuries. Trailing line can also become snagged on a floating or fixed object, entangling or further entangling the turtle, or the drag can cause the line to constrict around a turtle's appendage until the line cuts through it (NMFS 2004a, 2005, 2008a).

7.2.2 Exposure

7.2.2.1 Direct Effects

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 5,500 sets annually. Based on the number of sets made and the number of loggerhead interactions during the approximately 7-year period (100 percent observer coverage) since the re-opening of the shallow-set fishery in April 2004, 5,500 sets would result in 34 loggerhead interactions (Table 4). Therefore, loggerhead exposure to the direct effects of the proposed action is considered to be 34 loggerhead interactions annually.

7.2.2.2 Indirect Effects

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 reasonably certain to occur later in time) is expected to be a beneficial spillover effect. A description of the "spillover effect" is provided in the introduction to the Effects section above. A 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 production displacement of swordfish and the spillover effect of bycatch. Chan and Pan (2012) found that there was a reduction of up to 1,826 turtle interactions annually when the Hawaii shallow-set fishery re-opened due to lower imports of foreign swordfish into the U.S. market. The proposed action, which is the operation of the Hawaii shallow-set fishery to operate up to 5,500 sets, would amount to an increase in production from 1,761 mt (2009) to 5,461 mt replacing 3,700 mt of foreign swordfish production in the central and north Pacific. Due to differences in the catch rates of turtles per mt of swordfish in the area, there would be an additional decrease in turtle interactions by 12%, which is 221 individual turtles of all species combined (Chan and Pan 2012). Loggerheads represent about 52.8% of the turtles caught by the U.S. shallow-set fishery in the area (Table 4). If we apply this percentage to what international fleets would catch then we estimate that there would be 117 (221 * 52.8%) fewer loggerhead interactions in longline gear from international fisheries with this level of increase in U.S. swordfish production. As described previously the central and north Pacific includes four of the FAO statistical areas in the Pacific with the Eastern Central Pacific being the largest area of the four, and also where the majority of the action area occurs. Of these four areas, swordfish production has increased the most in the northwest and western central Pacific since 2001 (Chan and Pan 2012). Only a small portion of the western central Pacific statistical area is below the equator, which is the demarcation line for the North and South Pacific loggerhead DPSs, therefore NMFS assumes that the majority of the swordfish production displacement in the area would impact the North Pacific Loggerhead DPS the greatest. However there may also be a reduction in interactions with the South Pacific

Loggerhead DPS due to swordfish production in the portion of the western central Pacific below the equator.

7.2.3 Response

The response to stressors that can be quantified in the proposed action is the number of mortalities that can be expected to result from interactions with fishing gear from both the U.S. fleet (Direct) and international fleets (Indirect) operating in the area. It should be noted that the mortalities are estimates based on post-hooking criteria because all of the turtles caught in the shallow-set fishery since it re-opened in 2004 have been returned alive.

7.2.3.1 Direct Effects

Loggerhead response to the predicted exposure (34 interactions annually) from the proposed action can be converted to the annual number of estimated mortalities resulting from this exposure. For 67 loggerhead interactions observed in the shallow-set fishery from when it re-opened in late 2004 until November 18, 2011, based on NMFS' post-hooking mortality criteria (NMFS 2006b), post-hooking mortality of loggerheads in this fishery was 18.6 percent (NMFS 2011a). Using this post-hooking mortality rate, 34 interactions annually would lead to seven (34 x 0.186 = 6.32, round to 7) loggerhead mortalities (either sex, all ages). However, in order to estimate the risk that the proposed action poses to the North Pacific loggerhead DPS, a population assessment was done by NMFS (Van Houtan 2011) which is based on the number of adult females removed from the DPS. Adult females are the only component of the DPS for which data are available, from counts of adult females on nesting beaches. The response of loggerheads to 34 interactions must be quantified in terms of adult females in order to interpret the population assessment. As explained below, 34 loggerhead turtle interactions equate to a conservative estimate of 1 adult female mortality per year (0.31 adult females, round up to 1) (Table 6).

The shallow-set fishery interacts with male and female loggerheads, and most of these are juveniles. In order to estimate the number of adult female mortalities that would occur if there were 34 interactions, two adjustments 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. These adjustments are described in greater detail below.

The proportion of females in the adult population.
We assume the sex ratio of the North Pacific loggerhead population is 50:50 (Conant et al 2009). Therefore, we estimate that approximately half of animals incidentally caught are females.

The adult equivalent represented by each juvenile interaction.
Vaughan (2009) estimated the relationship between age and size (SCL) for loggerheads in the North Atlantic. Assuming similar loggerhead growth in the North Pacific, the Hawaii shallow-set fishery described under the proposed action would be expected to interact most frequently with loggerheads in their 13th year of age (Figure 4b). Age at first reproduction (AFR) (maturity) for this DPS is estimated at 25 years (Van Houtan and Halley 2011). Of the 223 measured loggerheads interacting with the Hawaii longline fishery from late 1994 through June 2011, 214 were less than 80 cm SCL, or less than 25 years of age (data provided by Eric Forney and Jeremy

Willson of the PIROP for Van Houtan 2011), hence at least 96 percent (214/223) of these turtles were juveniles (Figure 4a) (Vaughn 2009; Van Houtan, 2011). NMFS applied a conversion formula to determine the annual effect of the action on adult females. In order to estimate adult equivalents that will be affected by the action, survival rates (Snover 2002) were applied to three distinct life stages that would occur between age 13 and the AFR estimate of 25 years. (Figure 4c,Table 6). The three survival rates applied to convert juveniles to adults were 0.81, 0.79, and 0.88 (Snover 2002; Van Houtan 2011). Seven juvenile mortalities results in the annual removal of the equivalent of one adult female (.31 adult females round to 1) (Figure 4c, Table 6) (Van Houtan 2011).

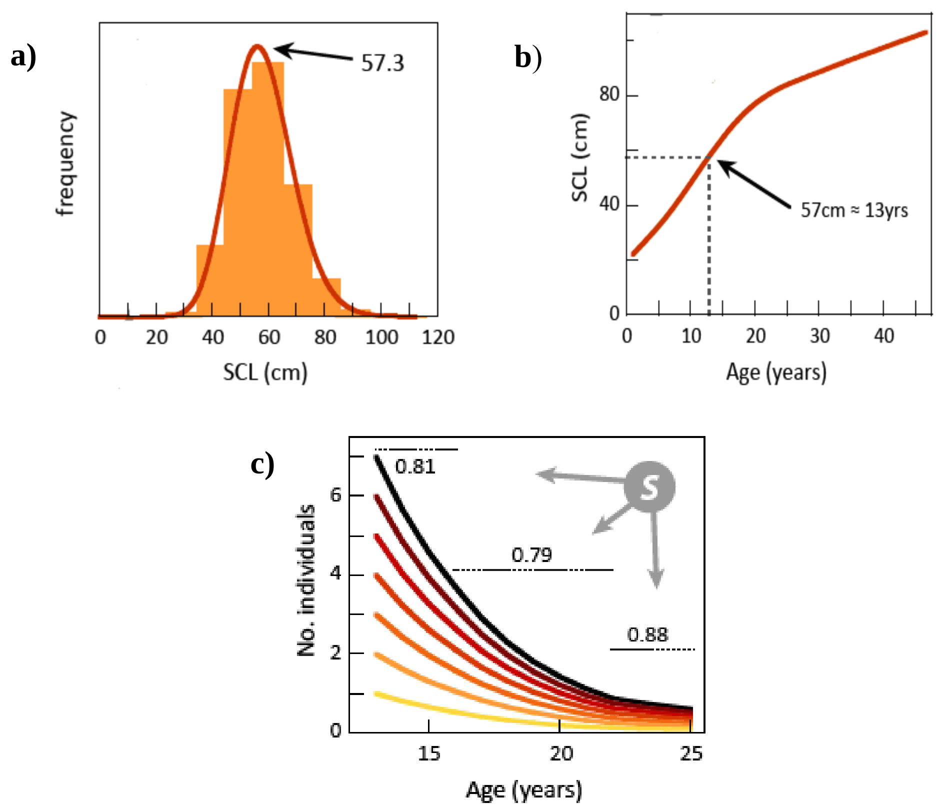

Figure 4. Determining adult equivalents of loggerhead turtle interactions in the Hawaii-based shallow-set longline fishery. Empirical observations indicate (a) 96% (214/223) of fishery interactions with loggerheads are with juveniles. Shaded histograms represent the raw data, lines are fitted probability models. Size is represented in straight carapace length (SCL). (b) Empirical relationship between age and size (SCL) for loggerheads in the western north Atlantic. (c) 7 juvenile mortalities discounted with 3 different survival rates (Van Houtan 2011).

Table 6. Annual adult female loggerhead mortality from from the proposed action.

Variable	Estimate
Maximum annual interactions	34
Post-hooking mortality	0.186 mortalities/capture
Sex ratio	50:50 (male: female)
Adult equivalents	.62 adult equivalent*
Annual adult female mortalities	1 adult female**

(34 captures)(0.186 mortalities/capture)= 6.32, round to 7 total mortalities.
* (7 juvenile mortalities) $(.81^{3})(.79^{6})(.88^{3})$=.62 adult equivalents
* * (0.62 adult equivalents)(.50 females)=.31 Adult females, round to 1

To summarize, in order to estimate the response of loggerheads to 34 interactions in terms of annual adult female mortalities, the interactions were first multiplied by the post-hooking mortality rate (0.186). In order to determine the number of female mortalities potentially caused by the proposed action, a 50/50 ratio was used. Morphometric models were then applied to estimate age of incidentally caught loggerheads and calculations were made to determine how many adult females the incidentally caught juveniles represent (Vaughn 2009; Van Houtan 2011). A total of seven juvenile loggerhead mortalities equates to less than one adult female (.31 adult females, rounded to 1) (Table 6) (Van Houtan 2011). 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 DPS was assessed by Van Houtan (2011), using a classical population viability assessment (PVA) and a climate-based PVA. The results are summarized below in the Risk Analysis (7.2.4.1).

All variables used in the calculations above were selected such that the potential impact from the proposed action was analyzed in a precautionary manner, given this DPS is listed as endangered. We used the maximum potential number of interactions per year (34) rather than a potential scenario of less than 34 interactions per year. For example, the maximum number of loggerhead interactions that has occurred in a year in the shallow-set fishery since 2004 is and 17 the mean annual number of actual interactions for the 7 -year period 2004-11 was 9.6 (Table 4). However, the proposed action is a fishery with up to 5,500 sets per year, which translates into as many as 34 loggerhead interactions per year. The post-hooking mortality rate of 18.6 percent is based on application of current NMFS criteria[15] (NMFS 2006b) to the 67 observed interactions in the fishery from late 2004 to November of 2011.

7.2.3.2 Indirect Effects

As described in the exposure section above, when the Hawaii shallow-set longline swordfish production at the effort level of 5,500 sets per year produces 5,461 mt of swordfish and a one-to-one displacement of foreign production results from the increased Hawaii swordfish effort, we expect a beneficial spillover of turtle bycatch. Specifically we expect that production displacement that occurs from the proposed action will reduce loggerhead interactions in the central and north Pacific (Chan and Pan 2012). According to Chan and Pan, the reduction in

[15] In November 2011, a webinar was held to discuss the most current research in post-interaction mortalities and whether the NMFS 2006 criteria should be adjusted. We recognized and considered the discussions of the webinar, but further research and analysis is necessary before we will know if and how rates can and should be adjusted. The NMFS 2006 criteria is the NMFS approved and vetted best information available at this time.

turtle interactions as a result of the spillover is expected to be 12% for all species combined. For loggerheads this equates to 117 (221 *52.8%) fewer interactions in the central and north Pacific, where the Hawaii shallow-set fleet operates. There are no data available on the size and mortality of loggerheads caught by international fleets, therefore assumptions have to be made to estimate the number of mortalities. Studies have demonstrated that the combination of circle hooks and mackerel type bait have reduced loggerhead interaction rates by 90% (Gilman et al. 2007) and that the use of circle hooks has lowered the number of turtles that ingest hooks leading to less severe hooking events and greater survival when proper handling techniques are employed and gear is removed. The estimated mortality rate for loggerheads was about 40% when the fleet used J style hooks. The combination of large circle hooks and whole finfish bait have been determined to be best practices for reducing sea turtle interactions and mortalities (Gilman 2011) and are only requirements in the U.S. based swordfish fleets (50 CFR 665.813). While there has been an increase in international effort to mitigate sea turtle interactions and mortalities by adopting sea turtle CMM's through RFMOs, there is still more to be done by international fleets so that their impacts will be equivalent to the low levels of U.S. fleets. The WCPFC is currently the only RFMO to adopt binding measures to require gear technology methods, as described in section 5.2.4, to reduce sea turtle interactions in swordfish fleets. However, not all best practice measures have been adopted since they only have to choose one of three methods, as described in section 5.2.4, and there are some fleets where they do not apply (CMM 2008-03). In addition these measures only apply to shallow-set style fishing and it is left up to the member country to define what a shallow-set is. In the case of the U.S. fishery, this distinction was not made until 2001 when swordfish targeted fishing was prohibited. After the swordfish targeting prohibition, the distinction was made between set and fishing types, where previously vessels could undertake mixed trips where they fished for tuna and swordfish often switching gear or mixing it. Without similar requirements in international fleets, they may do similar types of mixed fishing making it difficult to determine what is required under international agreements. While support for gear technology research and development has generally been strong, broad implementation of best practices is lacking (Gilman 2011). For example, at a recent Symposium on circle hooks researchers from over a dozen countries described experiments with circle hooks in many different fisheries that operate around the world but the U.S. was the only country in attendance to require circle hooks in both the Atlantic and Pacific swordfish fleets.

Further, data indicate that a number of international fleets have low rates of observer coverage, the maximum required by the WCPFC is 5% coverage for the majority of longliners by 2012 (CMM 2007-01). The U.S. shallow-set fishery operates with 100% observer coverage and in most instances the observer works with the crew to remove gear following NMFS guidelines for safe handling and gear removal (PIRO observer program, unpublished data). Both the observer and the captain are trained through required observer training and Protected Species workshops (50 CFR 665.814), in proper sea turtle handling and gear removal (50 CFR 665.812). Considering these factors, it is expected that mortality rates of turtles caught by other fleets would be higher than U.S. rates. The current estimated mortality rate resulting from loggerhead interactions in the Hawaii shallow-set fishery is 18.6%. This rate is low because observer data show that a significant portion of loggerheads are externally hooked and in most cases all gear is removed and the turtles are returned alive due to strict regulations on the fishery. Before the U.S. employed these methods, mortality rates were higher at about 40% (Gillman et al. 2007) and since international fleets do not employ all mitigation methods require by U.S. fleets, it is reasonable to conclude that their mortality rates are closer to 40%.

Table 7. Indirect reduction in annual loggerhead mortalities from the proposed action.

Variable	Estimate
Maximum annual interactions	117
Post-hooking mortality (Hawaii current rate)	0.186 mortalities/capture
Post-hooking mortality rate (Hawaii rate before mitigation requirements)	0.40 mortalities/capture
Annual mortalities reduction with .186 mortality rate	22
Annual mortalities reduction with .40 mortality rate	47

(117 captures)(0.186 mortalities/capture)= 21.76, round to 22 total mortalities.

(117 captures)(0.40 mortalities/capture)= 46.8, round to 47 total mortalities.

In order to determine the annual number of mortalities that would be expected to occur from 117 loggerhead interactions with shallow-set gear from International vessels, we have to make some assumptions related to mortality rates because we lack this information. We applied two different mortality rates discussed above to determine a likely range of mortalities that would be expected to occur. Once we calculated the number of expected mortalities, we then quantified the response to indirect effects of the action. The results represent the number of loggerheads that are likely to survive from the action due to production displacement of swordfish and the beneficial spillover effect of turtle mortalities. When applying these two rates, 18.6% and 40%, we get a reduction of loggerhead mortalities by 22 - 47 animals annually (Table 7). There is insufficient information on the age of loggerheads caught in international fisheries to allow us to determine the number of adult female equivalents to compare to the number of adult females impacted by the direct action. Therefore in this analysis we consider the numbers killed for all ages. The direct effect of the action is the removal of 7 turtles of all ages, including one adult female. The removal of such a small number of loggerheads in relation to total human caused mortalities is not expected to appreciably affect population dynamics. We also considered the indirect effect of the action, that is, the displacement of foreign production to meet U.S. market demand, which is expected to reduce mortalities by 22-47 loggerheads (of all ages), or an annual reduction of 15-40 loggerhead mortalities from all longlining in the central and north Pacific area. While the indirect beneficial spillover effect is expected to reduce loggerhead mortalities, the spillover effect analysis does not allow us to quantify with precision the number of adult female mortalities. Without an understanding of the number of adult female mortalities, we cannot quantify the reduction in risk to the population from all fisheries. However, we can conclude, with reasonable certainty, that there will be a reduction of loggerhead mortalities as a result of the spillover effect.

7.2.4 Risk

7.2.4.1 Direct Effects

The response of loggerheads to interactions with gear deployed by the Hawaii-based shallow-set fishery is considered to be the mortality of one adult female annually. The risk posed by this level of mortality to the north Pacific loggerhead population was assessed by Van Houtan (2011) for application to this opinion. Two different Population Viability Assessments[16] (PVA) were done in order to evaluate the impact of the proposed action on the North Pacific loggerhead DPS. The first model approach is a classical PVA and the second is a climate-based PVA. The results, including the strengths and limitations of each approach, are described below.

Classical PVA for Loggerheads

The classical PVA calculates population growth and its variability from time series of nest counts. A running-sum method is used over a three year period for loggerheads. The extinction probability is assessed by using Monte Carlo techniques in a stochastic exponential growth model over three generations, which was determined to be 95 years for loggerheads (Van Houtan 2011). The run-sum method linearly accumulates data from contiguous years, which is then converted to nest counts. For loggerheads, a three year run-sum was used and each nester produced four nests (Van Houtan 2011). This method was chosen based on previous assessments done by Snover and Heppell in 2008 and Conant et al. (2009).

A Quasi-Extinction Threshold (QET), consisting of a minimum population size reached over a certain amount of time, was chosen in order to calculate the effects of different levels of mortality on the population's likelihood of reaching QET. In this case the QET was set at 50% of the population from its current size (N_0). The proportion of runs that fall below the QET (N_0)/2 is considered to be analogous to a susceptibility to quasi-extinction (SQE) and is the main determinant of extinction risk in this approach (Van Houtan 2011). The QET provides a reference point with which to evaluate an assumed population decline of 50%, and does not necessarily have biological significance. A QET of 50% conforms to generally accepted standards (such as IUCN), but its level can be set to any fractional value. Accordingly, the QET is not necessarily equivalent to a species' functional extinction, which would be reflective of a decline of the population to a number that is insufficient to ensure viability of that species.

As designed, the classical PVA model does not consider factors other than nest counts and direct effects (i.e., mortality of adult females) in analyzing population trends. Factors such as spillover and cumulative effects are not incorporated into the model's projections because of the limitations in acquiring and quantifying the data for those factors.

[16] The diffusion approximation (DA) method that was used in the 2008 opinion (NMFS 2008) to determine extinction risk was not used in either PVA because recent studies have shown that the DA systematically overestimates extinction risk (Kendall 2009, Van Houtan 2011). Overestimation occurs because the model assumes continuous breeding throughout the year, which is not the case for sea turtles. This can be accounted for in stochastic exponential growth models by performing stochastic simulations rather than by evaluating the diffusion approximation (Kendall 2009), which was done in the classical PVA used in this opinion (Van Houtan 2011).

Results of the classical PVA for Loggerheads

The default trend, which can also be considered the baseline without human caused mortalities, of this model predicts that the population of North Pacific loggerhead DPS is going to increase significantly by 2110 (Figure 5). When the proposed action is run in the model with the mortality of one adult female, the baseline population increase is reduced by 2% after 99 years. The model starts with a population size of nesters (N_0) to be 7138 and at least 94% of model runs stay above QET ($(N_0)/2$) which is 3569 (Van Houtan 2011). According to Van Houtan (2011) the extinction risk is low and the model confidence is medium for this approach because the entire credible interval is not above the QET.

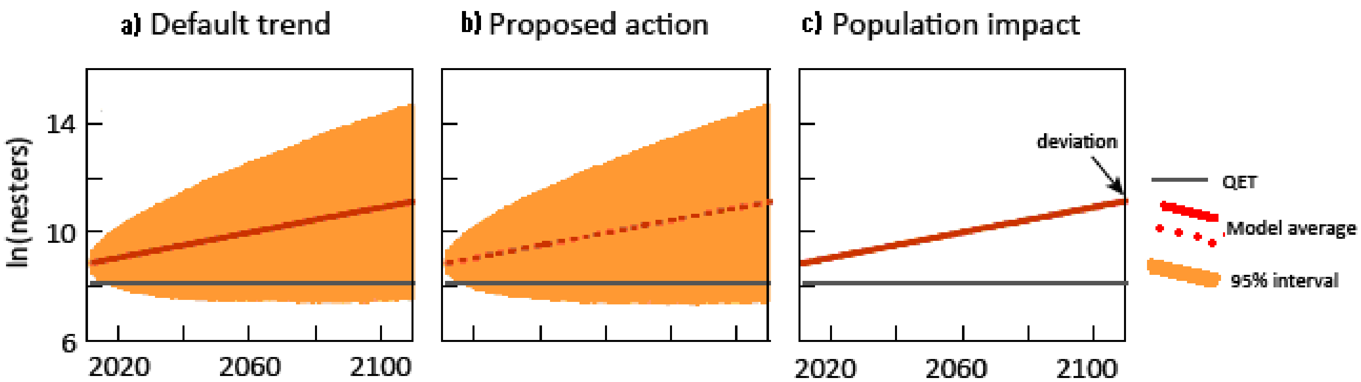

Figure 5. Classical population viability forecasts for loggerheads considering the proposed action. Left panels are the default forecast trend assuming observed population growth parameters. Solid, colored line is the average result of 10,000 model runs, shaded area is the 95% credible interval. Center panels are the default growth trend, annually discounted for the proposed mortalities (loggerheads = 1), with the dotted lines being the model averages. Right panel displays the deviation between the default trend and the proposed action. Grey horizontal line above the x-axis is the quasi extinction threshold (QET) or 50% decline from the current population size (Van Houtan 2011).

Considerations Relative to the Use of the Classical PVA for Loggerheads

While the classical PVA is an approach that has been used in the past to assess populations of sea turtles, it has limitations as a tool to predict population changes over time. This type of PVA predicts future population sizes in a linear fashion when many species, especially turtles, have populations that oscillate over time due to factors for which the model cannot account. Accordingly, this model cannot capture that inter-annual variability and project it into the future. Instead, a run sum method is used for a specified period of time (in this case three years) and the resulting growth rate is projected into the future. During the last three years loggerheads in the North Pacific have had the highest level of nesting since regular monitoring began in 1990, and the model projects future growth consistent with this limited data. The model assumes all environmental and anthropogenic pressures will remain constant, in the forecast period since it is not a dynamic model and it relies on nesting data alone (Van Houtan 2011).

Climate-based Approach PVA for Loggerheads

The second approach is the climate-based PVA that considers bottom-up climate forcing[17] at two life stages, neonates and breeding females. As discussed in previous sections, climate variability, such as the PDO is not "climate change." The climate-based model uses the historic nesting data for North Pacific Loggerheads but then adds in the long-term dynamics of climate forcing on the population. As described above, several studies have demonstrated that ocean conditions play a predominant role in the timing of female nesting (Chaloupka et al. 2008a; Saba 2007; Solow 2002; Van Houtan 2011). Van Houtan and Halley (2011) demonstrated that climate plays a primary role in juvenile recruitment for loggerheads in the North Pacific and for the Northwest Atlantic populations. Their model accurately accounts for the last several decades of nesting trends at various spatial scales in two different populations and accounted for annual fluctuations over the 20-30 years. The climate-based PVA also uses nesting data but because it does not have a run-sum of nesters to calculate the growth rate, it is able to account for inter annual variability in climate factors that strongly influence sea turtle population dynamics. Forecasts are based on fitted model relationships during the observed record, using available PDO series and modeled surrogates for the winter Sea Surface Temperature (SST) because it is considered a breeding cue for nesting females.

A Quasi-Extinction Threshold (QET), consisting of a minimum population size reached over a certain amount of time, was chosen in order to estimate the risk to the population from the proposed action. The model calculated the effects of different levels of mortality on the population's likelihood of reaching QET. For this model the last three years of nester estimates for loggerheads was averaged (to minimize forecast sensitivity to large annual fluctuations) to determine the nester population size now (N_0). One thousand model runs were then made and the proportion of runs that fell below the QET were calculated and used as the main determinant of the level of extinction risk, or SQE, for this model (Van Houtan 2011).

As designed, the climate-based PVA model does not consider factors other than climate data as applied to neonates and nesting females and the direct affects (i.e., mortality of adult females) in analyzing population trends. Factors such as spillover and cumulative effects are not incorporated into the model's projections because of the limitations in acquiring and quantifying the data for those factors.

[17] Climate forcing refers to the influence from environmental conditions such as the PDO, it does not mean anthropogenic climate change.

Results of the climate-based PVA for Loggerheads

The model shows a decline for the North Pacific Loggerhead population over the next generation without the proposed action, with 99.5% of the model runs falling below the QET, demonstrating that the risk is high in this model (Figure 6a, Van Houtan 2011). This decline is variable and falls below the QET and rises a couple of times over a 10 year period and then stays below the threshold for the remaining 15 years, with continued oscillations. When the same model is run with the proposed action, the mortality of 1 adult female, the results are similar with 99.5% to 100% of the runs falling below the QET (Figure 6b) (Van Houtan 2011). Depending on the reproductive value assigned to the adult female mortality (0, .01, .03, or .05), the additional loss to the loggerhead population resulting from the proposed action ranges from 4-11 percent. The model accounts not only for the loss of the single adult female annually, but also for the loss of her reproductive potential, including the lost reproductive potential of her unborn hatchlings. However, caution should be utilized in interpreting the magnitude of this additional loss to the population. The model does not account for the high mortality rate expected of these hatchlings from other sources, including climate-based threats. For these reasons, our qualitative analysis focuses more on the model's trend rather than its numerical determinations. This model demonstrates that while the direct effects of the proposed action has a detectable influence on the loggerhead population, there is no significant difference in the risk of extinction between the default, climate-based trend and the forecast considering the direct effects of the proposed action.

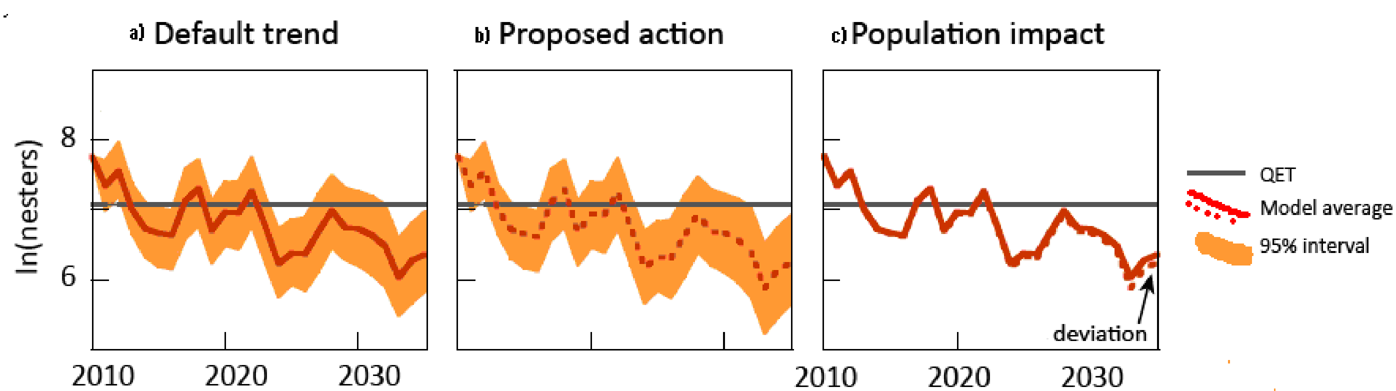

Figure 6. a) Climate-based population forecasts of the default trend with no fishery action. b) Climate-based population forecasts considering the proposed action. c) Comparison of the model averages for the default trend and the proposed action. Colored lines are the model average, shaded areas the 95% credible interval. Grey horizontal line above the x-axis is the quasi extinction threshold (QET) or 50% decline from the current population size (Van Houtan 2011).

Nesters yr^{-1} Mortality	AFR (φ)	r_M	Runs below QET	N_φ / N_0	Default Devation	Extinction risk	Model confidence
0	25	n/a	99.5%	0.24 (0.1-0.4)	0.0%	high	high
1	25	0	99.5%	0.23 (0.1-0.4)	-4.5%	high	high
1	25	0.01	100%	0.22 (0.1-0.4)	-8.8%	high	high
1	25	0.03	100%	0.22 (0.1-0.4)	-9.0%	high	high
1	25	0.05	100%	0.22 (0.1-0.4)	-11.0%	high	high

Table 8. Climate-based PVA model inputs and results for loggerheads (Van Houtan 2011).

Considerations Relative to the Use of the Climate-based PVA for Loggerheads

The climate-based PVA is a promising advancement in our understanding of the important influences of climate on the North Pacific Loggerhead DPS. This approach allows us to capture and project population variability in model averages by using known environmental oscillations rather than from uncertain parameters like the classical PVA. The model, however, does have limitations, including its focus on only two lifestages (neonates and nesters). While the model considers neonate survival it cannot account for beneficial actions on the DPS, such as conservation efforts that have increased nest protection and hatchlings as described in section 5.2.4, and that potentially enhance survival rates. In addition while it does consider mortalities from the proposed action, no other anthropogenic mortalities (i.e. international bycatch mortalities and direct harvest) are factored into the model (Figure 7). Finally, the model does not quantify the potential beneficial spillover effects from displaced foreign-fishery production of swordfish for U.S. markets.

The Climate-based PVA forecasts a population decline below the 50% QET-level set by Van Houtan (2011) within one generation (25 years). Although the model is considered highly accurate based on its ability to account for historical population changes, because of the difficulty predicting PDO, the model cannot forecast population trends beyond 25 years.

In the past we have associated large declines in the loggerhead populations with direct take from harvest and fisheries bycatch. However, this model considers climate, rather than these anthropogenic factors, as the predominant driver of population trends (Van Houtan and Halley 2010). In figure 7 below the climate forcing relationship with nest counts of loggerheads from Japan is shown. Further research is needed on the how climatic and anthropogenic forces together impact the trends of turtle populations (Van Houtan and Halley 2010; Edwards et. al 2010).

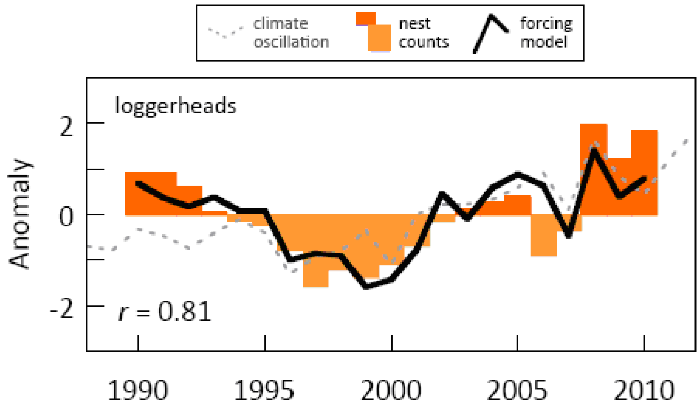

Figure 7. Establishing climatic forcing of loggerhead nesting populations over the empirical record. Nest observations (columns) are plotted against lagged ocean oscillations (dotted line) and forcing model (black line) (Van Houtan 2011).

Choice of PVA Approach in this Analysis

While both the classical and climate-based approaches have limitations, the climate-based model is more rigorous in applying actual data (i.e., PDO data) and therefore useful to our analysis, with caveats. One caveat is that the climate-based model has only recently been developed, and therefore is subject to additional development and refinement. Another caveat is that the climate-based model combines the expertise of only a small number of sea turtle experts. Still yet another limitation is the relatively short (25 year) predictive time period of the model. Given these caveats, we are cautious not to impute too much precision to any one model, and elect to proceed carefully with a quantitative and qualitative empirical evaluation of this model along with inputs from multiple experts and sources, where available. Accordingly, our analysis is primarily a qualitative evaluation of the general direction and magnitude of the probabilities that are projected in the outcome of the climate-based model, rather than from a strict application of the numerical determinations that form the basis of the model's conclusions, considered in the context of other relevant information from other sources. While we recognize the model's limitations and carefully consider the climate-based approach in this biological opinion, its use of qualitative and quantitative life history insights into AFR, empirical data on spatiotemporal population structure, and climate data series help make it useful to our analysis.

7.2.4.2 Indirect Effects

An expected beneficial spillover effect from the proposed action is expected to indirectly reduce North Pacific loggerhead DPS mortality. As described above, the reduction is estimated to be 117 fewer interactions in the central and north Pacific (Chan and Pan 2012), or 22 - 47 fewer loggerhead mortalities.

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. Leatherback turtles directly affected by fishing interactions resulting from the proposed action are expected to be entirely from the western Pacific population. 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), 2008 BiOp (NMFS 2008a), the SEIS for Amendment 18 (WPFMC 2009), the population assessment conducted by NMFS for the proposed action (Van Houtan 2011), 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 most common 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 collects on buoys and buoy lines at or near the surface, or some combination of these and/or other reasons. However, internal hooking in leatherbacks has been documented in the Hawaii-based longline fishery. 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 two 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,b, and 2008a).

7.3.2 Exposure

7.3.2.1 Direct Effects

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 5,500 sets annually. Based on the number of sets made and the number of leatherback interactions during the 7-year period (100 percent observer coverage) since the re-opening of the shallow-set fishery (10/04 – 11/11), 5,500 sets would result in 26 leatherback interactions (Table 4). Therefore, leatherback exposure to the effects of the proposed action is considered to be 26 leatherback interactions annually.

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. The Hawaii-based shallow-set longline fishery interacts primarily with the Jamursba-Medi component of the population. Recent studies suggest that the western Pacific population has a clear separation of migratory destinations for summer vs. winter nesters. Summer nesters move into the temperate north Pacific Ocean or into tropical waters of the South China Sea, whereas winter nesters move into temperate and tropical large marine ecosystems of the southern hemisphere (Benson et al. 2011). The majority of nesting in the summer months occurs on Birds Head peninsula of Papua Barat, Indonesia, which includes four main nesting sites described above in section 5.3.1 (Dutton et al. 2007; Benson et al. 2011), which may account for up to 90 percent of the summer nesters for the western Pacific metapopulation (Hitipeuw et al. 2007; Benson pers. comm. 2011). The Bird's Head Peninsula is estimated to account for 75% of the total nesting activity of the western Pacific Population. There is some summer nesting occurring at other places such as PNG and the Solomons but it is at much lower numbers (Dutton et al. 2007; Benson et al. 2011). Since we can't say for certain what percentage of summer nesters come from the Jamursba-Medi component of the population with which the fishery interacts, we have considered a range of percentages from 69% - 90% (Snover 2008; Benson personal communication 2011).

7.3.2.2 Indirect Effects

While the primary direct effect of the proposed action on leatherback turtles will be the stressor of fishing gear interactions, an expected indirect effect of the proposed action (one that is reasonably certain to occur later in time) is a beneficial spillover effect. A description of the spillover effect is provided in the introduction to the effects section above. A decrease in leatherback exposure to interactions with shallow-set gear deployed by other international swordfishing fleets is expected to be indirectly caused by the proposed action, due to a production displacement of swordfish and the spillover effect of bycatch. Chan and Pan (2012) found that there was a reduction of turtle interactions by up to 1,826 annually since the Hawaii shallow-set fishery re-opened due to lower imports of foreign swordfish into the U.S. market. The proposed action, which is the operation of the Hawaii shallow-set fishery to operate up to 5,500 sets, would amount to an increase from 1,761 mt (2009) to 5,461 mt, replacing 3,700 mt of foreign swordfish production in the central and north Pacific. Due to differences in catch rates of turtles per mt of swordfish in the area, this would be an additional decrease in turtle interactions by 12%, which is 221 individual turtles of all species combined (Chan and Pan 2012). Leatherbacks represent about 40.2% of the turtles caught in the U.S. shallow-set fishery in the action area (Table 4). If we apply this percentage to what international fleets would catch, we estimate that there would be 89 (221 * 40.2%) fewer leatherback interactions in longline gear from international fisheries with this level of increase in U.S. swordfish production.

7.3.3 Response

The response to stressors that can be quantified is the number of mortalities that can be estimated to result from interactions with fishing gear from both the U.S. fleet (Direct) and international fleets (Indirect) operating in the area.

7.3.3.1 Direct Effects

Leatherback response to predicted exposure (26 interactions annually) can be characterized as the annual number of mortalities estimated to result from this exposure. For the 51 leatherback interactions observed in the shallow-set fishery from when it re-opened in late 2004 until the November 18, 2011 closure, based on NMFS' post-hooking mortality criteria (NMFS 2006b), post-hooking mortality of leatherbacks in this fishery is 22.0 % (NMFS 2011a). Using this post-hooking mortality rate, 26 interactions annually would lead to six (rounded from 5.72) 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 NMFS (Van Houtan 2011[18]) 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 leatherbacks to 26 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 potentially be killed by 26 interactions, two adjustments 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. These adjustments are described in greater detail below.

The proportion of females in the adult population.

The 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 2008a; Snover 2008; Van Houtan 2011).

The adult equivalent.

Some leatherbacks interacting with the shallow-set fishery are juveniles. The minimum size when western Pacific leatherback females first breed is estimated to be >120[19] cm SCL (Jones et al. 2011; Stewart et al. 2007; Van Houtan 2011). Data collected by the observer program indicate that the majority of leatherbacks encountered by the fishery are adults with 26 out of the 28 (93%), turtles having an SCL of greater than 120 cm (Figure 8) (Van Houtan 2011).

[18] At the time the model was run only interactions up until the end of the second quarter were available, which was 23 leatherback interactions. The number of estimated mortalities did not change when new interaction data became available.

[19] Two studies found that the globabal average length of nesting was 147 cm SCl and the minimum size when turtles first start to breed is 121 cm SCL; this minimum size was used to determine adult equivalents.

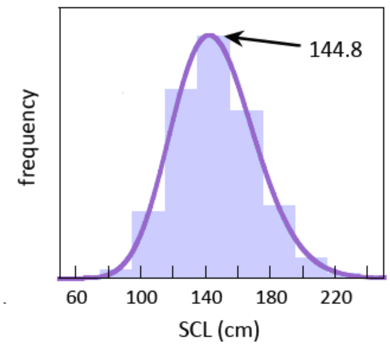

Figure 8. Determining adult equivalents of marine turtle interactions in the Hawaii-based shallow set longline fishery. Empirical observations indicate 93% (26/28) of fishery interactions are with breeding adults for leatherbacks (Data provided by Eric Forney and Jeremy Willson of the PIROP for Van Houtan 2011).

Table 9. Annual Adult female leatherback mortality from the proposed action.

Variable	Estimate
Maximum annual interactions Post-hooking mortality Sex ratio Adult equivalents	26 interactions 0.220 mortalities/capture 65:35 (female: male) = .65 females 0.93 adult equivalents
Annual adult female mortalities from western Pacific Population	4 (round from 3.46) adult females*
Annual adult female mortalities from Jamursba-Medi component	3 or 4 (round from 2.39 or 3.11) adult females**
Annual adult female mortalities from non Jamursba-Medi component	2 or 1 (round from 1.07 or 0.35) adult females**

*(26 captures) (0.220 mortalities/capture) (0.65 females) (0.93 adult equivalents) = 3.46 adult females, from the Jamursba-Medi + non-Jamursba-Medi components of the western Pacific population.
**Based on the assumption that all incidentally caught 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).

To summarize, in order to estimate the response of leatherbacks to 26 interactions in terms of annual adult female mortalities, the interactions were first multiplied by the post-hooking mortality rate (0.220). In order to estimate the mortality of females from the proposed action, a 65/35 ratio was used. Then the adult equivalent was determined using the rate of 0.93, giving an estimate of four adult female mortalities annually from the western Pacific population. Since we can't say for certain what percentage of the summer nesters come from the Jamursba-Medi component of the population with which the fishery is interacting, we have considered a range of percentages from 69% - 90% (Snover 2008; Benson personal communication 2011). The total mortalities anticipated to the entire western Pacific population is four (round from 3.46) (Table 9). We calculate a range of 2.39 to 3.11 of these turtles are from the Jamursba-Medi component, rounded to 3 - 4. The remaining turtles from the non-Jamursba-Medi component would range from 1.07 to 0.35 turtles, which would both be rounded to a maximum of 1 - 2 turtle mortalities assuming that 69% - 90% of the turtles come from Jamursba-Medi.

Three or four (rounded from 2.39 or 3.11, Table 9) adult female mortalities per year is the expected response of the Jamursba-Medi component to entanglement and hooking caused by the proposed action. One or two (rounded from 0.35 or 1.07, Table 9) adult female mortalities per year is the expected response for the non-Jamursba-Medi component. The impact of this level of mortality on the Jamursba-Medi component of the western Pacific population was assessed by Van Houtan (2011). The Risk Analysis below includes a summary from Van Houtan (2011) for the Jamursba-Medi component, as well as additional analysis of the non-Jamursba-Medi component based on the best available information.

All variables used in calculations above were selected such that the potential impact from the proposed action was analyzed in a precautionary manner. We used the maximum possible number of interactions per year (26) rather than a potential scenario of less than 26 interactions per year. For example, the maximum number of leatherback interactions that has occurred in a year in the shallow-set fishery since 2004 is 16 and the mean annual number of actual interactions for the 7-year period 2004-11 was 7.3 (Table 4). However, the proposed action is a fishery with up to 5,500 sets per year which translates into as many as 26 leatherback interactions per year. The post-hooking mortality rate of 22.0 percent is based on application of current NMFS criteria [20] (NMFS 2006b) to the 51 observed interactions in the fishery from late 2004 to the end of the 2011 season. However, one of the 51 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 50 leatherbacks was 20.7 percent. 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 0.93 is based on a simple proportion of mean length of incidentally caught leatherbacks (144.8 cm SCL) to the estimated length at maturity for this population (greater than 120 cm SCL). However, this calculation assumes 100 percent survival of the incidentally caught juveniles, so a more realistic adult equivalent estimate would be less than 0.93. Thus, the estimate of four adult female mortalities annually from the western Pacific leatherback population is considered to be the maximum number rather than a mean.

7.3.3.2 Indirect Effects

As described in the exposure section above, when the Hawaii shallow-set longline swordfish production at the effort level of 5,500 sets per year produces 5,461 mt of swordfish and a one-to-one displacement of foreign production results from the increased Hawaii swordfish effort, we expect a beneficial spillover of turtle bycatch. Specifically, we expect that production displacement that occurs from the proposed action will reduce leatherback interactions in the central and north Pacific (Chan and Pan 2012). The reduction in turtle interactions as a result of the beneficial spillover is expected to be 12% for all species combined. For leatherbacks this equates to 89 fewer interactions in the central and north Pacific, where the Hawaii shallow-set fleet operates. As discussed in the previous loggerhead section, impacts to turtles are not the same between U.S. longliners and international fleets. The current mortality rate for leatherbacks in the Hawaii shallow-set longline fishery is 22.0%. The mortality rate in the U.S. for leatherbacks before all current mitigation techniques were put in place was around 32% (Gillman et al. 2007). This current rate is lower because observer data shows that a significant portion of

[20] In November 2011, a webinar was held to discuss the most current research in post-interaction mortalities and whether the NMFS 2006 criteria should be adjusted. We recognized and considered the discussions of the webinar, but there was no clear idea on if and how rates could be adjusted. The NMFS 2006 criteria is the NMFS approved and vetted best information available at this time.

leatherbacks are externally hooked and in most cases all gear is removed due to strict regulations on the fishery. As explained in the previous section on loggerheads, international fleets do not follow all techniques that are required in the U.S. and therefore would have a higher mortality rate, closer to what the U.S. had previously.

Table 10. Indirect reduction in annual adult female leatherback mortality from the proposed action.

Variable	Estimate
Maximum annual interactions	89
Post-hooking mortality (current HI rate)	0.220 mortalities/capture
Post-hooking mortality rate (Hawaii rate before mitigation requirements)	0.32 mortalities/capture
Annual mortalities reduction with .220 mortality rate	20
Annual mortalities reduction with .32 mortality rate	29

(89 captures)(0.220 mortalities/capture)= 19.58, round to 20 total mortalities.

(89 captures)(0.32 mortalities/capture)= 28.48, round to 29 total mortalities.

In order to determine the annual number of mortalities that would be expected to occur from 89 leatherback interactions with shallow-set gear from International vessels, we have to make some assumptions related to mortality rates because we lack this information. We applied two different mortality rates discussed above to determine a likely range of mortalities that would be expected to occur. Once we calculated the number of expected mortalities, we then quantified the response to indirect effects of the action. The results represent the number of leatherbacks that are likely to survive from the action due to production displacement of swordfish and the beneficial spillover effect of turtle mortalities. When applying these two rates, 22% and 32%, we get a reduction of leatherback mortalities by 20 - 29 animals annually (Table 10). There is insufficient information on the age of leatherbacks caught in international fisheries to allow us to determine the number of adult female equivalents to compare to the number of adult females impacted by the direct action. Therefore in this analysis we consider the numbers killed for all ages. The direct effect of the action is the removal of 6 turtles of all ages, including four adult females. The removal of such a small number of leatherbacks in relation to total human caused mortalities is not expected to appreciably affect population dynamics. We also considered the indirect effect of the action, that is, the displacement of foreign production to meet U.S. market demand, which is expected to reduce mortalities by 20-29 leatherbacks (of all ages), or an annual reduction of 14-23 leatherbacks mortalities from all swordfish longlining in the central and north Pacific area. While the indirect beneficial spillover effect reduces leatherback mortalities, the spillover effect analysis does not allow us to quantify with precision the number of adult female mortalities. Without an understanding of the number of adult female mortalities, we cannot quantify the reduction in risk to the population from all fisheries. However, we can conclude, with reasonable certainty, that there will be a reduction of leatherback mortalities as a result of the spillover effect.

7.3.4 Risk

7.3.4.1 Direct effects

The response of leatherbacks to interactions with gear deployed by the Hawaii-based shallow-set fishery is considered to be the mortality of four adult females annually. The risk posed by this level of mortality to the western Pacific leatherback population was assessed by Van Houtan (2011) for application to this opinion. Two different Population Viability Assessments[21] (PVA) were done in order to evaluate the impact of the proposed action on western Pacific leatherbacks. The first model approach is a classical PVA and the second is a climate-based PVA. The risk assessment for western Pacific leatherbacks is more complex than for loggerheads because the population assessment modeling done for the proposed action only considered the Jamursba-Medi component of the population, due to data limitations[22]. However, this opinion must determine the risk posed by the proposed action to the entire western Pacific population because the fishery interacts with leatherbacks from the Jamursba-Medi and the non-Jamursba-Medi components of the population. Two different PVAs were done in order to examine risk to the population at Jamursba-Medi. The first approach is a classical PVA and the second is a climate-based PVA. The results including the strengths and limitations of each approach are described below.

7.3.4.1.1 Jamursba-Medi Component of the Western Pacific Population

The Jamursba-Medi component makes up 38 percent of the western Pacific leatherback population (Dutton et al. 2007), but the majority of leatherbacks interacting with the Hawaii-based shallow-set fishery are likely coming from this component due to its migration patterns (Van Houtan 2011; Benson 2011).

Classical PVA for Leatherbacks

Please refer to the description in Section 7.2.4 above of Van Houtan's methodology, as it applies here, except that the QET for leatherbacks averages the last four years to determine N_0.

As designed, the classical PVA model does not consider factors other than nest counts and direct effects (i.e., mortality of adult females) in analyzing population trends. Factors such as spillover and cumulative effects are not incorporated into the model's projections because of the limitations in acquiring and quantifying the data for those factors.

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[21] The diffusion approximation (DA) method that was used in the 2008 opinion (NMFS 2008) to determine extinction risk was not used in either PVA because recent studies have shown that the DA systematically overestimates extinction risk (Kendall 2009, Van Houtan 2011). Overestimation occurs because the model assumes continuous breeding throughout the year, which is not the case for sea turtles. This can be accounted for in stochastic exponential growth models by performing stochastic simulations rather than by evaluating the diffusion approximation (Kendall 2009), which was done in the classical PVA used in this opinion (Van Houtan 2011).

[22] 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; Van Houtan 2011).

Results of the classical PVA for Leatherbacks

The default trend of this model predicts that the Jamursba-Medi component of western Pacific leatherbacks is going to decrease significantly by 2110 (Figure 9). When the proposed action is run with the mortality of four[23] adult females, there is a greater decline in the overall population size but the extinction risk does not change since essentially all of the model runs fall below the QET, as does the entire 95% confidence interval for both the default trend and the proposed action (Figure 9(a)(b)). The model starts with a population size of 1,233 nesters (N_0), and nearly all model runs fall below the QET((N_0)/2) which is 617 (Van Houtan 2011).

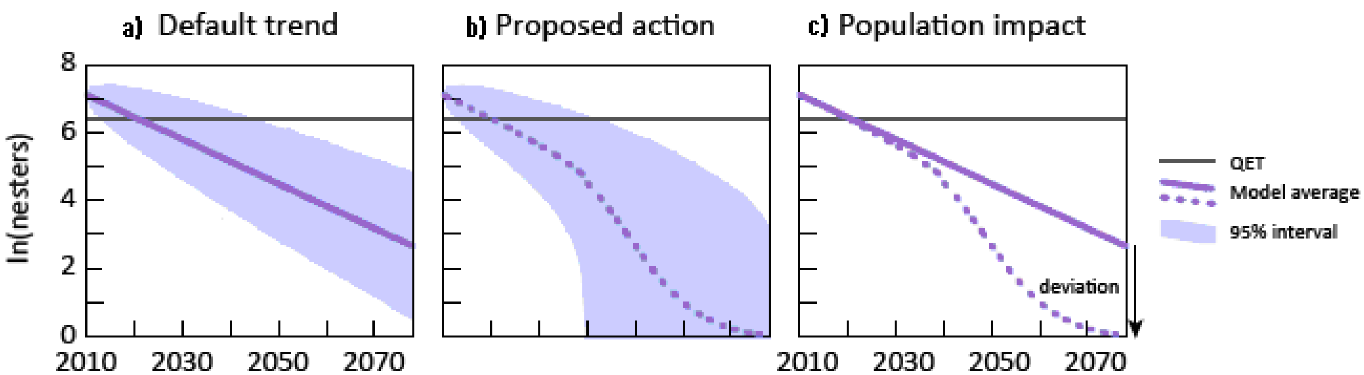

Figure 9. Classical population viability forecasts for leatherbacks considering the proposed action. a) The default forecast trend assuming observed population growth parameters. Solid, colored line is the average result of 10,000 model runs, shaded area is the 95% credible interval. b.) Default growth trend, annually discounted for the proposed mortalities (leatherbacks = 4), with the dotted lines being the model averages. c.) The deviation between the default trend and the proposed action. Grey horizontal line above the x-axis is the quasi extinction threshold (QET) or 50% decline from the current population size (Van Houtan 2011).

Considerations Relative to the Use of the Classical PVA for Leatherbacks

While classical PVA is an approach that has been used in the past to assess populations of sea turtles, it has some limitations that make it difficult for it to be used as a reliable tool to predict population changes over time. This type of PVA predicts population sizes over time in a linear fashion when many species, especially turtles, have populations that oscillate over time due to factors that can not be accounted for in this type of model. It cannot capture that inter-annual variability and project it out. Instead, a run-sum method is used for a specified period of time, in this case four years, the growth rate is calculated from this and then projected into the future. In the case of leatherbacks, the Jamursba-Medi nesting trends have been declining since records have first been kept, resulting in most of the changes being population losses and an overall negative population growth rate which accounts for the projected linear decline in the classical PVA model. In addition, this model assumes all environmental and anthropogenic pressures will remain constant in the forecast period since it is not a dynamic model and it relies on nesting data alone (Van Houtan 2011).

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[23] Four adult female mortalities were analyzed in the model due to the assumption that all of the turtles were from the Jamursba-Medi component of the population. Based on calculations above in Table 9 the estimated number of adult females from Jamursba-Medi is 3 or 4. The results of each level of mortality is shown in Table 11. Results from 4 adult mortalities are described in the results section since there is a possibility that 4 could be from this component of the population.

Climate-based PVA for Leatherbacks

The description in Section 7.2.4 above of Van Houtan's methodology applies here, except that different indices are used to project future nesting. For loggerheads the winter SST is used as an indicator for nesting females but for leatherbacks the upwelling index that describes the California Current dynamics is used since adult females congregate in this area to feed before heading back to the western Pacific to nest (Van Houtan 2011).

As designed, the climate-based PVA model does not consider factors other than climate data as applied to neonates and nesting females and the direct affects (i.e., mortality of adult females) in analyzing population trends. Factors such as spillover and cumulative effects are not incorporated into the model's projections because of the limitations in acquiring and quantifying the data for those factors.

Results of the climate-based PVA for Leatherbacks

The model shows an increase in the western Pacific (Jamursba-Medi) leatherback population over the next generation without the proposed action, with none of the model runs falling below the QET (Figure 10a) (Van Houtan 2011). Due to the uncertainty of the percentage of the population that comes from Jamursba-Medi summer nesters, a range of mortalities from the Jamursba-Medi component was input into the model with the highest possible number of four mortalities in case 100% of the population was from just this location (Table 10), (Van Houtan 2011). Results show that there is a measureable loss to the population as a result of the proposed action, but extinction risk remains in the low category. The scenario of four adult females (Table 8) being from this metapopulation equates a loss to the population at the end of 25 years of 15.8-29.9%, depending on the different reproductive values input in the model (Table 11). However, caution should be utilized in interpreting the magnitude of the loss to the population. The model accounts not only for the loss of the four adult females annually, but also for the loss of her reproductive potential. Accordingly, in these projections, the model does not account for the high mortality rate expected of these hatchlings from other sources, including climate-based threats. For these reasons, our qualitative analysis focuses more on the model's trend rather than its numerical determinations. This model demonstrates that while the direct effects of the proposed action has a detectable influence on the leatherback population, there is no significant difference in the risk of extinction between the default, climate-based trend and the forecast considering the direct effects of the proposed action.

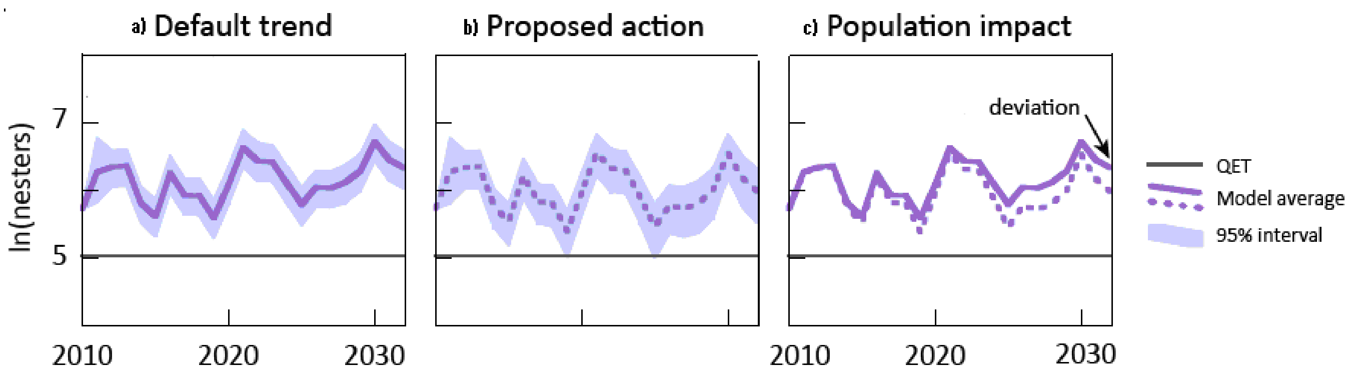

Figure 10. a) Climate-based population forecasts of the default trend with no fishery action. b) Climate-based population forecasts considering the proposed action. c) Comparison of the model averages for the default trend and the proposed action. Colored lines are the model average, shaded areas the 95% credible interval. Grey horizontal line above the x-axis is the quasi extinction threshold (QET) or 50% decline from the current population size (Van Houtan 2011).

Nesters yr^{-1} Mortality	AFR (φ)	r_M	Runs below QET	N_φ / N_0	Default Devation	Extinction risk	Model confidence
0	22	n/a	0.0%	1.82 (1.3-2.3)	0.0%	low	high
1	22	0	0.0%	1.75 (1.2-2.2)	-3.9%	low	high
1	22	0.01	0.0%	1.68 (1.2-2.2)	-7.8%	low	high
1	22	0.03	0.0%	1.68 (1.2-2.2)	-7.8%	low	high
1	22	0.05	0.0%	1.65 (1.1-2.2)	-9.1%	low	high
2	22	0	0.0%	1.67 (1.2-2.2)	-8.0%	low	high
2	22	0.01	0.0%	1.61 (1.1-2.1)	-11.7%	low	high
2	22	0.03	0.0%	1.58 (1.1-2.1)	-13.2%	low	high
2	22	0.05	0.0%	1.53 (1-2)	-15.8%	low	high
3	22	0	0.0%	1.6 (1.1-2.1)	-11.9%	low	high
3	22	0.01	0.0%	1.53 (1-2)	-15.7%	low	high
3	22	0.03	0.0%	1.48 (1-2)	-18.7%	low	high
3	22	0.05	0.0%	1.4 (0.9-1.9)	-22.8%	low	high
4	22	0	0.0%	1.53 (1-2)	-15.8%	low	high
4	22	0.01	0.0%	1.46 (0.9-2)	-19.8%	low	high
4	22	0.03	0.0%	1.38 (0.9-1.9)	-24.2%	low	high
4	22	0.05	0.0%	1.27 (0.8-1.8)	-29.9%	low	high

Table 11. Climate-based PVA model inputs and results for leatherbacks (Van Houtan 2011).

Considerations Relative to the Use of the Climate-based PVA for Leatherbacks

The climate-based PVA is a promising advancement in our understanding in the influences of climate on the western Pacific population of leatherbacks. This approach allows us to capture and project population variability in model averages by using known environmental oscillations rather than from uncertain parameters like the classical PVA. The predicted rebound in the population is due to decadal oscillations in the North Pacific Ocean, as captured in the PDO index, and their influence on juvenile leatherback recruitment (Van Houtan 2011). In Figure 11 below, the climate forcing relationship with nest counts of leatherbacks from Jamursba-Medi is shown and suggests that the overall observed decline since 1993 and the 77% drop between the 2004-05 season are likely linked to climate (Van Houtan 2011).

While the climate-based PVA gives us an opportunity to make future projections using climate indices, it is still not a complete picture of the population since it only accounts for two lifestages (neonates and nesters). In addition, no other anthropogenic factors that affect the population are considered in the model. There is also no way that the model can take into account positive influences on the population, such as conservation efforts that have increased nest protection and hatchlings described in section 5.3.4. While it does consider mortalities from the proposed action, no other negative anthropogenic mortalities (such as international bycatch mortalities or direct harvest) are factored into the model done for this BiOp or the historic nest count trend models. There is also no way to account for the beneficial spillover effect in the model. Another shortcoming of this model is that it cannot project out more than 25 years, which is a limitation when trying to assess extinction risk for species such as sea turtles.

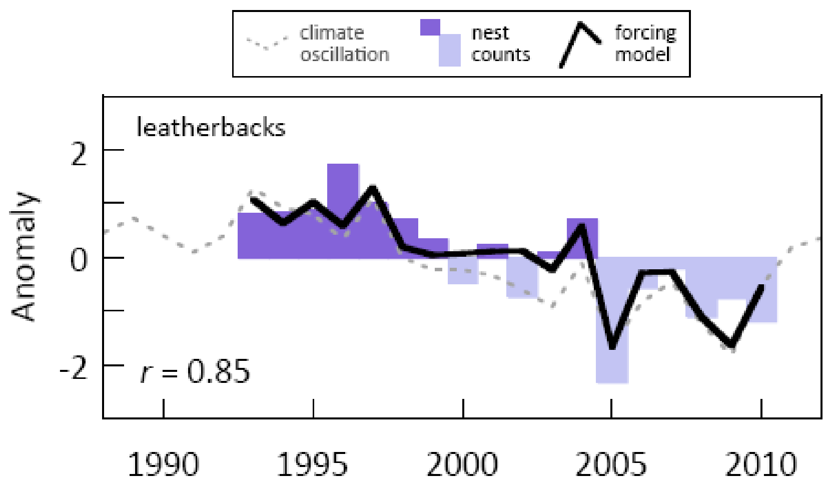

Figure 11. Establishing climatic forcing of nesting populations over the empirical record. Nest observations (columns) are plotted against lagged ocean oscillations (dotted line) and forcing model (black line). Highest-ranked forcing model incorporates the decadal series including the juvenile (PDO) and adult (California Current upwelling) climate indices (Van Houtan 2011).

Choice of PVA Approach in this Analysis

While both the classical and climate-based approaches have limitations, the climate-based model is more rigorous in applying actual data, and therefore useful to our analysis, with caveats. One caveat is that the climate-based model has only recently been developed, and therefore is subject to additional development and refinement. Another caveat is that the climate-based model combines the expertise of only a small number of sea turtle experts. Still yet another limitation is the relatively short (25 year) predictive value of the model. Given these caveats, we are cautious not to impute too much precision to any one model, and elect to proceed carefully with a quantitative and qualitative empirical evaluation of this model along with inputs from multiple experts and sources, where available. Accordingly, our analysis is primarily a qualitative evaluation of the general direction and magnitude of the probabilities that are projected in the outcome of the climate-based model, rather than a strict application of the numerical determinations that form the basis of the model's conclusions, considered in the context of other relevant information from other sources. While we recognize the model's limitations and carefully consider the climate-based approach in this biological opinion, its use of qualitative and quantitative life history insights into AFR, empirical data on spatiotemporal population structure, and climate data series make it useful to our analysis.

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

A risk assessment that considered a PVA 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 the three at Jamursba-Medi sites. 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 Barat, PNG, the Solomon Islands, and Vanuatu, as described in Section 5.4.1. As Table 7 explains, 10-31% of the leatherbacks interacting with the Hawaii-based shallow-set fishery are expected to originate from the non-Jamursba-Medi component, and effects to this component must be analyzed in order to determine the effects of the proposed action on the western Pacific population as a whole. Recent studies show that leatherbacks nesting in the winter in PNG, the Solomon Islands, and at Wermon beach head southward to the western South Pacific Ocean or Tasman Sea when nesting is complete (Benson 2011); therefore it is unlikely that they would be encountered in the action area of the proposed action. However there may also be some summer nesters at these locations as well and those turtles move into the temperate North Pacific Ocean or into tropical waters of the South China Sea creating a potential to interact with the proposed action.

As described in Section 5.3.1, annual nest counts at Wermon in Papua Barat 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 and have remained somewhat stable since then (NMFS 2011d). Impacts from threats to the population at Wermon are consistent with those occurring at Jamursba-Medi, although fortunately the mean hatching success rates are higher (e.g., Jamursba-Medi at 25.5 percent and Wermon at 47.1 percent) (Bellagio Steering Committee 2008). Summer nesting has been documented at Wermon as part of monitoring efforts, and between May and September 2004 through 2009, an average of about 500 nests per summer were laid (Wurlianty and Hitipeuw 2009).

For leatherbacks nesting at sites in the Huon area of PNG, the most reliable trend information is from the 2006-07 nesting season forward which appears to indicate a stable or slightly increasing trend, although four seasons is not enough data to determine a reliable trend estimate. Sites currently monitored along the Huon coast occur during the winter (November to March) nesting season; however, anecdotal information from local villagers suggests some year-round nesting occurs in other locations.

No information exists regarding population 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 (Bellagio Steering Committee 2008; NMFS 2008a). Conservation activities at these sites are inconsistent and monitoring programs are still in development, hampered by limited local capacity and insufficient funding. One of the 37 foraging leatherbacks satellite tracked from

California waters migrated to the Solomon Islands and nested at Santa Isabel Island in May providing evidence of summer breeding population linkage between the Solomons and California foraging habitats (Benson et al. 2011).

Jamursba-Medi nesting has declined since 1993 by more than half. The greatest decline was from 1993-1999. Since 1999, nesting has been variable from year to year with an overall declining trend (NMFS 2011d). Wermon is the other large nesting site for the western Pacific population but this site has not been monitored for as long. Monitoring at Wermon began in November 2002 and occurred the following winter in 2003. Starting in 2004, monitoring has been conducted year round. During this time there has been an overall reduction in nest numbers but they have been relatively stable since about 2005. These sites are both in the Bird's Head peninsula region and show similar migration patterns for their winter and summer nesters and have turtles that use both locations, perhaps making turtles from this region the main portion of the western Pacific population that interacts with the Hawaii fishery in the action area. The leatherbacks at Wermon face similar threats to those at Jamursba-Medi, in both nesting grounds and in their migration routes. For other non- Jamursba-Medi areas, trends have been similar to Wermon for areas that have been monitored for the last several years. These areas also face similar threats both on land and at sea.

Studies suggest that the majority of leatherbacks that are encountered in the fishery come from the Bird's Head peninsula, Papua Barat Indonesia (Jamursba-Medi and the Wermon) summer nesters and these turtles are likely part of the same sub-population, it is reasonable to conclude that the recent Jamursba-Medi assessment used for this biological opinion (Van Houtan 2011) is representative of impacts to the entire western Pacific population, and that the proposed action would not have a larger effect on the western Pacific population than on the Jamursba-Medi component alone.

7.3.4.1.3 Conclusion for Western Pacific Leatherback Risk Assessment

In conclusion, the proposed action is not expected to reduce the Jamursba-Medi component of the population to levels below the QET and this component is expected to grow (Figure 10) , even with the maximum of four annual mortalities. That is, the Jamursba-Medi component of the population is at a low risk of extinction as a result of the proposed action. The Jamursba-Medi component of the population represents about 38% of the entire western Pacific population, however it accounts for the majority of leatherback interactions with the Hawaii shallow-set fishery at the level of fishing effort of the proposed action. The remaining 62 % of the population has less of a chance of interacting with the fishery because the majority of nesting occurs in the winter and these animals have different migratory routes that don't enter the proposed action area. Given that the majority of interactions resulting from the proposed action are with the Jamursba-Medi component, there is low risk from the proposed action to this overall population. Considering that the remainder of the western Pacific population is larger than the Jamursba-Medi component, but proportionally significantly smaller in size with respect to the abundance of summer time nesters and that the maximum impact would be two adult females killed annually, we do not anticipate that two mortalities annually would appreciably reduce the likelihood of survival of the non-Jamursba-Medi component of the population. We believe that the proposed action will have a negligible impact on the risk to the Jamursba-Medi component, the non-Jamursba-Medi component, and therefore the western Pacific leatherback population as whole.

7.3.4.2 Indirect effects

An expected beneficial spillover effect from the proposed action is a reduction in leatherback mortality. As described above, the reduction is estimated to be 89 fewer interactions in the central and north Pacific (Chan and Pan 2012), or 20-29 fewer leatherback mortalities.

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), 2008 BiOp (NMFS 2008a), 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 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 Hawaii-based deep-set longline fishery (NMFS 2005), which fishes between 150 and 400 m of depth, and operates mostly to the south of Hawaii.

7.4.2 Exposure

Olive ridley interactions in the shallow-set fishery are rare, unpredictable events; for example, one olive ridley interacted with the shallow-set fishery in over three years between the re-opening of the fishery in 2004 and the end of 2007, but then two interacted with the fishery in less than three months in early 2008, for a total of three interactions in a 7 year period (NMFS 2011a). Of these interactions, two genetic samples were obtained and analysis indicates they are of eastern Pacific origin (Dutton unpublished data). Based on the number of sets made since the fishery re-opened in 2004, the three olive ridley interactions resulting from these sets, and a proposed action of 5,500 sets, NMFS estimates that the proposed action could interact with up to two (round from 1.51) olive ridleys annually (Table 4).

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 reasonably certain to occur later in time) is expected to be a beneficial spillover effect. A description of the spillover effect is provided in the introduction to the effects section above. A decrease in olive ridley 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 production displacement of swordfish and the spillover effect of bycatch. Chan and Pan (2012) estimated that there has been a reduction of turtle interactions by up to 1,826 annually since the Hawaii shallow-set fishery re-opened due to lower imports of foreign swordfish into the U.S. market. The proposed action, which is the operation of the Hawaii shallow-set fishery to make up to 5,500 sets, would amount to an increase from 1,761 mt (2009) to 5,461 mt, replacing 3,700 mt of foreign swordfish production in the central and north Pacific. Due to differences in catch rates of turtles per mt of swordfish in the area, there would be an additional decrease in turtle interactions by 12%, which is 221 individual turtles of all species combined (Chan and Pan 2012). Olive ridleys represent about 2.4% of turtles caught by the U.S. shallow-set fishery in the area (Table 4). If we apply this percentage to what international fleets would catch, we would estimate six (221 * 2.4%) fewer olive ridley interactions in longline gear of international fisheries with this level of increase in U.S. swordfish production.

7.4.3 Response

Because of the rarity of olive ridley[24] interactions in the shallow-set fishery, data are 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 18.6% for this species, based on post-hooking mortality rate of the more commonly-caught hard-shell turtle, loggerheads (NMFS 2011a). The population assessment done for this proposed action only included loggerheads and leatherbacks (Van Houtan 2011), thus the number of adult female olive ridleys killed by the proposed action was not estimated. Rather, we estimate that one olive ridley juvenile or adult (male or female) will be killed by the proposed action annually (1.54 interactions/yr x 0.186 post-hooking mortality = 0.29 mortality/yr, round to 1).

As described in the exposure section above, when the Hawaii shallow-set longline swordfish production at the effort level of 5,500 sets per year produces 5,461 mt of swordfish and a one-to-one displacement of foreign production results from the increased Hawaii swordfish effort, we expect a beneficial spillover of turtle bycatch. Specifically we expect that production displacement that occurs from the proposed action will reduce olive ridley interactions in the central and north Pacific (Chan and Pan 2012). The reduction in turtle interactions as a result of the beneficial spillover is expected to be 12% for all species combined. For olive ridleys this equates to six fewer interactions in the central and north Pacific, where the Hawaii shallow-set fleet operates. As discussed in the previous loggerhead section, impacts to turtles are not the same between U.S. longliners and international fleets. The current mortality rate for olive ridleys in the Hawaii shallow-set longline fishery is 18.6%. The mortality rate in the U.S. for hard shelled turtles before all of the current mitigation techniques were put in place was around 40% (Gillman et al. 2007a). As explained in the previous section on loggerheads, international fleets do not utilize the same fishing gear (large circle hooks and fish bait) or follow all safe handling techniques that are required in the U.S. and therefore would have a higher mortality rate, closer

[24] From the three turtles that have been caught in the shallow-set fishery since it reopened the estimated mortality based on the 2006 NMFS criteria was .16 or 5.3 percent (NMFS 2011a).

to what the U.S. had previously. Therefore, we expect a reduction in olive ridley mortalities of 1 - 2 per year[25], when mortality rates of 18.6% and 40% are applied.

7.4.4 Risk

As shown by genetic samples of olive ridleys from the shallow-set fishery (Table 2, Section 5), individuals may come from either the eastern or western Pacific populations. Since we estimate a total of one individual will be killed annually by the proposed action, and six of the 13 genetic samples analyzed so far were from the western Pacific population, and 7 were from the eastern Pacific we expect one turtle from the eastern Pacific population to be killed every two years, and one turtle from the western Pacific population to be killed every two years. 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 one annual mortality from the proposed action. Therefore risk to both populations from the proposed action is considered negligible. In addition, a beneficial spillover effect from the proposed action is expected to indirectly reduce olive ridley mortality. While the indirect beneficial spillover effect reduces the olive ridley mortalities, the spillover effect analysis does not allow us to quantify with precision the number of mortalities. However, we can conclude, with reasonable certainty, that there will be a reduction of olive ridley mortalities as a result of the spillover effect.

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 green turtles: the 2004 BiOp (NMFS 2004a), the 2005 BiOp (NMFS 2005), the 2008 Hawaii bottomfish opinion, (NMFS 2008c), 2008 Shallow-set BiOp (NMFS 2008a), 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 2008c).

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 three years without interacting with any green turtles. Then in both the 2008 and 2009 seasons, there was one green turtle interaction, zero in 2010, and then in the first two quarters of

[25] 6 olive ridley interactions * (.186) mortality rate = 2 (round from 1.1). 2 mortalities from international fleets – 1 mortality from U.S. fleet = 1. 6 olive ridley interactions * (.40) mortality rate = 3 (round from 2.4). 3 mortalities from international fleets – 1 mortality from U.S. fleet = 2.

2011 there were four green turtle interactions (NMFS 2011a). Based on this new information, NMFS estimates that there could be up to three (rounded from 3.02) interactions with green turtles annually if the Hawaii shallow-set fleet were to make 5,500 sets 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 combined) took approximately 1,500 trips annually in 2005-10, with only a small fraction shallow-set trips (≈100 trips/yr) (NMFS observer annual reports). The proposed action is expected to result in an approximate four-fold increase in fishing effort (Table 4); hence the number of trips resulting 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 2008c). 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).

While the primary direct effect of the proposed action on green turtles will be the stressor of fishing gear interactions, an indirect effect of the proposed action (one that is reasonably certain to occur later in time) is expected to be a beneficial spillover effect. A description of the spillover effect is provided in the introduction to the effects section above. A decrease in green 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 production displacement of swordfish and the spillover effect of bycatch. Chan and Pan (2012) found that there has been a reduction of turtle interactions by 1,826 annually since the Hawaii shallow-set fishery re-opened due to lower imports of foreign swordfish into the U.S. market. The proposed action, which is the operation of the Hawaii shallow-set fishery to operate up to 5,500 sets, would amount to an increase from 1,761 mt (2009) to 5,461 mt, replacing 3,700 mt of foreign swordfish production in the central and north Pacific. Due to differences in the catch rate of turtles per mt of swordfish in the area, there would be an additional decrease in turtle interactions by 12%, which is 221 individual turtles of all species combined (Chan and Pan 2012). Greens represent about 4.7 % of turtles caught by the U.S. shallow-set fishery in the area (Table 4). If we apply this percentage to what international fleets would catch than we would estimate 11 (221 * 4.7 %) fewer green interactions in longline gear of international fisheries with this level of increase in U.S. swordfish production.

7.5.3 Response

Because of the rarity of green turtle interactions in the shallow-set fishery, data are 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)[26]. Thus we estimate a post-hooking mortality rate of 0.186 for this species, based on post-hooking mortality rates of the more commonly-caught hard-shelled turtle, loggerheads (NMFS 2011a). The population assessment done for this proposed action only

[26] From the 6 captures that have occurred in this fishery the mortality rate calculated using the 2006 guidelines results in 0.51 mortalities or a rate of 8.5% (NMFS 2011a).

included loggerheads and leatherbacks (Van Houtan 2011), hence the number of adult female green turtles killed by the proposed action was not estimated. Rather, we estimate that one green turtle juvenile or adult (male or female) will be killed by the proposed action annually (3.02 interaction/yr x 0.186 post-hooking mortality = 0.56 mortality/yr from shallow-set fishing + 0.02 mortality/yr from shallow-set boat collisions, round to 1).

As described in the exposure section above, when the Hawaii shallow-set longline swordfish production at the effort level of 5,500 sets per year produces 5,461 mt of swordfish and a one-to-one displacement of foreign production results from the increased Hawaii swordfish effort, we expect a beneficial spillover of turtle bycatch. Specifically we expect that production displacement that occurs from the proposed action will reduce green turtle interactions in the central and north Pacific (Chan and Pan 2012). The reduction in turtle interactions as a result of the beneficial spillover is expected to be 12% for all species combined. For greens this equates to 11 fewer interactions in the central and north Pacific, where the Hawaii shallow-set fleet operates. As discussed in the previous loggerhead section, impacts to turtles are not the same between U.S. longliners and international fleets. The current mortality rate for greens in the Hawaii shallow-set longline fishery is 18.6 %. The mortality rate in the U.S. for hard-shelled turtles before all of the current mitigation techniques were put in place was around 40% (Gillman et al. 2007). As explained in the previous section on loggerheads, international fleets do not follow all techniques that are required in the U.S. and therefore would have a higher mortality rate, closer to what the U.S. had previously. Therefore we would expect a reduction in green mortalities of 1 - 4 per year[27], when mortality rates of 18.6% and 40% are applied.

7.5.4 Risk

As shown by the eight genetic samples of green turtles from the shallow-set (Table 2, Section 5), individuals may come from either the central or eastern Pacific populations. Since we estimate a total of one individual will be killed annually by the proposed action, one turtle from each population is expected to be killed every two 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 spillover effect from the proposed action is expected to indirectly reduce green turtle mortality from the eastern Pacific and possibly other populations. As described above, the reduction is estimated to be 11 fewer interactions in the central and north Pacific (Chan and Pan 2012), or four fewer green turtle mortalities. While the indirect beneficial spillover effect reduces the green turtle mortalities, the spillover effect analysis does not allow us to quantify with precision the number of mortalities. However, we can conclude, with reasonable certainty, that there will be a reduction of green turtle mortalities as a result of the spillover effect.

[27] 11 green interactions * (.186) mortality rate = 2 (round from 2.0). 2 mortalities from international fleets – 1 mortality from U.S. fleet = 1. 11 green interactions * (.40) mortality rate = 5 (round from 4.4) mortalities from international fleets. 5 mortalities from international fleets – 1 mortality from U.S. fleet = 4.

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 five species addressed by this opinion are likely to occur as a result of worsening climate change, and any increase in 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 also could result in corresponding increases in fishing gear entanglements and ship strikes of humpback whales and in fishing gear interactions of the four turtle species. In addition, any increases in marine debris could also increase entanglements of all five species.

Global anthropogenic climate change is expected to continue and therefore may impact humpback whales and their habitat in the future. As stated previously, the humpback whale is a cosmopolitan species ranging throughout the world's oceans and thermal and prey limitations related to climate change are unlikely to impact the range of this species (MacLeod 2009). Whilst oceanic cetaceans are unlikely to be directly affected by rises in sea levels, important habitats for coastal species and species that require coastal bays and lagoons for breeding, such as humpback whales, could be adversely affected in the future (Simmonds and Elliot 2009). Humpback whales that feed in polar-regions may also encounter reduced prey.

Global anthropogenic climate change is expected to continue and to therefore continue to impact sea turtles and their habitats. Rising temperatures at nesting beaches may continue to exacerbate a female bias in hatchling sex ratio and could also increase embryonic mortality if beaches are already at the high end of thermal tolerance for sea turtle nests (Matsuzawa et al. 2002). In addition the number of severe storms is expected to increase with warming ocean temperatures which is expected to change the shape of nesting beaches and to wipe out nests. This has been documented in the Atlantic; comparisons were made between loggerhead and green turtle nesting and cyclone intensity and they found that hatching success declines with increased cyclone intensity (Van Houtan and Bass 2009). Only low-level nesting of greens takes place inside the action area. However, turtles that occur in the action area come from nesting aggregations that may be affected by impacts at their nesting beaches of origin throughout the Pacific. The best available demonstrations of the potential effects of sea level rise indicate that some sea turtle nesting beaches will lose a percentage of their current area by 2100 (Fish et al. 2005; Baker et al. 2006; Fuentes et al. 2009), however these were modeled on static systems and did not account for geomorphological dynamics, such as the natural sinking of islands or the natural growth of coral reefs to keep up with sea level rise. A quantitative analysis of physical changes in 27 atoll islands in the central Pacific over a 19 to 61 year period that corresponds with a rate of sea level rise of 2.0 mm/y shows that 86% of islands remained stable (43%) or increased in area (43%) while only 14% of study islands exhibited a net reduction in island area (Webb and Kench 2010, Van Houtan 2010), evidence that changes will not be uniform or predictable and sea level rise may or may not result in beach loss.

Alterations to foraging habitats and prey resources, changes in phenology and reproductive capacity that correlate with fluctuations in SST, and potential changes in migratory pathways and range expansion (all discussed previously in Environmental Baseline) are additional ways in which sea turtles may continue to be impacted by climate change. Many marine species, including the pelagic life stages of sea turtle species in the action area, forage in areas of nutrient rich oceanic upwelling, the strength, location, and predictability of which may change with increasing global temperatures (Harwood 2001).

Recent studies have shown that several sea turtle populations are correlated with climate variability over long periods of time (Van Houtan and Halley 2010; del Monte-Luna et al. 2011). The Pacific Decadal Oscillation (PDO) and the Atlantic Multidecadal Oscillation (AMO) reflect atmospheric circulation patterns that regulate oceanographic processes and ecosystem productivity. The greatest influence appears to occur early on in a hatchling's life, when "climate is the parent," and there is high or low productivity (Van Houtan and Halley 2010). Years of high productivity are correlated later in time (when they reach maturity) with higher levels of nesters appearing at beaches, and low productivity years with the opposite for loggerheads in both the Atlantic and the Pacific (Van Houtan and Halley 2010). Another component of this study is the climate influence on nesting females, where SST temperatures have been shown to influence breeding remigration, as mentioned earlier. The studies have some value in using current environmental conditions to predict how many nesting females may exist at some future date. This provides us with an idea of what current conditions will mean over the next generation, however we are unable at this time to predict the PDO or AMO for projecting trends in future generations. Additionally, we are currently unable to predict what influence anthropogenic climate change and increasing temperatures will have on the PDO or AMO.

Although there is much speculation about potential impacts of climate change to species and ecosystems, there are multiple layers of uncertainty associated with these analyses making it impossible to accurately predict the most likely scenario that will result and consequently what impacts species and ecosystems will face, particularly in Pacific Island countries (Barnett 2001). Effects of climate change will not be globally uniform (Walther et al. 2002) and information regarding the magnitude of future climate change is speculative and fraught with uncertainties (Nicholls and Mimura 1998). In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles or humpback whales that may be within the action area.

In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Impact assessment models that include adaptation often base assumptions on when, how, and to what adaptations occur on theoretical principles, inference from observations, and arbitrary selection, speculation, or hypothesis (see review in Smit 2000). Impacts of climate change and hence its 'seriousness' can be modified by adaptations of various kinds (Tol et al. 1998). Ecological systems evolve in an ongoing fashion in response to stimuli of all kinds, including climatic stimuli (Smit et al. 2000). Sea turtles and humpback whales may exhibit a variety of adaptations to cope with climate change-related impacts, although it will likely take decades to centuries for both climate-related impacts and associated adaptations to occur (Limpus 2006) making it increasingly difficult to predict future impacts of climate change on these species in the action area. For example, sea turtles are known to be highly mobile and in the past have shown the ability to adapt to changes in their environment and relocate to more suitable foraging and nesting sites over the course of multiple generations. Implications of climate change at the population level are a key area of uncertainty and one of active research (e.g. Jonzén et al. 2007) and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale, nor can they be qualitatively described or predicted in such a way as could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action, which is 25 years, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

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' together with the 'Environmental Baseline' and the 'Cumulative Effects', 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 is 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 a population's base condition (established in the Status of Listed Species and Environmental Baseline sections of this opinion) as context for the overall effects of the action on affected populations. Finally, our opinion determines if changes in population viability, based on the Effects of the Action and the Cumulative Effects, are likely to be sufficient to reduce viability of the species those populations comprise. The following discussions summarize the probable risks the proposed action poses to the five listed species addressed by this opinion.

Humpback Whales. As discussed in the humpback section of the Status of Listed Species (Section 5.1), there were an estimated 21,000 adults in the north Pacific population in 2010, and the population has grown at approximately 4.9 to 6.8 percent per year. The CNP stock is at approximately 10,000 (NMFS 2011f; Allen and Angliss 2010). As discussed in the humpback section of the Environmental Baseline (Section 6.1), up to one mortality annually from the CNP stock is occurring within the action area due to fishery interactions and boat strikes from all international and domestic fleets. As described in the Effects of the Action (Section 7.1), if we assume that the proposed action will result in 5,500 sets annually, that level of effort will result in one humpback interaction annually, which will result in one mortality every five years from the CNP stock.

As discussed in the Cumulative Effects section, effects to humpback whales may occur as a result of worsening climate change, and any increase in 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, as well as an increase in effects resulting from fishing gear interactions. In addition, any increases in marine debris could also increase entanglements. Global climate change is expected to continue and therefore may impact humpback whales and their habitat in the future. As stated previously, the humpback whale is a cosmopolitan species ranging throughout the world's oceans and thermal and prey limitations related to climate change are unlikely to impact the range of this species (MacLeod 2009). Whilst oceanic cetaceans are unlikely to be directly affected by rises in sea levels, important habitats for coastal species and species that require coastal bays and lagoons for breeding, such as humpback whales, could be adversely affected in the future (Simmonds and Elliot 2009). Humpback whales that feed in polar-regions may also encounter reduced prey. As discussed earlier in this opinion, although there is much speculation on the potential impacts of climate change to species and ecosystems, there are multiple layers of uncertainty associated with these analyses and the effects of climate change will not be globally uniform. In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to humpback whales that may be within the action area. In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Implications of climate change at the population level are a key area of uncertainty and one of active research (e.g. Jonzén et al. 2007) and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way as could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action of 25 years, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

We considered to what extent the effects of the action affect survival and recovery of the humpback whale. The NMFS and USFWS' ESA Section 7 Handbook (USFWS and NMFS 1998) provides further definitions for *survival* and *recovery*, as they apply to the ESA's jeopardy standard[28].

> *Survival* means: the species' persistence beyond the conditions leading to its endangerment, with sufficient resilience to allow recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficiently large population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter.

[28] "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).

> *Recovery* means: improvement in the status of a listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act. Said another way, recovery is the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities.

The NMFS (1991) humpback whale recovery plan contains a number of goals and criteria that should be met to achieve recovery. 1) To increase humpback whale population to at least 60% of the number existing before commercial exploitation or of current environmental carrying capacity; acceptable evidence of ongoing recovery will be statistically significant trends of population increase; 2) statistically significant trends of population increases in portions of the range known to have been occupied in historical times; 3) maintain and enhance habitat; and 4) Reduce human-related mortality, injury and disturbance.

The population size for the entire north Pacific is estimated to be approximately 21,000. The population size of the CNP stock is approximately 10,000 and this is the stock that the Hawaii shallow-set interacts with based on the locations of the observed interactions. As discussed above, the anticipated deaths resulting from the proposed action results in the removal of approximately one every five years, or 0.02 percent of the estimated current total north Pacific population over 25 years. However, these animals would be removed from a population which is increasing at a greater rate suggesting that the percentage of loss to the overall north Pacific population will decrease over the 25 years. Additionally, the north Pacific population is one of several populations that make up the humpback whale species. Because this contribution to mortality is small and will be a decreasing fraction of what total mortality for the species might be, we do not believe that the small effect posed by lethal takes in this fishery, when considered together with the environmental baseline and the cumulative effects, will be detectable or appreciable.

We conclude that the incidental take and resulting mortality of north Pacific humpback whales associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of the species. We expect the overall population to continue to grow and to maintain genetic heterogeneity, broad demographic representation, and to successfully reproduce. The proposed action will have a small effect on the overall size of the population, and we do not expect it to affect the humpbacks' ability to meet their lifecycle requirements and to retain the potential for recovery.

The ESA allows for incidental take of species resulting from otherwise lawful activities (such as the proposed action), provided that such take does not result in jeopardy, and the impact of such take is minimized to the extent practicable. In addition, section 101(a)(5)(E) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. 1361 et seq., has provisions for NOAA's National Marine Fisheries Service (NMFS) to issue permits for the taking of marine mammals designated as depleted because of their listing under the Endangered Species Act (ESA), 16 U.S.C. 1531 et seq., by U.S. vessels, only after an analysis has been conducted to determine if the incidental mortality and serious injury from commercial fisheries will have a negligible impact on the affected species or stock. This analysis was conducted in 2010 for the Central North Pacific stock. NMFS determined that the annual mortality and serious injury incidental to commercial fisheries in Hawaii (0.2) will have a negligible impact for purposes of issuing a permit under section 101(a)(5)(E) of the MMPA because total fisheries-related serious injuries and mortalities are greater than 0.1 PBR and less than 1.0 PBR and the population is increasing.

While the proposed action would result in some incidental take of this species by the U.S. fishery, the impact of that take would be reduced to the best extent possible. These takes are rare and based on descriptions from observers of past interactions from both the deep-set and shallow-set fisheries, the majority of interactions were determined to be non-lethal because they were either released with all gear removed or they were able to break free from the gear without noticeable impairment of the animal's ability to swim or feed. In one case the interaction was determined to be serious because the gear was not removed and could potentially lead to mortality. Based on these past interactions, the majority of humpback whale takes from the proposed action are expected to be non-lethal, which are not expected to have any measurable impact on their numbers, reproduction, or distribution. The anticipated non-lethal takes are not expected to impact the reproductive potential, fitness, or growth of any of the incidentally caught humpback whales since they will be released unharmed shortly after capture, or released with only minor injuries from which they are expected to recover.

We believe that the incidental lethal and non-lethal takes of humpback whales associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the species. Although any level of take and mortality can have an adverse effect on the overlying population, we find that the expected level of take from the overall action, including a small number of mortalities, is extremely small when considered together with all impacts considered in the Status of the Species, Environmental Baseline and Cumulative Effects sections, including other federally authorized fisheries and foreign fisheries. As stated previously, the proposed action is expected to result in the mortality of one humpback every five years and the affected population is increasing. We believe the population will remain large and continue to grow to contribute to species recovery. Moreover, we do not believe that the proposed action is reasonably likely to result in an appreciable reduction in the likelihood of recovery of the species. The proposed action does not appreciably impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy

Loggerhead Turtles. 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 (NMFS 2011d). However, in 2008 the number of nests laid was the highest on record, at 11,082 nests, since comprehensive counts were started in the 1980s. Nest counts have been variable, as is typical of sea turtle nesting dynamics, going down slightly in 2009, 2010, and 2011 to 7,495, 10,121, and 9,011 respectively. While nesting trends do not necessarily reflect overall population trends (NRC 2010), the nesting trend data from Japan are currently the best available information on the status of the North Pacific DPS through 2011. The increase from approximately 2,000 nests (representing approximately 500 nesting females) in 1999, to 6,500 – 11,082 nests (representing approximately 2,500 nesting females) in 2010 demonstrates that the population trend may not directly correlate with fishing mortality rates because large numbers of turtles were caught before, during, and after this time period as described in section 6. Surveys in Japan indicated a greater than three-fold (linear scale) increase from 2007–2008. While a purely demographic model could not reproduce this trend, the climate-based model that combines the PDO and winter SST, captures this dramatic increase emphasizing the importance (forcing) of climate on this population (Van Houtan and Halley 2011, Van Houtan 2011).

As discussed in the loggerhead section of the Environmental Baseline (Section 6.2), 92 to 198 juvenile and adult North Pacific loggerhead mortalities may be occurring annually due to longline fishery interactions from all vessels targeting swordfish 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 over several hundred annually.

As described in the loggerhead section of the Effects of the Action (Section 7.2), our analysis assumes that the proposed action will result in up to 5,500 sets annually, which will result in 34 loggerhead interactions annually, and a maximum of seven mortalities annually (representing one adult female) from the North Pacific DPS. The effort level of 5,500 sets annually is based on the approximate maximum annual number of shallow sets during the period 1994-1999 and, consistent with Amendment 18, assumes an expansion of the shallow set fishery to achieve optimum yield in the swordfish fishery. The climate-based PVA model default trend predicts that the number of nesting females will decrease in the next 25 years and by the year 2035 levels could be as low as they were in 1999. While the model demonstrates that this level of decline represents a heightened risk of extinction for the DPS (species), it also indicates that there is little to no difference in the extinction risk when the annual removal of one adult female loggerhead resulting from the proposed action is considered in the model. We considered the classical PVA model's projected nine-fold loggerhead population increase by 2110, based primarily on recent strong nesting data trends in Japan. The proposed action amounting to a single annual nesting female mortality reduces the final run value by no more than 2% from the default trend, producing a small effect on population dynamics. We discounted the results of this model because it assumes static (though stochastic) growth that is based solely on the empirical nest counts and extends the recent average growth trends into the future, without accounting for empirical periodicity or future oscillations that effect sea turtle populations, such as from climate influences.

We also considered the climate-based model, which produced multiple runs below a QET, indicating high loggerhead extinction risk with high model confidence. It should be noted in this regard that QET represents an assumed fraction (in this case 50%) of the current population size, and does not necessarily mean that a population decline below that QET will be unrecoverable, or that the species is functionally extinct as previously described. The climate-based model demonstrates that environmental conditions drive long-term population dynamics and are primarily responsible for the observed time series patterns. The climate-based model better accounts for the observed changes in the empirical record to predict future population dynamics. Thus, the climate-based PVA provides a more robust analysis of the likelihood of extinction over the first generation, but has no predictive value beyond 25 years because of the inability of the model to predict PDO. The climate-based model does not consider threats other than climate influences on population dynamics. However, NMFS has high confidence in the climate-forcing model because of its ability to account for past demographic changes that cannot otherwise be accounted for. For example, the model accounted for the sharp increase in loggerhead nesting after nesting data plummeted in 1999. At the same time, we are mindful of the limitations on predicting population trends over one generation, and therefore are persuaded that a proper qualitative analysis relies on the general direction and magnitude of the probable outcomes identified in the climate-forcing model, rather than on a strict application of its numerical determinations.

Based on the projected increase in effort to 5,500 annual sets, our analysis further concludes that the spillover effect is reasonably certain to contribute to a reduction in loggerhead mortalities from the North Pacific DPS due to reduced effort in foreign fisheries. As explained in the Effects section, the displacement of foreign swordfish production is expected to result in the reduction in loggerhead mortalities because the Pacific foreign fleets analyzed by Chan and Pan interact with loggerhead sea turtles at higher rates than the Hawaii-based shallow-set fishery. Given the Hawaii-based longline fishery's effort level of 5,500 sets per year, and the expected one-to-one displacement of foreign swordfish production attributable to the beneficial spillover effect, we calculated that the proposed action would result in 22-47 fewer loggerhead sea turtle mortalities annually in the central and north Pacific. Accordingly, after considering the direct effects of the action and the indirect effects of spillover effects, we calculated that the proposed action would result in a decrease in loggerhead mortalities of 15 - 40 individuals annually from foreign fisheries. However, because the data on foreign fisheries is likely incomplete or inaccurate, foreign fishery bycatch rate estimation is imprecise. We also note that the expected number of sea turtle interactions with foreign fisheries that would have occurred but for the proposed action cannot be confirmed by direct observation. Finally, notwithstanding our conclusion that a beneficial spillover effect occurs from the regulation of the Hawaii-based shallow-set fishery, the mortality reduction data associated with spillover effects are not as robust as those analyzed for the direct effects of the proposed action. For these reasons, we do not incorporate the numerical determination that 22-47 sea turtle mortalities will be avoided as a result of the spillover effect in our quantitative PVA models.

As discussed in the Cumulative Effects section (Section 8), effects to this DPS are likely to occur as a result of worsening climate change, and any increase in 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, as well as an increase effects resulting from fishing gear interactions with this DPS. In addition, any increases in marine debris could also increase entanglements. Global climate change is expected to continue and therefore may impact sea turtles and their habitats in the future. As discussed in this opinion, rising temperatures at nesting beaches may have negative consequences for incubating nests. While loggerhead nesting does not take place inside the action area, turtles that occur in the action area come from nesting aggregations that may be affected by impacts at their nesting beaches of origin throughout the Pacific, although changes will likely not be uniform or predictable. As also discussed in the Cumulative Effects section of this opinion, climate change may impact aquatic aspects of sea turtle biology and ecology, including foraging habitats and prey resources, phenology, and migration. As discussed earlier in this opinion, although there is much speculation about potential impacts of anthropogenic induced climate change to species and ecosystems, there are multiple layers of uncertainty associated with these analyses and the effects of climate change will not be globally uniform. In particular, there is no comprehensive assessment of potential impacts of anthropogenic climate change within the action area or specific to sea turtles that may be within the action area. In addition to uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Implications of climate change at the population level are a key area of uncertainty and one of active research and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way as could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant. Viewed within the context of the Status of the Species, the Environmental Baseline, and the Cumulative Effects, the annual loss of the equivalent of up to one adult female due to the proposed action (Section 7.2) is not expected to adversely affect population dynamics of the North Pacific loggerhead DPS.

We considered to what extent the effects of the action affect survival and recovery of the North Pacific loggerhead DPS sea turtles. The NMFS and USFWS' ESA Section 7 Handbook (USFWS and NMFS 1998) provides further definitions for *survival* and *recovery*, as they apply to the ESA's jeopardy standard (please refer to the humpback whale discussion in this section for definitions).

The NMFS and USFWS (1998) loggerhead sea turtle recovery plan contains a number of goals and criteria that should be met to achieve recovery. These include reducing, to the best extent possible, take in international waters; identifying regional stocks to source beaches; ensuring all females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 25 years; ensuring each "stock" has an average 5,000 FENA (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) over six years; ensuring foraging areas are maintained as healthy environments; ensuring foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; ensuring all priority #1 tasks have been implemented; ensuring a management plan designed to maintain stable or increasing populations of turtles is in place; ensuring there is a formal cooperative relationship with a regional sea turtle management program; and ensuring international agreements are in place to protect shared stocks (e.g., Mexico and Japan). Priority 1 tasks include a number of actions, including but not limited to, monitoring of nesting activity, determining population trends, identifying stock boundaries, reducing incidental mortality in commercial fisheries, and ensuring protection of marine habitat.

As discussed above, recent population estimates and modeling present differing conclusions regarding whether loggerhead nesting and adult female populations in the North Pacific Ocean are in decline. Although we are persuaded that the climate-based model provides the most accurate analysis of population trends, we recognize that it is possible that observed declines may be transitory effects, which will be compensated for by a wave of recruitment during a future climate cycle.

Adult female nesting population size for the North Pacific DPS is conservatively estimated at approximately 7,100. As discussed above, the anticipated deaths resulting from the continued authorization of the shallow set fishery results in the removal of approximately one adult female annually, or 0.35 percent of the estimated total population over 25 years. Because this contribution to mortality is an insignificant fraction of what total mortality for the species might be, we do not believe that the small effect posed by the lethal takes in this fishery, when considered together with the environmental baseline and the cumulative effects, will be detectable or appreciable. As discussed in this opinion, the results of the climate-based PVA also suggest that the additional risk to the North Pacific DPS that would result from loss of one adult female annually is considered negligible.

We conclude that the incidental take and resulting mortality of North Pacific loggerhead turtles associated with the direct effects of the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of the DPS. Despite the projected population decline over one generation, we expect the overall population to remain large enough to maintain genetic heterogeneity, broad demographic representation, and successful reproduction. The proposed action will have a small effect on the overall size of the population, and we do not expect it to affect the loggerheads' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not believe that the proposed action will impede progress on carrying out any aspect of the recovery plan or achieving the overall recovery strategy. The majority of the recovery criteria and priority 1 tasks will not be affected by the proposed action. Those that could potentially be affected and are most relevant to the analysis of the proposed action on recovery are 1) To the best extent possible, reducing take in international waters, 2) Ensuring all females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 25 years; 3) Ensuring each "stock" has an average 5,000 FENA (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) over six years"; 4) Ensuring foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; and 5) Reducing incidental mortality in commercial, recreational fisheries.

The ESA allows for incidental take of species resulting from otherwise lawful activities (such as the proposed action), provided that such take does not result in jeopardy, and the impact of such take is minimized to the extent practicable. While the direct effects of the proposed action would result in some incidental take of this DPS by the U.S. fishery, the impact of that take would be reduced to the best extent possible. The vast majority of the loggerhead sea turtle takes from the proposed action are expected to be non-lethal, which are not expected to have any measurable impact on their numbers, reproduction, or distribution. We have applied the post-release mortality criteria conservatively to ensure that sea turtles that are likely to be seriously injured by capture in the fisheries are counted as lethal takes. The anticipated non-lethal takes are not expected to impact the reproductive potential, fitness, or growth of any of the incidentally caught sea turtles because they will be released unharmed shortly after capture, or released with only minor injuries from which they are expected to recover. Individual takes may occur anywhere in the action area and turtles would be released within the general area where they are caught. Additionally, based on the results of the spillover effects analysis (Chan and Pan 2012), an indirect effect of the proposed action is that there would be a reduction of sea turtles taken lethally if the proposed action is permitted to occur and expand to 5,500 sets per year.

Although the proposed action would result in the mortality of up to one nesting female annually, as discussed above, this level of mortality would present negligible additional risk to the North Pacific DPS. Since it represents a negligible risk to the DPS, the proposed action would not prohibit the DPS from stabilizing or increasing, nor would it prohibit the DPS from reaching a biologically reasonable FENA based on the goal of maintaining a stable population in perpetuity. The negligible risk to the DPS nesting population, which is the source of animals found at foraging grounds, means it would not substantially impair or prohibit increases to DPS foraging populations at key foraging grounds. The effects of the action would not prohibit or substantially impair continuing efforts to reduce mortality in commercial fisheries. Additionally, there would be no negative indirect effects to nesting females from the proposed action. Rather, indirect effects are expected to result in a reduction in sea turtles taken lethally by foreign fisheries, which would be beneficial to the recovery of the DPS.

We believe that the incidental lethal and non-lethal takes of loggerhead turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the North Pacific DPS. Although any level of take and mortality can have an adverse effect on the overlying population, we find that the expected level of take from the action, including a small number of mortalities, is extremely small when considered together with all impacts considered in the Status of the Species, Baseline and Cumulative Effects sections, including other federally authorized fisheries and foreign fisheries. As stated previously, the proposed action is expected to result in the annual mortality of only one adult female equivalent. Although population trends reveal a declining population over the next 25 years, we believe that the population will remain large enough to retain the potential for recovery. Moreover, we do not believe that the proposed action is reasonably likely to result in an appreciable reduction in the likelihood of recovery of the North Pacific DPS. The proposed action does not appreciably impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy. In addition the proposed action is expected to have a beneficial effect on the North Pacific DPS because baseline impacts contributing to recent declines will be reduced due to the spillover effect.

To summarize, when considering the effects of the proposed action, together with the status of the listed species, the environmental baseline, and the cumulative effects, we believe that the lethal and non-lethal takes of loggerhead sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of both the survival and recovery of the North Pacific loggerhead DPS in the wild. We reach our no jeopardy conclusion with or without the beneficial effect of spillover.

Leatherback Turtles. As discussed in the leatherback section of the Status of Listed Species (Section 5.3), the western Pacific leatherback population harbors the last remaining nesting aggregation of significant size in the Pacific with approximately 2700–4500 breeding females (Dutton et al. 2007; Hitipeuw et al. 2007). The total number of adult females in the Jamursba-Medi component of the western Pacific population was estimated at 1,233 for the period 2008-2010 by Van Houtan (2011), 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 1,233/0.38 = 3,245. As discussed in the leatherback section of the Environmental Baseline (Section 6.3), 83 to 120 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.

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 up to 5,500 sets annually, then that level of effort will result in 26 leatherback interactions annually, and a maximum of 6, mostly adult mortalities annually (representing 4 adult females) from the western Pacific population. The effort level of 5,500 sets annually is based on the approximate maximum annual number of shallow sets during the period 1994-1999, and consistent with Amendment 18, assumes an expansion of the shallow set fishery to achieve optimum yield in the swordfish fishery. The climate-based PVA model default trend predicts that the number of nesting females will increase in the next 25 years and by the year 2035 there could be an over 80% increase. When the loss of 4 adult females is modeled none of the runs fall below QET and there is still an increase in the population of 27-82% (Figure 10b) (Van Houtan 2011). Figure 10c shows the two model averages together which shows that there is a noticeable deviation between the default trend and the proposed action trends (Van Houtan 2011). However, in both instances, (the default trend and the proposed action) there is a low risk for extinction and high model confidence. The results show that there is a measureable loss to the population as a result of the proposed action, but the population still shows growth. The classical approach projects a large population decrease by 2110, based primarily on an overall decline in nesting data trends in Jamursba-Medi. When the proposed action is run with the mortality of 4 adult females, there is a greater decline in the overall population size but the extinction risk does not change since essentially all of the model runs fall below the QET, as does the entire 95% confidence interval for both the default trend and the proposed action (Figure 9(a)(b)). The model's limitations are that it assumes static (though stochastic) growth that is based solely on the empirical nest counts and extends the recent average growth trends into the future, without accounting for empirical periodicity or future oscillations, such as from climate influences. The climate-based model, on the other hand, produced zero runs below a QET, indicating low leatherback extinction risk with high model confidence. It should be noted in this regard that QET represents an assumed fraction (in this case 50%) of the current population size, and does not necessarily mean that a population decline below that QET will be unrecoverable, or that the species is functionally extinct. The climate-based model assumes that environmental conditions may likely drive long-term population dynamics and are mostly responsible for the observed time series patterns. The climate-based model better accounts for the observed changes in the empirical record to predict future population dynamics. Thus, the climate-based PVA provides a more robust analysis of the likelihood of extinction over the first generation, but has no predictive value beyond 25 years because of the inability of the model to predict PDO. Like the classical approach, the climate-based model does not consider threats other than climate influences on population dynamics. NMFS has confidence in the climate-based model because of its ability to account for past demographic changes that cannot otherwise be accounted for. For example, the model accounted for the overall observed decline since 1993 and the 77% drop between the 2004-05 season. At the same time, we are mindful of the limitations on predicting population trends over one generation, and therefore are persuaded that a proper qualitative analysis should consider aspects of both models.

The Jamursba-Medi component of the population represents about 38% of the entire western Pacific population, however it accounts for the majority of leatherback interactions with the Hawaii shallow-set fishery at the level of fishing effort of the proposed action. The remaining 62 % of the population has less of a chance of interacting with the fishery because the majority of nesting occurs in the winter, which means these animals have different migratory routes that don't enter the proposed action area. Given that the majority of interactions resulting from the proposed action are with the Jamursba-Medi component, the risk to it is the best measure of the risk of the proposed action to the overall population. Considering that the remainder of the population is larger than the Jamursba-Medi component, the nesting trend for the remainder of the population is fairly stable from the data we have, and that the maximum impact would be 2 adult female mortalities annually, we do not anticipate that these 2 mortalities annually would appreciably reduce the likelihood of survival of the non Jamursba-Medi component of the population. We believe that the proposed action will have a negligible impact on the risk to the Jamursba-Medi component, the non-Jamursba-Medi component, and therefore the western Pacific leatherback population as whole.

Based on the projected increase in effort to 5,500 annual sets, our analysis further concludes that in the spillover effect is reasonably certain to contribute to a reduction in leatherback mortality from the western pacific population due to reduced effort in foreign fisheries. As explained in the Effects section, the displacement of foreign swordfish production is expected to result in the reduction of leatherback mortalities because the Pacific foreign fleets analyzed by Chan and Pan interact with leatherback sea turtles at higher rates than the Hawaii-based shallow-set fishery. Given the Hawaii-based longline fishery's effort level of 5,500 sets per year, and the one-to-one displacement of foreign swordfish production attributable to the beneficial spillover effect, we calculated that the proposed action would result in 20-29 fewer leatherback sea turtle mortalities annually in the central and north Pacific. Accordingly, after considering the direct effects of the action and the indirect effects of spillover effects, we calculated that the proposed action would result in an overall decrease in leatherback mortalities of 14 - 23[29] individuals annually from foreign fisheries. However, because the data on foreign fisheries is likely incomplete or inaccurate, foreign fishery bycatch rate estimation is imprecise. We also note that the expected number of sea turtle interactions with foreign fisheries that would have occurred but for the proposed action cannot be confirmed by direct observation. Finally, notwithstanding our conclusion that a beneficial spillover effect occurs from the regulation of the Hawaii-based shallow-set fishery, the mortality reduction data associated with spillover effects are not as robust as those analyzed for the direct effects of the proposed action. For these reasons, we do not incorporate the numerical determination that 20-29 sea turtle mortalities will be avoided as a result of the spillover effect in our quantitative PVA models.

As discussed in the Cumulative Effects section, effects to leatherback sea turtles are likely to occur as a result of worsening climate change, and any increase in 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, as well as an increase in effects resulting from fishing gear interactions. In addition, any increases in marine debris could also

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[29] Spillover reduction in turtles minus the direct take mortalities from the Hawaii-based shallow-set fishery, which is 6 annually.

increase entanglements. Global climate change is expected to continue and therefore may impact sea turtles and their habitat in the future. As discussed in this opinion, rising temperatures at nesting beaches may have negative consequences for nesting females. While leatherback nesting does not take place inside the action area, turtles that occur in the action area come from nesting aggregations that may be affected by impacts at their nesting beaches of origin throughout the Pacific, although changes will likely not be uniform or predictable. As also discussed in the Cumulative Effects section of this opinion, climate change may impact aquatic aspects of sea turtle biology and ecology, including foraging habitats and prey resources, phenology, and migration. As discussed earlier in this opinion, although there is much speculation on the potential impacts of climate change to species and ecosystems, there are multiple layers of uncertainty associated with these analyses and the effects of climate change will not be globally uniform. In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles that may be within the action area. In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Implications of climate change at the population level are a key area of uncertainty and one of active research (e.g. Jonzén et al. 2007) and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way as could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action of 25 years, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

We considered to what extent the effects of the action affect survival and recovery of the leatherback sea turtle. The NMFS and USFWS' ESA Section 7 Handbook (USFWS and NMFS 1998) provides further definition for *survival* and *recovery*, as they apply to the ESA's jeopardy standard (please refer to the humpback whale discussion in this section for definitions).

The NMFS and USFWS (1998) leatherback sea turtle recovery plan contains a number of goals and criteria that should be met to achieve recovery. These include all regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters; each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years; nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period; existing foraging areas are maintained as healthy environments; foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; all Priority #1 tasks have been implemented; a management plan designed to maintain sustained populations of turtles is in place.

As discussed above, recent population estimates and modeling present differing conclusions regarding whether leatherback nesting and adult female populations in the western Pacific Ocean are in decline. Although we are persuaded that the climate-based model provides the most accurate analysis of population trends, we recognize that it is possible that observed increases may be transitory effects, and that population reductions may be expected to occur during a future climate cycle.

Adult female nesting population size for the western Pacific population is estimated at approximately 3,245.[30] As discussed above, the anticipated deaths resulting from the continued authorization of the shallow set fishery results in the removal of approximately four adult females annually, or 33.1 percent of the estimated current total western Pacific population over 25 years. However, these animals would be removed from a population which is oscillating, but increasing, which suggests that the percentage of loss to the overall western Pacific population will decrease over the 25 years. Additionally, the western Pacific population is one of several populations that make up the leatherback species. Because this contribution to mortality is small and will be a decreasing fraction of what total mortality for the species might be, we do not believe that the small effect posed by the lethal takes in this fishery, when considered together with the environmental baseline and the cumulative effects, will be detectable or appreciable. As discussed in this opinion, the results of the climate-based PVA also suggest that the leatherback population will continue to grow, even when considering the direct effects of the proposed action.

We conclude that the incidental take and resulting mortality of western Pacific leatherback sea turtles associated with the direct effects of the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of the species. We expect the overall population to continue to grow and to maintain genetic heterogeneity, broad demographic representation, and successfully reproduce. The proposed action will have a small effect on the overall size of the population, and we do not expect it to affect the leatherbacks' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not believe that the proposed action will impede progress on carrying out any aspect of the recovery plan or achieving the overall recovery strategy. The majority of the recovery criteria and priority 1 tasks will not be affected by the proposed action. Those that could potentially be affected and are most relevant to the analysis of the proposed action on recovery are: 1) each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years; 2) nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period; 3) foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; 5) reduce incidental mortality in commercial, recreational fisheries.

The ESA allows for incidental take of species resulting from otherwise lawful activities (such as the proposed action), provided that such take does not result in jeopardy, and the impact of such take is minimized to the extent practicable. While the direct effects of the proposed action would result in some incidental take of this species by the U.S. fishery, the impact of that take would be reduced to the best extent possible. The vast majority of the leatherback sea turtle takes from the proposed action are expected to be non-lethal, which are not expected to have any measurable impact on their numbers, reproduction, or distribution. We have applied the post-release mortality criteria conservatively to ensure that sea turtles that are likely to be seriously injured by capture in the fisheries are counted as lethal takes. The anticipated non-lethal takes are not

[30] Number of females nesting at Jamursba-Medi is calculated to be approximately 1233, which is approximately 38% of the Western Pacific population of nesters. 1233 divided by 38% is 3245 females.

expected to impact the reproductive potential, fitness, or growth of any of the incidentally caught sea turtles because they will be released unharmed shortly after capture, or released with only minor injuries from which they are expected to recover. Individual takes may occur anywhere in the action area and turtles would be released within the general area where they are caught. Additionally, based on the results of the spillover effects analysis (Chan and Pan 2012), an indirect effect of the proposed action is that there would be a reduction of sea turtles taken lethally by foreign fisheries if the proposed action is permitted to occur and expand to 5,500 sets per year.

Although the proposed action would result in the mortality of up to 4 nesting females annually, as discussed above, this level of mortality would present negligible additional risk to the leatherback sea turtle. Since it represents a negligible risk to the species, the proposed action would not prohibit the species nesting populations from increasing as predicted, nor would it prohibit the species from reaching a biologically reasonable FENA based on the goal of maintaining a stable population in perpetuity. The negligible risk to the species nesting population, which is the source of animals found at foraging grounds, means it would not substantially impair or prohibit increases to leatherback foraging populations at key foraging grounds. The effects of the action would not prohibit or substantially impair continuing efforts to reduce mortality in commercial fisheries. Additionally, there would be no negative indirect effects to nesting females from the proposed action. Rather, indirect effects are expected to result in a reduction in sea turtles taken lethally by foreign fisheries, which would be beneficial to the recovery of the species.

We believe that the incidental lethal and non-lethal takes of leatherback sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the species. Although any level of take and mortality can have an adverse effect on the overlying population, we find that the expected level of take from the overall action, including a small number of mortalities, is extremely small when considered together with all impacts considered in the Status of the Species, Baseline and Cumulative Effects sections, including other federally authorized fisheries and foreign fisheries. As stated previously, the proposed action is expected to result in the annual mortality of four adult females. However, the affected population is expected to increase, even with this loss of females. We believe the population will remain large enough to retain the potential to contribute to species recovery. Moreover, we do not believe that the proposed action is reasonably likely to result in an appreciable reduction in the likelihood of recovery of the species. The proposed action does not appreciably impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy. In addition the proposed action is expected to have a beneficial effect on the leatherback sea turtle as well because baseline impacts will be reduced due to the spillover effect. We expect the proposed action to reduce leatherback mortalities by at least 14 individuals annually from the western Pacific population.

To summarize, when considering the effects of the proposed action, together with the status of the listed species, the environmental baseline, and the cumulative effects, we believe that the lethal and non-lethal takes of leatherback sea turtles associated with the proposed action are not expected to appreciably reduce the reproduction, numbers, or distribution of the western Pacific leatherback population, and thus the leatherback sea turtle as a species. The proposed action is not expected to cause an appreciable reduction in the likelihood of both the survival and recovery of the leatherback sea turtle in the wild. We reach our no jeopardy conclusion with or without the beneficial effect of spillover.

Olive Ridley Turtles. 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 but may also include approximately 100,000 turtles nesting annually in the Indian Ocean (NMFS and USFWS 2007c)..

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.

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 5,500 sets annually, then that level of effort will result in 2 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.

Based on the projected increase in effort to 5,500 annual sets, our analysis further concludes that the spillover effect is reasonably certain to contribute to a reduction in olive ridley mortality from the eastern or western population due to reduced effort in foreign fisheries. As explained in the Effects section, the displacement of foreign swordfish production is expected to result in the reduction in olive ridley mortalities because the Pacific foreign fleets analyzed by Chan and Pan interact with olive ridley sea turtles at higher rates than the Hawaii-based shallow-set fishery. Given the Hawaii-based longline fishery's effort level of 5,500 sets per year, and the one-to-one displacement of foreign swordfish production attributable to the beneficial spillover effect, we calculated that the proposed action would result in 2-3 fewer olive ridley sea turtle mortalities annually in the central and north Pacific. Accordingly, after considering the direct effects of the action and the indirect effects of spillover effects, we calculated that the proposed action would result in a decrease in olive ridley mortalities of 1-2 individuals annually from foreign fisheries. However, because the data on foreign fisheries is likely incomplete or inaccurate, foreign fishery bycatch rate estimation is imprecise. We also note that the expected number of sea turtle interactions with foreign fisheries that would have occurred but for the proposed action cannot be confirmed by direct observation. Finally, notwithstanding our conclusion that a beneficial spillover effect occurs from the regulation of the Hawaii-based shallow-set fishery, the mortality reduction data associated with spillover effects are not as robust as those analyzed for the direct effects of the proposed action. For these reasons, we do not incorporate the numerical determination that 2-3 sea turtle mortalities will be avoided as a result of the spillover effect in our quantitative PVA models.

As discussed in the Cumulative Effects section, effects to this species are likely to occur as a result of worsening climate change, and any increase in 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, as well as an increase effects resulting from fishing gear interactions with this species. In addition, any increases in marine debris could also increase entanglements. Global climate change is expected to continue and therefore may impact sea turtles and their habitat in the future. As discussed in this opinion, rising temperatures at nesting beaches may have negative consequences for nesting females. While olive ridley nesting does not take place inside the action area, turtles that occur in the action area come from nesting aggregations that may be affected by impacts at their nesting beaches of origin throughout the Pacific, although changes will likely not be uniform or predictable. As also discussed in the Cumulative Effects section of this opinion, climate change may impact aquatic aspects of sea turtle biology and ecology, including foraging habitats and prey resources, phenology, and migration. As discussed earlier in this opinion, although there is much speculation on the potential impacts of climate change to species and ecosystems, there are multiple layers of uncertainty associated with these analyses and the effects of climate change will not be globally uniform. In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles that may be within the action area. In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Implications of climate change at the population level are a key area of uncertainty and one of active research and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way as could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action of 25 years, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

We considered to what extent the effects of the action affect survival and recovery of the olive ridley sea turtle. The NMFS and USFWS' ESA Section 7 Handbook (USFWS and NMFS 1998) provides further definition for *survival* and *recovery*, as they apply to the ESA's jeopardy standard (please refer to the humpback whale discussion of this section for definitions).

The NMFS and USFWS (1998) olive ridley sea turtle recovery plan contains a number of goals and criteria that should be met to achieve recovery. These include all regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters; foraging populations are statistically significantly increasing at several key foraging grounds within each stock region; all females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 10 years; a management plan based on maintaining sustained populations for turtles is in effect; international agreements are in place to protect shared stocks.

As discussed above, the anticipated deaths resulting from the continued authorization of the shallow set fishery results in the removal of approximately one juvenile or adult turtle (either sex) annually, or 25 turtles over the length of the proposed action. Viewed within the context of the Status of the Species, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects, we believe the annual mortality of 1 individual olive ridley caused by the proposed action 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, and thus the species.

We conclude that the incidental take and resulting mortality of olive ridley turtles associated with the direct effects of the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of the species. We expect the overall population to remain large enough maintain genetic heterogeneity, broad demographic representation, and successful reproduction. The proposed action will have a negligible effect on the overall size of the population, and we do not expect it to affect the olive ridleys' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not believe that the proposed action will impede progress on carrying out any aspect of the recovery plan or achieving the overall recovery strategy. The majority of the recovery criteria will not be affected by the proposed action. Those that could potentially be affected and are most relevant to the analysis of the proposed action on recovery are: 1) ensuring foraging populations are statistically significantly increasing at several key foraging grounds within each stock region; and 2) all females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 10 years.

The ESA allows for incidental take of species resulting from otherwise lawful activities (such as the proposed action), provided that such take does not result in jeopardy, and the impact of such take is minimized to the extent practicable. While the direct effects of the proposed action would result in some incidental take of this species by the U.S. fishery, the impact of that take would be reduced to the best extent possible. There are very few anticipated takes of olive ridley sea turtles due to the proposed action and most are expected to be non-lethal, which are not expected to have any measurable impact on their numbers, reproduction, or distribution. We have applied the post-release mortality criteria conservatively to ensure that sea turtles that are likely to be seriously injured by capture in the fisheries are counted as lethal takes. The anticipated non-lethal takes are not expected to impact the reproductive potential, fitness, or growth of any of the incidentally caught sea turtles because they will be released unharmed shortly after capture, or released with only minor injuries from which they are expected to recover. Individual takes may occur anywhere in the action area and turtles would be released within the general area where they are caught. Additionally, based on the results of the spillover effects analysis (Chan and Pan 2012), an indirect effect of the proposed action is that there would be a reduction of olive ridley sea turtles taken lethally by foreign fisheries if the proposed action is permitted to occur and expand to 5,500 sets per year.

Although the proposed action would result in the mortality of up to one olive ridley turtle annually, as discussed above, this level of mortality would present negligible additional risk to the species. Since it represents a negligible risk to the species, the proposed action would not prohibit the species from stabilizing or increasing, nor would it prohibit the species from reaching a biologically reasonable FENA based on the goal of maintaining a stable population in perpetuity. The negligible risk to the olive ridley nesting population, which is the source of animals found at foraging grounds, means it would not substantially impair or prohibit increases to olive ridley foraging populations at key foraging grounds. The effects of the action would not prohibit or substantially impair continuing efforts to reduce mortality in commercial fisheries. Additionally, there would be no negative indirect effects to the species from the proposed action.

Rather, indirect effects are expected to result in a reduction in sea turtles taken lethally by foreign fisheries, which would be beneficial to the recovery of the species.

We believe that the incidental lethal and non-lethal takes of olive ridley sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the species. Although any level of take and mortality can have an adverse effect on the overlying population, we find that the expected level of take from the overall action, including a small number of mortalities, is extremely small when considered together with all impacts considered in the Status of the Species, Baseline and Cumulative Effects sections, including other federally authorized fisheries and foreign fisheries. As stated previously, the proposed action is expected to result in the annual mortality of only one olive ridley sea turtle. We believe that the population will remain large enough to retain the potential for recovery. Moreover, we do not believe that the proposed action is reasonably likely to result in an appreciable reduction in the likelihood of recovery of the olive ridley sea turtle. The proposed action does not appreciably impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy. In addition the proposed action is expected to have a beneficial effect on the olive ridley as well because baseline impacts contributing to declines will be reduced due to the spillover effect. We expect the proposed action to reduce olive ridley mortalities.

To summarize, when considering the effects of the proposed action, together with the status of the listed species, the environmental baseline, and the cumulative effects, we believe that the lethal and non-lethal takes of olive ridley sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of both the survival and recovery of the eastern or western Pacific olive ridley sea turtle in the wild. We reach our no jeopardy conclusion with or without the beneficial effect of spillover.

Green Turtles. 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 likely to be 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.

As described in the green turtle section of the Effects of the Action, if we assume that the proposed action will result in 5,500 sets annually, then that level of effort will result in three green turtle interactions annually, which will result in a maximum of one juvenile or adult mortality annually, from either the eastern Pacific or the Hawaii component of the central Pacific populations.

Based on the projected increase in effort to 5,500 annual sets, our analysis further concludes that the spillover effect is reasonably certain to contribute to a reduction in green turtle mortality from the eastern pacific or the Hawaiian component of the central pacific population due to reduced effort in foreign fisheries. As explained in the Effects section, the displacement of foreign swordfish production is expected to result in the reduction in green turtle mortalities because the Pacific foreign fleets analyzed by Chan and Pan interact with green sea turtles at higher rates than the Hawaii-based shallow-set fishery. Given the Hawaii-based longline fishery's effort level of 5,500 sets per year, and the one-to-one displacement of foreign swordfish production attributable to the beneficial spillover effect, we calculated that the proposed action is expected to result in 2-5 fewer green sea turtle mortalities annually in the central and north Pacific. Accordingly, after considering the direct effects of the action and the indirect effects of spillover effects, we calculated that the proposed action would result in a decrease in green turtle mortalities of 1-4 individuals annually from foreign fisheries. However, because the data on foreign fisheries is likely incomplete or inaccurate, foreign fishery bycatch rate estimation is imprecise. We also note that the expected number of sea turtle interactions with foreign fisheries that would have occurred but for the proposed action cannot be confirmed by direct observation. Finally, notwithstanding our conclusion that a beneficial spillover effect occurs from the regulation of the Hawaii-based shallow-set fishery, the mortality reduction data associated with spillover effects are not as robust as those analyzed for the direct effects of the proposed action. For these reasons, we do not incorporate the numerical determination that 2-5 sea turtle mortalities will be avoided as a result of the spillover effect in our quantitative PVA models.

As discussed in the Cumulative Effects section, effects to this species are likely to occur as a result of worsening climate change, and any increase in 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, as well as an increase effects resulting from fishing gear interactions with this species. In addition, any increases in marine debris could also increase entanglements. Global climate change is expected to continue and therefore may impact sea turtles and their habitat in the future. As discussed in this opinion, rising temperatures at nesting beaches may have negative consequences for nesting females. Turtles that occur in the action area come from nesting aggregations that may be affected by impacts at their nesting beaches of origin throughout the Pacific, although changes will likely not be uniform or predictable. As also discussed in the Cumulative Effects section of this opinion, climate change may impact aquatic aspects of sea turtle biology and ecology, including foraging habitats and prey resources, phenology, and migration. As discussed earlier in this opinion, although there is much speculation on the potential impacts of anthropogenic climate change to species and ecosystems, there are multiple layers of uncertainty associated with these analyses and the effects of climate change will not be globally uniform. In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles that may be within the action area. In addition to the uncertainty of the rate, magnitude, and distribution of future climate change and its associated impacts on temporal and spatial scales, the adaptability of species and ecosystems are also unknown. Implications of climate change at the population level are a key area of uncertainty and one of active research and cannot currently be reliably quantified in terms of actual mortalities resulting from climate change impacts over any time scale. Nor can they be qualitatively described or predicted in such a way as could be more meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action of 25 years, any future synergistic impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

We considered to what extent the effects of the action affect survival and recovery of the green sea turtle. The NMFS and USFWS' ESA Section 7 Handbook (USFWS and NMFS 1998) provides further definition for *survival* and *recovery*, as they apply to the ESA's jeopardy standard (please refer to the humpback whale discussion of this section for definitions).

The NMFS and USFWS (1998) Green Turtle and NMFS and USFWS (1998) East Pacific Green Turtle recovery plans contain a number of goals and criteria that should be met to achieve recovery. These include all regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters; each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years; nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period; existing foraging areas are maintained as healthy environments; foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; all Priority #1 tasks have been implemented; a management plan to maintain sustained populations of turtles is in place; international agreements are in place to protect shared stocks.
As discussed above, the anticipated deaths resulting from the continued authorization of the shallow set fishery results in the removal of approximately one juvenile or adult turtle (either sex) annually, or 25 turtles over the length of the proposed action. Viewed within the context of the Status of the Species, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects, we believe the annual mortality of one individual green sea turtle caused by the proposed action is insufficient to adversely affect the population dynamics of either eastern Pacific or central Pacific green sea turtles. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of the species.

We conclude that the incidental take and resulting mortality of green turtles associated with the direct effects of the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of the species. We expect the overall populations to remain large enough to maintain genetic heterogeneity, broad demographic representation, and successful reproduction. The direct effect of the proposed action will have a small effect on the overall size of the populations, and we do not expect it to affect the green turtles' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not believe that the proposed action will impede progress on carrying out any aspect of the recovery plan or achieving the overall recovery strategy. The majority of the recovery criteria and priority 1 tasks will not be affected by the proposed action. Those that could potentially be affected and are most relevant to the analysis of the proposed action on recovery are: 1) each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years; 2) nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period; 3) foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; and 4) reduce incidental mortality in fisheries.

The ESA allows for incidental take of species resulting from otherwise lawful activities (such as the proposed action), provided that such take does not result in jeopardy, and the impact of such take is minimized to the extent practicable. While the direct effects of the proposed action would result in some incidental take of this species by the U.S. fishery, the impact of that take would be reduced to the best extent possible. The majority of the green sea turtle takes from the proposed action are expected to be non-lethal, which are not expected to have any measurable impact on their numbers, reproduction, or distribution. We have applied the post-release mortality criteria conservatively to ensure that sea turtles that are likely to be seriously injured by capture in the fisheries are counted as lethal takes. The anticipated non-lethal takes are not expected to impact the reproductive potential, fitness, or growth of any of the incidentally caught sea turtles because they will be released unharmed shortly after capture, or released with only minor injuries from which they are expected to recover. Individual takes may occur anywhere in the action area and turtles would be released within the general area where they are caught. Additionally, based on the results of the spillover effects analysis (Chan and Pan 2012), an indirect effect of the proposed action is that there would be a reduction of green sea turtles taken lethally by foreign fisheries if the proposed action is permitted to occur and expand to 5,500 sets per year.

Although the proposed action would result in the mortality of up to one green sea turtle annually, as discussed above, this level of mortality would present negligible additional risk to the species. Since it represents a negligible risk to the species, the proposed action would not prohibit the species from stabilizing or increasing, nor would it prohibit the species from reaching a biologically reasonable FENA based on the goal of maintaining a stable population in perpetuity. The negligible potential risk to the green nesting population, which is the source of animals found at foraging grounds, means it would not substantially impair or prohibit increases to green sea turtle foraging populations at key foraging grounds. The effects of the action would not prohibit or substantially impair continuing efforts to reduce mortality in commercial fisheries. Additionally, there would be no negative indirect effects to the species from the proposed action. Rather, indirect effects are expected to result in a reduction in sea turtles taken lethally by foreign fisheries, which would be beneficial to the recovery of the species.

We believe that the incidental lethal and non-lethal takes of green sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the species. Although any level of take and mortality can have an adverse effect on the overlying population, we find that the expected level of take from the overall action, including a small number of mortalities, is extremely small when considered together with all impacts considered in the Status of the Species, Baseline and Cumulative Effects sections, including other federally authorized fisheries and foreign fisheries. As stated previously, the proposed action is expected to result in the annual mortality of only one green sea turtle. We believe that the population will remain large enough to retain the potential for recovery. Moreover, we do not believe that the proposed action is reasonably likely to result in an appreciable reduction in the likelihood of recovery of the green sea turtle. The proposed action does not appreciably impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy. In addition the proposed action is expected to have a beneficial effect on the green sea turtle as well because baseline impacts contributing to declines will be reduced due to the spillover effect. We expect the proposed action to reduce green sea turtle mortalities from foreign fisheries.

To summarize, when considering the effects of the proposed action, together with the status of the listed species, the environmental baseline, and the cumulative effects, we believe that the lethal and non-lethal takes of green sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of both the survival and recovery of the eastern Pacific or central Pacific green sea turtle in the wild. We reach our no jeopardy conclusion with or without the beneficial effect of spillover.

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) or result in destruction or adverse modification of designated critical habitat. "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, North Pacific loggerhead DPS, leatherback sea turtles, olive ridley sea turtles, and green 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 five species, and is not likely to destroy or adversely modify designated critical habitat.

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. NMFS should work with the fishing industry to 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. The Western and Central Pacific Fisheries Commission (WCPFC) sea turtle conservation and management measure for commercial longline fisheries operating in the western Pacific;
    c. The wide dissemination and implementation of NMFS Sea Turtle Handling Guidelines that increase post-hooking turtle survivorship;
    d. Technical assistance workshops to assist other longlining nations to build capacity for observer programs and implement longline gear and handling measures on commercial vessels operating in the western Pacific;
    e. Continuation of ecological, habitat use, and genetics studies of loggerhead turtles occurring in nearshore foraging habitats in Eastern Tropical Pacific, continue monitoring impacts through stranding programs, and promote mitigation studies for fisheries operating in these waters, and;
    f. Continuation of bycatch reduction efforts in the Western Pacific to reduce commercial and artisanal fishery impacts (e.g., mitigation of Japan poundnets and other fisheries operating in the South China and Sulu Sulawesi Seas).

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. NMFS should continue to investigate long term climate variability and its impacts to turtle populations.

6. NMFS should assess the need for additional study of the spillover effect on sea turtles due to 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 2009). 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;
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; 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. Section 101(a)(5)(E) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. 1361 *et seq*., has provisions for NOAA's National Marine Fisheries Service (NMFS), as delegated by the Secretary of Commerce, to issue permits for the taking of marine mammals designated as depleted because of their listing under the Endangered Species Act (ESA), 16 U.S.C. 1531 *et seq.,* by U.S. vessels and those vessels which have valid fishing permits issued by the Secretary in accordance with section 204(b) of the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1824(b), for a period of up to three years. NMFS may issue the authorization to take ESA-listed marine mammals incidental to these commercial fisheries only after the agency has determined, after notice and opportunity for public comment, that:

(1) the incidental mortality and serious injury from commercial fisheries will have a negligible impact on the affected species or stock;

(2) a recovery plan has been developed or is being developed for such species or stock under the ESA; and

(3) where required under section 118 of the MMPA, a monitoring program has been established, vessels engaged in such fisheries are registered in accordance with section 118 of the MMPA, and a take reduction plan has been developed or is being developed for such species or stock.

An analysis was completed by NMFS PRD on May 17, 2010 and a permit for a period of three years to authorize the incidental, but not intentional, taking of individuals of the Central North Pacific stock of endangered humpback whales by the Hawaii-based longline fisheries was issued

(NMFS 2010c). The authorization was based on determinations that mortality and serious injury of humpback whales incidental to commercial fishing will have a negligible impact on the CNP stock of humpback whales, that a recovery plan has been developed, that a monitoring program is established, that vessels in the fisheries are registered, and that the MMPA does not require a take reduction plan at this time (NMFS 2010a).

13.2 Anticipated Amount or Extent of Incidental Take

NMFS anticipates the following incidental takes may occur as a result of the continued operation of the Hawaii shallow-set longline fishery with a projected expansion of up to 5,500 sets. The annual numbers of interactions and mortalities expected to result from implementation of the proposed action are shown for 1-year and 2-year periods in Table 12 below (i.e., 1-year and 2-year ITSs). However, only the 2-year ITS will be used for purposes of reinitiation. Annual take estimates can have high variability because of natural variation. It is unlikely that all species evaluated in this opinion will be consistently impacted year after year by the fishery. The interactions and mortalities in Table 12 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 (Van Houtan 2011). This approach will allow us to reduce the likelihood of requiring reinitiation unnecessarily because of inherent variability in take levels, but still allow for an accurate assessment of how the shallow-set fishery is performing versus our expectations.

Table 12. The number of Humpback whale and turtle interactions expected from the proposed action during 1 calendar year, and 2 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			**2-year**	
Species	Interactions	Total mortalities	Equivalent AFMs	**Interactions**	**Total mortalities**
Humpback whales	1	.20	N/A	**2**	**.40**
N. Pacific Loggerhead turtles	34	7	1	**68**	**14**
Leatherback turtles	26	6	4	**52**	**12**
Olive ridley turtles	2	1	N/A	**4**	**2**
Green turtles	3	1	N/A	**6**	**2**

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, North Pacific loggerhead DPS, leatherback turtle, green turtle, or olive ridley 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 12 above for each sea turtle species.

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 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.

2. NMFS shall require that sea turtles incidentally caught alive be released from fishing gear in a manner that minimizes injury and the likelihood of further gear entanglement or entrapment to increase post-release survivorship, as practicable and in consideration of best practices for safe vessel and fishing operations.

3. 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.

4. 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. *Observers*. NMFS shall maintain observer coverage at rates that have been determined to be statistically reliable for estimating protected species interaction rates onboard Hawaii-based shallow-set longline vessels.

    1B. *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 place tags on any untagged turtles that are safely brought aboard a vessel. Observers shall also collect life-history information on sea turtles incidentally caught 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.

1C. *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.

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

2A. 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, including disseminating new scientific information such as TurtleWatch for loggerhead turtles.

2B. NMFS shall continue to train observers about sea turtle biology and techniques for proper handling, dehooking, and resuscitation.

2C. 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).

2D. 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.

2E. 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.

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

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.

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

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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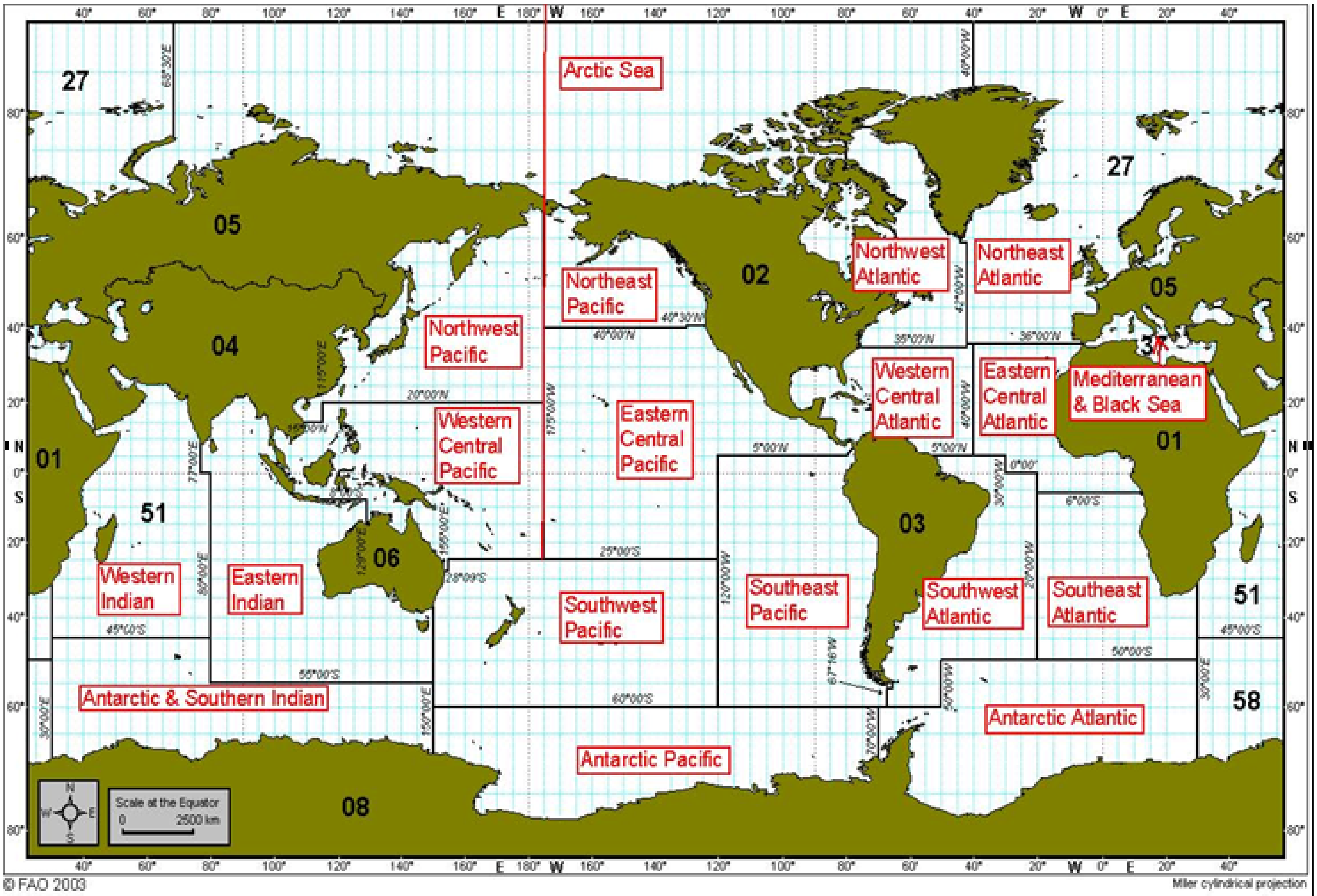
15 APPENDIX

Appendix 1. FAO Fishing Areas used in the Spillover Analysis.



Appendix 2: A Selection of Code of Federal Regulations at Title 50, Chapter VI, Part 665.

Electronic Code of Federal Regulations (e-CFR) data was current as of January 4, 2012.[31] The following is an excerpt of e-CFR Part 665 – Fisheries in the Western Pacific. For the regulations in their entirety, see http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfrandsid=d0cb2aff765a82c32fad1c8aac81f3eaandtpl=/ecfrbrowse/Title50/50cfr665_main_02.tpl

Title 50: Wildlife and Fisheries
PART 665—FISHERIES IN THE WESTERN PACIFIC

Subpart F—Western Pacific Pelagic Fisheries

§ 665.798 Management area.

The western Pacific pelagic fishery management area includes all areas of fishing operations in the EEZ or on the high seas for any vessels of the United States or persons that:

(a) Fish for, possess, or transship western Pacific pelagic fishery MUS within the EEZ waters around American Samoa, CNMI, Guam, Hawaii, or PRIA; or

(b) Land western Pacific pelagic fishery MUS in American Samoa, CNMI, Guam, Hawaii, or PRIA.

Section 665.799 was purposefully omitted.

§ 665.800 Definitions.

As used in §§665.798 through 665.818:

Branch line (or *dropper line*) means a line with a hook that is attached to the mainline.

Deep-set or Deep-setting means the deployment of, or deploying, respectively, longline gear in a manner consistent with all the following criteria: With all float lines at least 20 meters in length; with a minimum of 15 branch lines between any two floats (except basket-style longline gear which may have as few as 10 branch lines between any two floats); without the use of light sticks; and resulting in the possession or landing of no more than 10 swordfish (*Xiphias gladius*) at any time during a given trip. As used in this definition "float line" means a line used to suspend the main longline beneath a float and "light stick" means any type of light emitting device, including any fluorescent "glow bead," chemical, or electrically powered light that is affixed underwater to the longline gear.

Float line means a line attached to a mainline used to buoy, or suspend, the mainline in the water column.

Hawaii longline limited access permit means the permit required by §665.801 to use a vessel to fish for western Pacific pelagic MUS with longline gear in the EEZ around Hawaii or to land or transship longline-caught western Pacific pelagic MUS shoreward of the outer boundary of the EEZ around Hawaii.

Longline fishing prohibited area means the portions of the EEZ in which longline fishing is prohibited as specified in §665.806.

Longline fishing vessel means a vessel that has longline gear on board the vessel.

[31] Web site accessed on January 6, 2012. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfrandsid=762e5a62edc3c07e169e907fd879c407andrgn=div6andview=textandnode=50:11.0.1.1.2.6andidno=50

Longline gear means a type of fishing gear consisting of a main line that exceeds 1 nm in length, is suspended horizontally in the water column either anchored, floating, or attached to a vessel, and from which branch or dropper lines with hooks are attached; except that, within the protected species zone as defined in §665.806, longline gear means a type of fishing gear consisting of a main line of any length that is suspended horizontally in the water column either anchored, floating, or attached to a vessel, and from which branch or dropper lines with hooks are attached.

Shallow-set or shallow-setting means the deployment of, or deploying, respectively, longline gear in a manner that does not meet the definition of deep-set or deep-setting as defined in this section.

§ 665.801 Permits.

(a) A vessel of the United States must be registered for use with a valid permit under the High Seas Fishing Compliance Act if that vessel is used to fish on the high seas, as required under §300.15 of this title.

(b) A vessel of the United States must be registered for use under a valid Hawaii longline limited access permit if that vessel is used:

(1) To fish for western Pacific pelagic MUS using longline gear in the EEZ around the Hawaiian Archipelago; or

(2) To land or transship, shoreward of the outer boundary of the EEZ around the Hawaiian Archipelago, western Pacific pelagic MUS that were harvested using longline gear.

(d) A vessel of the United States must be registered for use under a valid Western Pacific general longline permit, American Samoa longline limited access permit, or Hawaii longline limited access permit if that vessel is used to:

(1) Fish for western Pacific pelagic MUS using longline gear in the EEZ around Guam, CNMI, or PRIA (with the exception of Midway Atoll); or

(2) Land or transship shoreward of the outer boundary of the EEZ around Guam, CNMI, or PRIA (with the exception of Midway Atoll), western Pacific pelagic MUS that were harvested using longline gear.

(e) A receiving vessel of the United States must be registered for use with a valid receiving vessel permit if that vessel is used to land or transship, shoreward of the outer boundary of the EEZ around American Samoa, Hawaii, Guam, CNMI, or PRIA, western Pacific pelagic MUS that were harvested using longline gear.

(h) Any required permit must be valid and on board the vessel and available for inspection by an authorized agent, except that, if the permit was issued (or registered to the vessel) during the fishing trip in question, this requirement applies only after the start of any subsequent fishing trip.

(i) A permit is valid only for the vessel for which it is registered. A permit not registered for use with a particular vessel may not be used.

(m) A Hawaii longline limited access permit will not be registered for use with a vessel that has a LOA greater than 101 ft (30.8 m).

(n) Only a person eligible to own a documented vessel under the terms of 46 U.S.C. 12102(a) may be issued or may hold (by ownership or otherwise) a Hawaii longline limited access permit.

§ 665.802 Prohibitions.

In addition to the prohibitions specified in §600.725 of this chapter, it is unlawful for any person to do any of the following:

(a) Falsify or fail to make and/or file all reports of western Pacific pelagic MUS landings, containing all data and in the exact manner, as required by applicable state law or regulation, as specified in §665.14(a), provided that the person is required to do so by applicable state law or regulation.

(b) Use a vessel without a valid permit issued under the High Seas Fishing Compliance Act to fish for western Pacific pelagic MUS using longline gear, on the high seas, in violation of §§665.801(a), and 300.15 of this title.

(c) Use a vessel in the EEZ around the Hawaiian Archipelago without a valid Hawaii longline limited access permit registered for use with that vessel, to fish for western Pacific pelagic MUS using longline gear, in violation of §665.801(b)(1).

(d) Use a vessel shoreward of the outer boundary of the EEZ around the Hawaiian Archipelago without a valid Hawaii longline limited access permit registered for use with that vessel, to land or transship western Pacific pelagic MUS that were harvested with longline gear, in violation of §665.801(b)(2).

(e) Use a vessel in the EEZ around American Samoa without a valid American Samoa longline limited access permit registered for use with that vessel, to fish for western Pacific pelagic MUS using longline gear, in violation of §665.801(c)(1).

(f) Use a vessel shoreward of the outer boundary of the EEZ around American Samoa without a valid American Samoa longline limited access permit registered for use with that vessel, to land western Pacific pelagic MUS that were caught with longline gear within the EEZ around American Samoa, in violation of §665.801(c)(2).

(g) Use a vessel within the EEZ around American Samoa without a valid American Samoa longline limited access permit registered for use with that vessel, to transship western Pacific pelagic MUS that were caught with longline gear, in violation of §665.801(c)(3).

(h) Use a vessel in the EEZ around Guam, CNMI, or PRIA (with the exception of Midway Atoll) without either a valid Western Pacific general longline permit, American Samoa longline limited access permit or a Hawaii longline limited access permit registered for use with that vessel, to fish for western Pacific pelagic MUS using longline gear, in violation of §665.801(d)(1).

(i) Use a vessel shoreward of the outer boundary of the EEZ around Guam, CNMI, or PRIA (with the exception of Midway Atoll) without either a valid Western Pacific general longline permit, American Samoa longline limited access permit or a Hawaii longline limited access permit registered for use with that vessel, to land or transship western Pacific pelagic MUS that were harvested using longline gear, in violation of §665.801(d)(2).

(j) Use a vessel shoreward of the outer boundary of the EEZ around American Samoa, CNMI, Guam, Hawaii, or PRIA, to land or transship western Pacific pelagic MUS caught by other vessels using longline gear, without a valid receiving vessel permit registered for use with that vessel, in violation of §665.801(e).

(k) Use a vessel in the EEZ around the PRIA employing handline or trolling methods to fish for western Pacific pelagic MUS without a valid PRIA pelagic troll and handline fishing permit registered for use for that vessel, in violation of §665.801(f).

(l) Fish in the fishery after failing to comply with the notification requirements in §665.803.

(m) Fail to comply with notification requirements set forth in §665.803 or in any EFP issued under §665.17.

(n) Fail to comply with a term or condition governing longline gear configuration in §665.813(k) if using a vessel longer than 40 ft (12.2 m) registered for use with any valid longline permit issued pursuant to §665.801 to fish for western Pacific pelagic MUS using longline gear south of the Equator (0° lat.).

(o)–(u) [*Reserved*]

(v) Use longline gear to fish within a longline fishing prohibited area in violation of §665.806, except as allowed pursuant to an exemption issued under §§665.17 or 665.807.

(w) Fish for western Pacific pelagic MUS with longline gear within the protected species zone, in violation of §665.806(b).

(x) Fail to comply with a term or condition governing the observer program established in §665.808, if using a vessel registered for use with a Hawaii longline limited access permit, or a vessel registered for use with a size Class B, C or D American Samoa longline limited access permit, to fish for western Pacific pelagic MUS using longline gear.

(y) Fail to comply with other terms and conditions that the Regional Administrator imposes by written notice to either the permit holder or the designated agent of the permit holder to facilitate the details of observer placement.

(z) Fail to fish in accordance with the seabird take mitigation techniques set forth at §§665.815(a)(1) or 665.815(a)(2) when operating a vessel registered for use under a Hawaii longline limited access permit.

(aa)–(bb) [*Reserved*]

(cc) Own or operate a vessel registered for use under any longline permit issued under §665.801 while engaged in longline fishing for western Pacific pelagic MUS and fail to be certified for completion of a NMFS protected species workshop, in violation of §665.814(a).

(dd) Own or operate a vessel registered for use under any longline permit issued under §665.801 while engaged in longline fishing for western Pacific pelagic MUS without having on board a valid protected species workshop certificate issued by NMFS or a legible copy thereof, in violation of §665.814(d).

(ee) Possess light sticks on board a vessel registered for use under a Hawaii longline limited access permit at any time during a trip for which notification to NMFS under §665.803(a) indicated that deep-setting would be done, in violation of §665.813(d).

(ff) Fail to carry, or fail to use, a line clipper, dip net, or dehooker on a vessel registered for use under any longline permit issued under §665.801, in violation of §665.812.

(gg)–(hh) [*Reserved*]

(ii) When operating a vessel registered for use under any longline limited access permit issued under §665.801, fail to comply with the sea turtle handling, resuscitation, and release requirements, in violation of §665.812(b).

(jj) Engage in shallow-setting from a vessel registered for use under any longline permit issued under §665.801 north of the Equator (0° lat.) with hooks other than circle hooks sized 18/0 or larger with an offset not to exceed 10 degrees, in violation of §665.813(f).

(kk) Engage in shallow-setting from a vessel registered for use under any longline permit issued under §665.801 north of the Equator (0° lat.) with bait other than mackerel-type bait, in violation of §665.813(g).

(ll) [*Reserved*]

(mm) Fail to use a line setting machine or line shooter, with weighted branch lines, to set the main longline when operating a vessel that is registered for use under a Hawaii longline limited access permit and equipped with monofilament main longline, when making deep sets north of 23° N. lat., in violation of §665.815(a)(1) or (a)(2).

(nn) Fail to employ basket-style longline gear such that the mainline is deployed slack when operating a vessel registered for use under a Hawaii longline limited access north of 23° N. lat., in violation of §665.815(a)(2)(v).

(oo) Fail to maintain and use blue dye to prepare thawed bait when operating a vessel registered for use under a Hawaii longline limited access permit that is fishing north of 23° N. lat., in violation of §665.815(a)(2)(vi) through (viii).

(pp) Fail to retain, handle, and discharge fish, fish parts, and spent bait, strategically when operating a vessel registered for use under a Hawaii longline limited access permit that is fishing north of 23° N. lat., in violation of §665.815(a)(2)(i) through (iv).

(qq) Fail to be begin the deployment of longline gear at least 1 hour after local sunset or fail to complete the setting process before local sunrise from a vessel registered for use under a Hawaii longline limited access permit while shallow-setting north of 23° N. lat., in violation of §665.815(a)(4).

(rr) Fail to handle short-tailed albatrosses that are caught by pelagic longline gear in a manner that maximizes the probability of their long-term survival, in violation of §665.815(b).

(ss) Engage in shallow-setting from a vessel registered for use under a Hawaii longline limited access permit after the shallow-set component of the longline fishery has been closed pursuant to §665.813(b), in violation of §665.813(i).

(tt) Fail to immediately retrieve longline fishing gear upon receipt of actual notice that the shallow-set component of the longline fishery has been closed pursuant to §665.813(b), in violation of §665.813(i).

(uu)–(vv) [*Reserved*]

(ww) Fail to handle seabirds other than short-tailed albatrosses that are caught by pelagic longline gear in a manner that maximizes the probability of their long-term survival, in violation of §665.815(c).

(xx) Use a large vessel to fish for western Pacific Pelagic MUS within an American Samoa large vessel prohibited area in violation of §665.806, except as allowed pursuant to an exemption issued under §§665.17 or 665.818.

(yy) Fish for western Pacific pelagic MUS using gear prohibited under §665.810 or not permitted by an EFP issued under §665.17.

(zz) Use a vessel that is greater than 50 ft (15.4 m) LOA to squid jig fish in EEZ waters around American Samoa, CNMI, Guam, Hawaii, or PRIA, without a Western Pacific squid jig fishing permit registered for use with that vessel, in violation of §665.801(g).

[75 FR 2205, Jan. 14, 2010, as amended at 76 FR 37288, June 27, 2011; 76 FR 52889, Aug. 24, 2011]

§ 665.803 Notifications.

(a) The permit holder, or designated agent, for any vessel registered for use under a Hawaii longline limited access permit, or for any vessel greater than 40 ft (12.2 m) LOA that is registered for use under an American Samoa longline limited access permit, shall provide a notice to the Regional Administrator at least 72 hours (not including weekends and Federal holidays) before the vessel leaves port on a fishing trip, any part of which occurs in the EEZ around the Hawaiian Archipelago or American Samoa. The vessel operator will be presumed to be an agent designated by the permit holder unless the Regional Administrator is otherwise notified by the permit holder. The permit holder or designated agent for a vessel registered for use under Hawaii longline limited access permits must also provide notification of the trip type (either deep-setting or shallow-setting).

(b) The permit holder, or designated agent, for any vessel registered for use under a Western Pacific squid jig fishing permit that is greater than 50 ft (15.4 m) LOA, shall provide a notice to the Regional Administrator at least 72 hours (not including weekends and Federal holidays) before the vessel leaves port on a fishing trip, any part of which occurs in western Pacific EEZ waters. The vessel operator will be presumed to be an agent designated by the permit holder unless the Regional Administrator is otherwise notified by the permit holder.

(c) For purposes of this section, the notice must be provided to the office or telephone number designated by the Regional Administrator. The notice must provide the official number of the vessel, the name of the vessel, the intended departure date, time, and location, the name of the operator of the vessel, and the name and telephone number of the permit holder or designated agent to be available between 8 a.m. and 5 p.m. (local time) on weekdays for NMFS to contact to arrange observer placement.

(d) The operator of any vessel subject to the requirements of this subpart who does not have on board a VMS unit while transiting the protected species zone as defined in §665.806, must notify the NMFS Special-Agent-In-Charge immediately upon entering and immediately upon departing the protected species zone. The notification must include the name of the vessel, name of the operator, date and time (GMT) of access or exit from the protected species zone, and location by latitude and longitude to the nearest minute.

(e) The permit holder for any American Samoa longline limited access permit, or an agent designated by the permit holder, must notify the Regional Administrator in writing within 30 days of any change to the permit holder's contact information or any change to the vessel documentation associated with a permit registered to an American Samoa longline limited access permit. Complete changes in the ownership of the vessel registered to an American Samoa longline limited access permit must also be reported to PIRO in writing within 30 days of the change. Failure to report such changes may result in a delay in processing an application, permit holders failing to receive important notifications, or sanctions pursuant to the Magnuson-Stevens Act at 16 U.S.C. 1858(g) or 15 CFR part 904, subpart D.

Sections 665.804 and 665.805 were purposefully omitted.

§ 665.806 Prohibited area management.

(a) *Longline fishing prohibited areas.* Longline fishing is prohibited in the longline fishing prohibited areas as defined in paragraphs (a)(1) through (a)(4) of this section.

(1) *NWHI protected species zone.* The NWHI protected species zone is the portion of the EEZ within 50 nm of the center geographical positions of certain islands and reefs in the NWHI, as follows:

Name	N. lat.	W. long.
Nihoa Island	23°05'	161°55'
Necker Island	23°35'	164°40'
French Frigate Shoals	23°45'	166°15'
Gardner Pinnacles	25°00'	168°00'
Maro Reef	25°25'	170°35'
Laysan Island	25°45'	171°45'

Lisianski Island	26°00'	173°55'
Pearl and Hermes Reef	27°50'	175°50'
Midway Island	28°14'	177°22'
Kure Island	28°25'	178°20'
Where the areas are not contiguous, parallel lines drawn tangent to and connecting those semicircles of the 50-nm areas that lie between Nihoa Island and Necker Island, French Frigate Shoals and Gardner Pinnacles, Gardner Pinnacles and Maro Reef, and Lisianski Island and Pearl and Hermes Reef, delimit the remainder of the NWHI longline protected species zone.		

(2) *Main Hawaiian Islands (MHI).* (i) From February 1 through September 30 each year, the MHI longline fishing prohibited area is the portion of the EEZ around Hawaii bounded by straight lines connecting the following coordinates in the order listed:

Point	N. lat.	W. long.
A	18°05'	155°40'
B	18°20'	156°25'
C	20°00'	157°30'
D	20°40'	161°40'
E	21°40'	161°55'
F	23°00'	161°30'
G	23°05'	159°30'
H	22°55'	157°30'
I	21°30'	155°30'
J	19°50'	153°50'
K	19°00'	154°05'
A	18°05'	155°40'

(ii) From October 1 through the following January 31 each year, the MHI longline fishing prohibited area is the portion of the EEZ around Hawaii bounded by straight lines connecting the following coordinates in the order listed:

Point	N. lat.	W. long.
A	18°05'	155°40'
L	18°25'	155°40'
M	19°00'	154°45'
N	19°15'	154°25'
O	19°40'	154°20'
P	20°20'	154°55'
Q	20°35'	155°30'
R	21°00'	155°35'
S	22°30'	157°35'
T	22°40'	159°35'
U	22°25'	160°20'
V	21°55'	160°55'
W	21°40'	161°00'

E	21°40'	161°55'
D	20°40'	161°40'
C	20°00'	157°30'
B	18°20'	156°25'
A	18°05'	155°40'

Section 665.807 was purposefully omitted.

§ 665.808 Conditions for at-sea observer coverage.

(a) NMFS shall advise the permit holder or the designated agent of any observer requirement at least 24 hours (not including weekends and Federal holidays) before any trip for which NMFS received timely notice in compliance with these regulations.

(b) The “Notice Prior to Fishing Trip” requirements in this subpart commit the permit holder to the representations in the notice. The notice can be modified by the permit holder or designated agent because of changed circumstance, if the Regional Administrator is promptly provided a modification to the notice that complies with the notice requirements. The notice will also be considered modified if the Regional Administrator and the permit holder or designated agent agrees to placement changes.

(c) When NMFS notifies the permit holder or designated agent of the obligation to carry an observer in response to a notification under this subpart, or as a condition of an EFP issued under §665.17, the vessel may not engage in the fishery without taking the observer.

(d) A NMFS observer shall arrive at the observer's assigned vessel 30 minutes before the time designated for departure in the notice or the notice as modified, and will wait 1 hour for departure.

(e) A permit holder must accommodate a NMFS observer assigned under these regulations. The Regional Administrator's office, and not the observer, will address any concerns raised over accommodations.

(f) The permit holder, vessel operator, and crew must cooperate with the observer in the performance of the observer's duties, including:

(1) Allowing for the embarking and debarking of the observer.

(2) Allowing the observer access to all areas of the vessel necessary to conduct observer duties.

(3) Allowing the observer access to communications equipment and navigation equipment as necessary to perform observer duties.

(4) Allowing the observer access to VMS units to verify operation, obtain data, and use the communication capabilities of the units for official purposes.

(5) Providing accurate vessel locations by latitude and longitude or loran coordinates, upon request by the observer.

(6) Providing sea turtle, marine mammal, or seabird specimens as requested.

(7) Notifying the observer in a timely fashion when commercial fishing operations are to begin and end.

(g) The permit holder, operator, and crew must comply with other terms and conditions to ensure the effective deployment and use of observers that the Regional Administrator imposes by written notice.

(h) The permit holder must ensure that assigned observers are provided living quarters comparable to crew members and are provided the same meals, snacks, and amenities as are normally provided to other vessel personnel. A mattress or futon on the floor or a cot is not acceptable if a regular bunk is provided to any crew member, unless other arrangements are approved in advance by the Regional Administrator.

(i) Reimbursement requirements are as follows:

(1) Upon observer verification of vessel accommodations and the number of assigned days on board, NMFS will reimburse vessel owners a reasonable amount for observer subsistence as determined by the Regional Administrator.

(2) If requested and properly documented, NMFS will reimburse the vessel owner for the following:

(i) Communications charges incurred by the observer.

(ii) Lost fishing time arising from a seriously injured or seriously ill observer, provided that notification of the nature of the emergency is transmitted to the Observer Program, NMFS (see address for PIRO Regional Administrator) at the earliest practical time. NMFS will reimburse the owner only for those days during which the vessel is unable to fish as a direct result of helping the NMFS employee who is seriously injured or seriously ill. Lost fishing time is based on time traveling to and from the fishing grounds and any documented out-of-pocket expenses for medical services. Payment will be based on the current target fish market prices and that vessel's average target fish catch retained per day at sea for the previous 2 years, but shall not exceed $5,000 per day or $20,000 per claim. Detailed billing with receipts and supporting records are required for allowable communication and lost fishing time claims. The claim must be completed in ink, showing the claimant's printed name, address, vessel name, observer name, trip dates, days observer was on board, an explanation of the charges, and claimant's dated signature with a statement verifying the claim to be true and correct. Requested reimbursement claims must be submitted to the Fisheries Observer Branch, Pacific Islands Region, NMFS. NMFS will not process reimbursement invoices and documentation submitted more than 120 days after the occurrence.

(j) If a vessel normally has cabins for crew members, female observers on a vessel with an all-male crew must be accommodated either in a single person cabin or, if NMFS concludes that adequate privacy can be ensured by installing a curtain or other temporary divider, in a two-person shared cabin. If the vessel normally does not have cabins for crew members, alternative accommodations must be approved by NMFS. If a cabin assigned to a female observer does not have its own toilet and shower facilities that can be provided for the exclusive use of the observer, or if no cabin is assigned, then arrangements for sharing common facilities must be established and approved in advance by NMFS.

Sections 665.809 through 665.811 were purposefully omitted.

§ 665.812 Sea turtle take mitigation measures.

(a) Possession and use of required mitigation gear. The gear required in paragraph (a) of this section must be used according to the sea turtle handling requirements set forth in paragraph (b) of this section.

(1) Hawaii longline limited access permits. Any owner or operator of a vessel registered for use under a Hawaii longline limited access permit must carry aboard the vessel line clippers meeting the minimum design standards specified in paragraph (a)(5) of this section, dip nets meeting the minimum design standards specified in paragraph (a)(6) of this section, and dehookers meeting the minimum design and performance standards specified in paragraph (a)(7) of this section.

(2) Other longline vessels with freeboards of more than 3 ft (0.91m). Any owner or operator of a longline vessel with a permit issued under §665.801 other than a Hawaii limited access longline permit and that has a freeboard of more than 3 ft (0.91 m) must carry aboard the vessel line clippers meeting the minimum design standards specified in paragraph (a)(5) of this section, dip nets meeting the minimum design standards specified in paragraph (a)(6) of

this section, and dehookers meeting this minimum design and performance standards specified in paragraph (a)(7) of this section.

(3) Other longline vessels with freeboards of 3 ft (0.91 m) or less. Any owner or operator of a longline vessel with a permit issued under §665.801 other than a Hawaii limited access longline permit and that has a freeboard of 3 ft (0.91 m) or less must carry aboard their vessels line clippers capable of cutting the vessels fishing line or leader within approximately 1 ft (0.3 m) of the eye of an embedded hook, as well as wire or bolt cutters capable of cutting through the vessel's hooks.

(4) Handline, troll, pole-and-line, and other vessels using hooks other than longline vessels. Any owner or operator of a vessel fishing under the Pelagics FEP with hooks other than longline gear are not required to carry specific mitigation gear, but must comply with the handling requirements set forth in paragraph (b) of this section.

(5) *Line clippers.* Line clippers are intended to cut fishing line as close as possible to hooked or entangled sea turtles. NMFS has established minimum design standards for line clippers. The Arceneaux line clipper (ALC) is a model line clipper that meets these minimum design standards and may be fabricated from readily available and low-cost materials (see Figure 3 to this part). The minimum design standards are as follows:

(i) A protected cutting blade. The cutting blade must be curved, recessed, contained in a holder, or otherwise afforded some protection to minimize direct contact of the cutting surface with sea turtles or users of the cutting blade.

(ii) Cutting blade edge. The blade must be capable of cutting 2.0-2.1 mm monofilament line and nylon or polypropylene multi-strand material commonly known as braided mainline or tarred mainline.

(iii) An extended reach holder for the cutting blade. The line clipper must have an extended reach handle or pole of at least 6 ft (1.82 m).

(iv) Secure fastener. The cutting blade must be securely fastened to the extended reach handle or pole to ensure effective deployment and use.

(6) *Dip nets.* Dip nets are intended to facilitate safe handling of sea turtles and access to sea turtles for purposes of cutting lines in a manner that minimizes injury and trauma to sea turtles. The minimum design standards for dip nets that meet the requirements of this section nets are:

(i) An extended reach handle. The dip net must have an extended reach handle of at least 6 ft (1.82 m) of wood or other rigid material able to support a minimum of 100 lb (34.1 kg) without breaking or significant bending or distortion.

(ii) Size of dip net. The dip net must have a net hoop of at least 31 inches (78.74 cm) inside diameter and a bag depth of at least 38 inches (96.52 cm). The bag mesh openings may be no more than 3 inches by 3 inches (7.62 cm by 7.62 cm).

(7) *Dehookers.* (i) Long-handled dehooker for ingested hooks. This item is intended to be used to remove ingested hooks from sea turtles that cannot be boated, and to engage a loose hook when a turtle is entangled but not hooked and line is being removed. One long-handled dehooker for ingested hooks is required on board. The minimum design and performance standards are as follows:

(A) *Hook removal device.* The hook removal device must be constructed of 5/16 inch (7.94 mm) 316L stainless steel and have a dehooking end no larger than 1 7/8 inches (4.76 cm) outside diameter. The device must be capable of securely engaging and controlling the leader while shielding the barb of the hook to prevent the hook from re-engaging during removal. It must not have any unprotected terminal points (including blunt ones), as these could cause injury to the esophagus during hook removal. The device must be of a size capable of securing the range of hook sizes and styles used by the vessel.

(B) *Extended reach handle.* The hook removal device must be securely fastened to an extended reach handle or pole with a length equal to or greater than 150 percent of the vessel's freeboard or 6 ft (1.83 m), whichever is greater. It is recommended that the handle be designed so that it breaks down into sections. The handle must be sturdy and strong enough to facilitate the secure attachment of the hook removal device.

(ii) Long-handled dehooker for external hooks. This item is intended to be used to remove externally-hooked hooks from sea turtles that cannot be boated. The long-handled dehooker for ingested hooks described in paragraph (a)(7)(i) of this section meets this requirement. The minimum design and performance standards are as follows:

(A) *Construction.* The device must be constructed of 5/16 inch (7.94 mm) 316 L stainless steel rod. A 5 inch (12.70 cm) tube T-handle of 1 inch (2.54 cm) outside diameter is recommended, but not required. The dehooking end must be blunt with all edges rounded. The device must be of a size capable of securing the range of hook sizes and styles used by the vessel.

(B) *Handle.* The handle must have a length equal to or greater than the vessel's freeboard or 3 ft (0.91 m), whichever is greater.

(iii) Long-handled device to pull an “inverted V.” This item is intended to be used to pull an “inverted V” in the fishing line when disentangling and dehooking entangled sea turtles. One long-handled device to pull an “inverted V” is required on the vessel. The minimum design and performance standards are as follows:

(A) *Hook end.* It must have a hook-shaped end, like that of a standard boat hook or gaff, which must be constructed of stainless steel or aluminum.

(B) *Handle.* The handle must have a length equal to or greater than 150 percent of the vessel's freeboard or 6 ft (1.83 m), whichever is greater. The handle must be sturdy and strong enough to allow the hook end to be effectively used to engage and pull an “inverted V” in the line.

(C) The long-handled dehookers described in paragraphs (a)(7)(i) and (ii) of this section meet this requirement.

(iv) Short-handled dehooker for ingested hooks. This item is intended to be used to remove ingested hooks, externally hooked hooks, and hooks in the front of the mouth of sea turtles that can be boated. One short-handled dehooker for ingested hooks is required on board. The minimum design and performance standards are as follows:

(A) *Hook removal device.* The hook removal device must be constructed of 1/4 inch (6.35 mm) 316 L stainless steel, and the design of the dehooking end must be such to allow the hook to be secured and the barb shielded without re-engaging during the hook removal process. The dehooking end must be no larger than 1 5/16 inch (3.33 cm) outside diameter. It must not have any unprotected terminal points (including blunt ones), as this could cause injury to the esophagus during hook removal. The dehooking end must be of a size appropriate to secure the range of hook sizes and styles used by the vessel.

(B) *Sliding plastic bite block.* The dehooker must have a sliding plastic bite block, which is intended to be used to protect the sea turtle's beak and facilitate hook removal if the turtle bites down on the dehooker. The bite block must be constructed of a 3/4 inch (1.91 cm) inside diameter high impact plastic cylinder (for example, Schedule 80 PVC) that is 10 inches (25.40 cm) long. The dehooker and bite block must be configured to allow for 5 inches (12.70 cm) of slide of the bite block along the shaft of the dehooker.

(C) *Shaft and handle.* The shaft must be 16 to 24 inches (40.64 to 60.69 cm) in length, and must have a T-handle 4 to 6 inches (10.16 to 15.24 cm) in length and 3/4 to 1 1/4 inches (1.90 to 3.18 cm) in diameter.

(v) Short-handled dehooker for external hooks. This item is intended to be used to remove externally hooked hooks from sea turtles that can be boated. One short-handled dehooker for external hooks is required on board. The short-handled dehooker for ingested hooks required to comply with paragraph (a)(7)(v) of this section meets this requirement. The minimum design and performance standards are as follows:

(A) *Hook removal device.* The hook removal device must be constructed of 5/16 inch (7.94 cm) 316 L stainless steel, and the design must be such that a hook can be rotated out without pulling it out at an angle. The dehooking end must be blunt, and all edges rounded. The device must be of a size appropriate to secure the range of hook sizes and styles used by the vessel.

(B) *Shaft and handle.* The shaft must be 16 to 24 inches (40.64 to 60.69 cm) in length, and must have a T-handle 4 to 6 inches (10.16 to 15.24 cm) in length and 3/4 to 1 1/4 inches (1.90 to 3.18 cm) in diameter.

(8) Tire. This item is intended to be used for supporting a turtle in an upright orientation while it is on board. One tire is required on board, but an assortment of sizes is recommended to accommodate a range of turtle sizes. The tire must be a standard passenger vehicle tire and must be free of exposed steel belts.

(9) Long-nose or needle-nose pliers. This item is intended to be used to remove deeply embedded hooks from the turtle's flesh that must be twisted in order to be removed, and also to hold in place PVC splice couplings when used as mouth openers. One pair of long-nose or needle-nose pliers is required on board. The minimum design standards are as follows: The pliers must be 8 to 14 inches (20.32 to 35.56 cm) in length. It is recommended that they be constructed of stainless steel material.

(10) Wire or bolt cutters. This item is intended to be used to cut through hooks in order to remove all or part of the hook. One pair of wire or bolt cutters is required on board. The minimum design and performance standards are as follows: The wire or bolt cutters must be capable of cutting hard metals, such as stainless or carbon steel hooks, and they must be capable of cutting through the hooks used by the vessel.

(11) Monofilament line cutters. This item is intended to be used to cut and remove fishing line as close to the eye of the hook as possible if the hook is swallowed or cannot be removed. One pair of monofilament line cutters is required on board. The minimum design standards are as follows: Monofilament line cutters must be 6 to 9 inches (15.24 to 22.86 cm) in length. The blades must be 1 3/4 (4.45 cm) in length and 5/8 inches (1.59 cm) wide when closed.

(12) Mouth openers and gags. These items are intended to be used to open the mouths of boated sea turtles, and to keep them open when removing ingested hooks in a way that allows the hook or line to be removed without causing further injury to the turtle. At least two of the seven different types of mouth openers and gags described below are required on board. The seven types and their minimum design standards are as follows.

(i) A block of hard wood. A block of hard wood is intended to be used to gag open a turtle's mouth by placing it in the corner of the jaw. It must be made of hard wood of a type that does not splinter (for example, maple), and it must have rounded and smoothed edges. The dimensions must be 10 to 12 inches (24.50 to 30.48 cm) by 3/4 to 1 1/4 inches (1.90 to 3.18 cm) by 3/4 to 1 1/4 inches (1.90 to 3.18 cm).

(ii) A set of three canine mouth gags. A canine mouth gag is intended to be used to gag open a turtle's mouth while allowing hands-free operation after it is in place. A set of canine mouth gags must include one of each of the following sizes: small (5 inches, 12.7 cm), medium (6 inches, 15.2 cm), and large (7 inches, 17.8 cm). They must be constructed of stainless steel. A 1 3/4 inch (4.45 cm) long piece of vinyl tubing (3/4 inch, 1.91 cm) outside diameter and 5/8 inch (1.59 cm) inside diameter) must be placed over the ends of the gags to protect the turtle's beak.

(iii) A set of two sturdy canine chew bones. A canine chew bone is intended to be used to gag open a turtle's mouth by placing it in the corner of the jaw. They must be constructed of durable nylon, zylene resin, or thermoplastic polymer, and strong enough to withstand biting without splintering. To accommodate a variety of turtle beak sizes, a set must include one large (5 1/2 to 8 inches (13.97 to 20.32 cm) in length) and one small (3 1/2 to 4 1/2 inches (8.89 to 11.43 cm) in length) canine chew bones.

(iv) A set of two rope loops covered with hose. A set of two rope loops covered with a piece of hose is intended to be used as a mouth opener and to keep a turtle's mouth open during hook and/or line removal. A set consists of two 3-foot (0.91 m) lengths of poly braid rope, each covered with an 8 inch (20.32 cm) section of 1/2 inch (1.27 cm) or 3/4 inch (1.91 cm) light-duty garden hose, and each tied into a loop.

(v) A hank of rope. A hank of rope is intended to be used to gag open a sea turtle's mouth by placing it in the corner of the jaw. A hank of rope is made from a 6 foot (1.83 m) lanyard of braided nylon rope that is folded to create a hank, or looped bundle, of rope. The hank must be 2 to 4 inches (5.08 to 10.16 cm) in thickness.

(vi) A set of four PVC splice couplings. PVC splice couplings are intended to be used to allow access to the back of the mouth of a turtle for hook and line removal by positioning them inside a turtle's mouth and holding them in place with long-nose or needle-nose pliers. The set must consist of the following Schedule 40 PVC splice coupling sizes: 1 inch (2.54 cm), 1 1/4 inches (3.18 cm), 1 1/2 inches (3.81 cm), and 2 inches (5.08 cm).

(vii) A large avian oral speculum. A large avian oral speculum is intended to be used to hold a turtle's mouth open and control the head with one hand while removing a hook with the other hand. It must be 9 inches (22.86 cm) in length and constructed of 3/16 inch (4.76 mm) wire diameter surgical stainless steel (Type 304). It must be covered with 8 inches (20.32 cm) of clear vinyl tubing 5/16 inch (7.94 mm) outside diameter, 3/16 inch (4.76 mm) inside diameter.

(b) Handling requirements. If a sea turtle is observed to be hooked or entangled in fishing gear from any vessel fishing under the Pelagics FEP, vessel owners and operators must use the required mitigation gear set forth in paragraph (a) of this section to comply with these handling requirements. Any hooked or entangled sea turtle must be handled in a manner to minimize injury and promote survival.

(1) Sea turtles that cannot be brought aboard. In instances where a sea turtle is too large to be brought aboard or the sea turtle cannot be brought aboard without causing further injury to the sea turtle, the vessel owner or operator must disentangle and remove the gear, or cut the line as close as possible to the hook or entanglement, to remove the maximum amount of the gear from the sea turtle.

(2) Sea turtles that can be brought aboard. In instances where a sea turtle is not too large to be brought aboard, or the sea turtle can be brought aboard without causing further injury to the turtle, the vessel owner or operator must take the following actions:

(i) Immediately bring the sea turtle aboard;

(ii) Handle the sea turtle in accordance with the procedures in paragraphs (b)(3) and (b)(4) of this section; and

(iii) Disentangle and remove the gear, or cut the line as close as possible to the hook or entanglement, to remove the maximum amount of the gear from the sea turtle.

(3) *Sea turtle resuscitation.* If a sea turtle appears dead or comatose, the following actions must be taken:

(i) Place the sea turtle on its belly (on the bottom shell or plastron) so that the sea turtle is right side up and its hindquarters elevated at least 6 inches (15.24 cm) for a period of no less than 4 hours and no more than 24 hours. The amount of the elevation varies with the size of the sea turtle; greater elevations are needed for larger sea turtles;

(ii) Administer a reflex test at least once every 3 hours. The test is to be performed by gently touching the eye and pinching the tail of a sea turtle to determine if the sea turtle is responsive;

(iii) Keep the sea turtle shaded and damp or moist (but under no circumstances place the sea turtle into a container holding water). A water-soaked towel placed over the eyes, carapace and flippers is the most effective method of keeping a sea turtle moist; and

(iv) Return to the sea any sea turtle that revives and becomes active in the manner described in paragraph (b)(4) of this section. Sea turtles that fail to revive within the 24-hour period must also be returned to the sea in the manner described in paragraph (b)(4) of this section.

(4) *Sea turtle release.* After handling a sea turtle in accordance with the requirements of paragraphs (b)(2) and (b)(3) of this section, the sea turtle must be returned to the ocean after identification unless NMFS requests the retention of a dead sea turtle for research. In releasing a sea turtle the vessel owner or operator must:

(i) Place the vessel engine in neutral gear so that the propeller is disengaged and the vessel is stopped, and release the sea turtle away from deployed gear; and

(ii) Observe that the turtle is safely away from the vessel before engaging the propeller and continuing operations.

(5) Other sea turtle requirements. No sea turtle, including a dead turtle, may be consumed or sold. A sea turtle may be landed, offloaded, transshipped, or kept below deck only if NMFS requests the retention of a dead sea turtle for research.

§ 665.813 Western Pacific longline fishing restrictions.

(a) [*Reserved*]

(b) Limits on sea turtle interactions. (1) Maximum annual limits are established on the number 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. The annual limit for leatherback sea turtles (*Dermochelys coriacea*) is 16, and the annual limit for loggerhead sea turtles (*Caretta caretta*) is 17.

(2) Upon determination by the Regional Administrator that, based on data from NMFS observers, either of the two sea turtle interaction limits has been reached during a given calendar year:

(i) As soon as practicable, the Regional Administrator will file for publication at the Office of the Federal Register a notification of the sea turtle interaction limit having been reached. The notification will include an advisement that the shallow-set component of the longline fishery shall be closed, and that shallow-set longline fishing north of the Equator by vessels registered for use under Hawaii longline limited access permits will be prohibited beginning at a specified date, until the end of the calendar year in which the sea turtle interaction limit was reached. Coincidental with the filing of the notification, the Regional Administrator will also provide actual notice that the shallow-set component of the longline fishery shall be closed, and that shallow-set longline fishing north of the Equator by vessels registered for use under Hawaii longline limited access permits will be prohibited beginning at a specified date, to all holders of Hawaii longline limited access permits via telephone, satellite telephone, radio, electronic mail, facsimile transmission, or post.

(ii) Beginning on the fishery closure date indicated by the Regional Administrator in the notification provided to vessel operators and permit holders and published in the Federal Register under paragraph (b)(2)(i) of this section, until the end of the calendar year in which the sea turtle interaction limit was reached, the Hawaii-based shallow-set component of the longline fishery shall be closed.

(c) [*Reserved*]

(d) Vessels registered for use under a Hawaii longline limited access permit may not have on board at any time during a trip for which notification to NMFS under §665.803(a) indicated that deep-setting would be done any float lines less than 20 meters in length or light sticks. As used in this paragraph “float line” means a line used to suspend the main longline beneath a float and “light stick” means any type of light emitting device, including any fluorescent “glow bead,” chemical, or electrically powered light that is affixed underwater to the longline gear.

(e) [*Reserved*]

(f) Any owner or operator of a vessel registered for use under any longline permit issued under §665.801 must use only circle hooks sized 18/0 or larger, with an offset not to exceed 10 degrees, when shallow-setting north of the Equator (0° lat.). As used in this paragraph, an offset circle hook sized 18/0 or larger is one with an outer diameter at its widest point no smaller than 1.97 inches (50 mm) when measured with the eye of the hook on the vertical axis (y-axis) and perpendicular to the horizontal axis (x-axis). As used in this paragraph, the allowable offset is measured from the barbed end of the hook, and is relative to the parallel plane of the eyed-end, or shank, of the hook when laid on its side.

(g) Any owner or operator of a vessel registered for use under any longline permit issued under §665.801 must use only mackerel-type bait when shallow-setting north of the Equator (0° lat.). As used in this paragraph, mackerel-type bait means a whole fusiform fish with a predominantly blue, green, or gray back and predominantly gray, silver, or white lower sides and belly.

(h) Owners and operators of vessels registered for use under a Hawaii longline limited access permit may make sets only of the type (shallow-setting or deep-setting) indicated in the notification to NMFS pursuant to §665.803(a).

(i) Vessels registered for use under Hawaii longline limited access permits may not be used to engage in shallow-setting north of the Equator (0° lat.) any time during which the shallow-set component of the longline fishery is closed pursuant to paragraph (b)(2)(ii) of this section.

(j) Owners and operators of vessels registered for use under a Hawaii longline limited access permit may land or possess no more than 10 swordfish from a fishing trip for which the permit holder notified NMFS under §665.803(a) that the vessel would engage in a deep-setting trip.

(k) When fishing south of the Equator (0° lat.) for western Pacific pelagic MUS, owners and operators of vessels longer than 40 ft (12.2 m) registered for use with any valid longline permit issued pursuant to §665.801 must use longline gear that is configured according to the requirements in paragraphs (k)(1) through (k)(5) of this section.

(1) Each float line must be at least 30 m long.

(2) At least 15 branch lines must be attached to the mainline between any two float lines attached to the mainline.

(3) Each branch line must be at least 10 meters long.

(4) No branch line may be attached to the mainline closer than 70 meters to any float line.

(5) No more than 10 swordfish may be possessed or landed during a single fishing trip.

[75 FR 2205, Jan. 14, 2010, as amended at 76 FR 13299, Mar. 11, 2011; 76 FR 52889, Aug. 24, 2011]

§ 665.814 Protected species workshop.

(a) Each year, both the owner and the operator of a vessel registered for use under any longline permit issued under §665.801 must attend and be certified for completion of a workshop conducted by NMFS on interaction mitigation techniques for sea turtles, seabirds and other protected species.

(b) A protected species workshop certificate will be issued by NMFS annually to any person who has completed the workshop.

(c) An owner of a vessel registered for use under any longline permit issued under §665.801 must have a valid protected species workshop certificate issued by NMFS to the owner of the vessel, in order to maintain or renew their vessel registration.

(d) An owner and an operator of a vessel registered for use under any longline permit issued under §665.801 must have on board the vessel a valid protected species workshop certificate issued by NMFS to the operator of the vessel, or a legible copy thereof.

Sections 665.815 through the end of this subpart were purposefully omit