Endangered Species Act – Section 7 Consultation

Biological Opinion
and
Conference Opinion

Action Agency: National Marine Fisheries Service, Pacific Islands Region, Sustainable Fisheries Division

Activity: Continued operation of the American Samoa longline fishery

Consulting Agency: National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division

Approved By:

Michael D. Tosatto
Regional Administrator, Pacific Islands Region

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Table of Contents

Figures and Tables

Acronyms

AFM	Adult female mortalities
AFR	Age at First Reproduction
ANE	Adult nester equivalent
BE	Biological Evaluation
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
FENA	Females estimated to nest annually
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
LVPA	Large vessel prohibited areas
MHI	Main Hawaiian Islands
NMFS	National Marine Fisheries Service (also NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
PDO	Pacific Decadal Oscillation
PIBHMC	Pacific Island Benthic Habitat Mapping Center
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
SCL	Straight 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
FWS	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. 1536(a)(2)) requires each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" an ESA-listed species, that agency is required to consult formally with the National Marine Fisheries Service (NMFS) for marine species or their designated critical habitat or the U.S. Fish and Wildlife Service (FWS) 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 NMFS or the FWS concur with that conclusion (50 CFR 402.14(b)).

If an action is likely to adversely affect a listed species, the appropriate agency (either NMFS or FWS) must provide a biological opinion to determine if the proposed action is likely to jeopardize the continued existence of listed species (50 CFR 402.02). "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.

For species and critical habitat proposed for listing, each federal agency shall confer on any agency action that is likely to jeopardize the continued existence of any species proposed for listing or result in the destruction or adverse modification of proposed critical habitat (16 U.S.C. 1536(a)(4). Federal agencies may also request a conference on any proposed action that may affect proposed species or proposed critical habitat (50 CFR 402.10(d)). Formal conference follows the same procedures as formal consultation, and results in a conference opinion in the same format and content of a biological opinion.

NMFS Pacific Islands Regional Office (PIRO) Sustainable Fisheries Division (SFD) initiated formal consultation on May 8, 2015 with the Protected Resources Division (PRD) on the continuing operation of the American Samoa longline fishery, as managed under the existing regulatory framework. The proposed action considers future management changes recommended by the Western Pacific Fishery Management Council (Council), but not yet implemented by NMFS, including an exemption to certain portions of the Large Vessel Prohibited Areas (LVPA), modifications to the limited access program, and retention limits for swordfish. This document represents the NMFS biological and conference opinion (Opinion) on the effects of the continued operation of the American Samoa longline fishery, under the existing regulatory framework and with the management changes recommended by the Council, and its effects on threatened and endangered species, their designated critical habitat, and species proposed for listing as threatened or endangered.

1.1.1 American Samoa Pelagic Longline Fishery

The U.S. pelagic longline fishery based in American Samoa is a limited access fishery with a maximum of 60 vessels under the federal permit program. Vessels range in size from 32 to 96.7

ft (9.8 to 29.5 m) long. The fishery primarily targets albacore for canning in the local Pago Pago cannery, although the fishery also catches and retains other tunas (e.g., bigeye, yellowfin, and skipjack), and other pelagic management unit species (PMUS) (e.g., billfish, mahimahi, wahoo, oilfish, opah, and sharks) for sale and home consumption.

By definition, all longline vessels employ a mainline longer than one nautical mile, which fishermen deploy as the fishing vessel moves across the water. The mainline is suspended horizontally below the surface with floats attached along the mainline. Branch lines with circle hooks and bait are attached to the mainline. In the American Samoa fishery, all hooks must be deployed to fish at least 100 m deep. This is accomplished by requiring a minimum float line length of 30 m, together with a minimum of 70 m of blank mainline (no hooks) between each float line and the first branch line in either direction along the mainline (Figure 1). Longline deployment is typically referred to as “setting,” and the gear, once deployed, is typically referred to as a “set.” Sets normally drift separated from the vessel for several hours before they are retrieved, known as the “haul” or “hauling,” along with any catch.

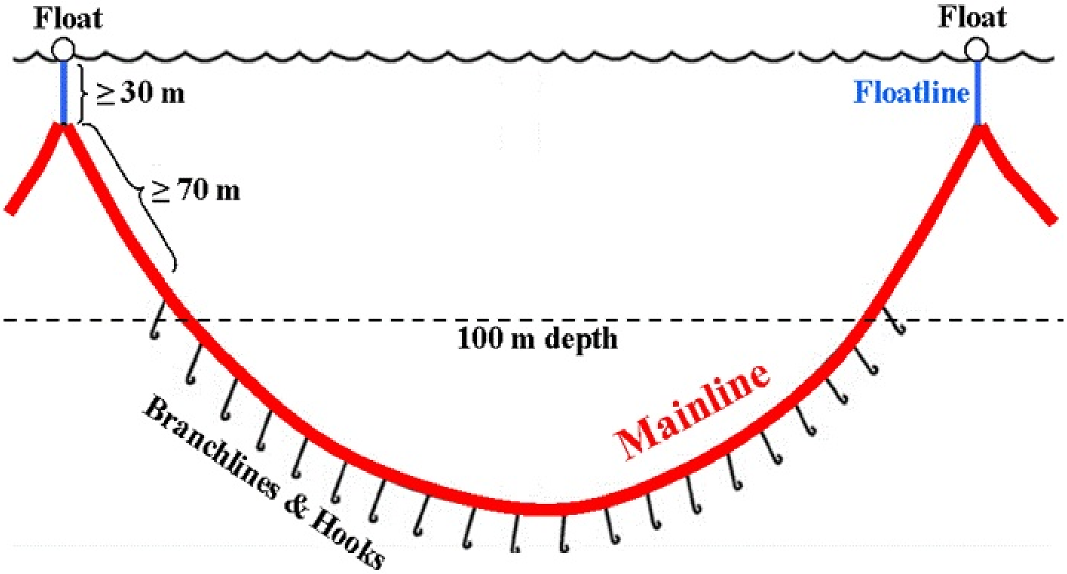


Figure 1. General gear configuration while deployed in the American Samoa longline fishery.

Longline fishing in American Samoa began in the mid-1990s, as fishermen shifted from troll or handline gear to longline gear. At this time, longline fishing was conducted mostly from alia, a locally-built catamaran less than 30 ft long, using hand-operated reels. A high producing alia with an experienced captain and crew can make up to 160 trips annually, with one set per trip, and deploy 65,500 hooks (Kaneko and Bartram 2005). Around 2000–2001, the longline fishery began to expand rapidly, principally through the influx of large (≥50 ft overall length) conventional monohull vessels similar to the type used in the Hawaii longline fisheries. These monohull vessels are larger, have a greater range, and are able to set more hooks per trip than the alia. Additionally, they are outfitted with hydraulically powered reels to set and haul mainline, and with modern electronic equipment for navigation, communications, and fish finding.

1.1.2 The Regulatory framework for the American Samoa Longline Fishery

The Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific Region (Pelagics FEP) establishes the framework for the Council and NMFS to manage U.S. pelagic fisheries in the Western Pacific Region (WPFMC 2009a). It contains a description of the pelagic and benthic environment, pelagic species managed, and the fisheries managed by the Council and NMFS, including the American Samoa longline fishery. It also includes information regarding the management program, identification, and description of essential fish habitat and Federal, State, and local laws that apply to pelagic fisheries under the Council's jurisdiction. For the complete set of these federal regulations, see 50 CFR Part 665, Title 50 of the Code of Federal Regulations (CFR), Parts 229, 300, 404, 600, and 665, and, for a summary, see Summary of Hawaii Longline Regulations (NMFS 2013b). The Biological Evaluation (BE) prepared by SFD in May 2015 to support reinitiation of consultation also provides details of the fishery's management (NMFS 2015a).

Actions taken to amend the plan or modify regulations that govern the fishery, including those mentioned in the section below, are undertaken in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA), National Environmental Policy Act (NEPA), ESA, Marine Mammal Protection Act (MMPA), and other applicable Federal statutes.

Under 50 CFR 665.806, all pelagic fishing vessels 50 ft (15.2 m) and longer, including longline fishing vessels are prohibited from fishing within approximately 50 nautical miles (nm) around Swains Island and Rose Atoll, and approximately 30–40 nm around the island of Tutuila and the Manua Islands, consisting of Ofu, Olosega, and Tau (Figure 2). These prohibited areas collectively are called the LVPA. NMFS and the Council established the LVPA in 2002 to prevent potential gear conflicts and resource competition between large vessels (≥50 ft) and the small vessel fleet (<50 ft) of American Samoa (67 FR 4369, January 30, 2002). However, federal regulations exempt a person who owns a large vessel to use that vessel to fish for Western Pacific PMUS in the LVPA, if the person seeking the exemption had been the owner of the vessel when it was registered for a longline permit and made at least one landing of PMUS in American Samoa prior to 1997. Currently, fewer than three people qualify for this exemption.

The specific requirements governing the American Samoa longline fishery are grouped into the following categories, and each category is summarized below:

Fishing Permits and Certificates on board the vessel:

- American Samoa Longline Limited Access Permit.
- Marine Mammal Authorization Program Certificate.
- High Seas Fishing Compliance Act Permit for fishing on the high seas.
- Western and Central Pacific Fisheries Commission (WCPFC) Convention Area Endorsement for fishing on the high seas in the convention area.
- Protected Species Workshop (PSW) certificate.
- Western Pacific Receiving Vessel Permit, if applicable.

Area Restrictions:

- Pelagic fishing vessels 50 ft (15.2 m) and longer (including longline vessel) are prohibited from fishing within the LVPA (Figure 2).
- All commercial fishing is prohibited within the boundary of the Rose Atoll Marine National Monument.

Reporting, Monitoring, and Gear Requirements:

- Logbook for recording effort, catch, and other data.
- Transshipping Logbook, if applicable.
- Marine Mammal Authorization Program Mortality/Injury Reporting Form.
- Vessel monitoring system unit.
- Vessel and fishing gear identification.
- Owners and operators of vessels longer than 40 ft (12.2 m) must use longline gear that is configured according to the following requirements:
    - Each float line must be at least 30 m long.
    - At least 15 branch lines must be attached to the mainline between any two float lines attached to the mainline.
    - Each branch line must be at least 10 m long.
    - No branch line may be attached to the mainline closer than 70 m to any float line.
    - No more than 10 swordfish may be possessed or landed during a single fishing trip.

Notification Requirement and Observer Placement:

- Notify NMFS before departure on a fishing trip to declare the trip.
- Carry a fishery observer on board if requested by NMFS; since 2010, NMFS placed observers on approximately 20 percent or greater percentage of all longline trips annually.
- Follow fishery observer guidelines.

NMFS regulation summaries and compliance guides for the fishery provide an overview of the current regulations and requirements for permit holders, vessel owners, and operators (http://www.fpir.noaa.gov/SFD/SFD_regs_2.html).

1.1.3 Protected Species Requirements for the Fishery

The Pelagics FEP and its implementing regulations at 50 CFR 665 contain a number of requirements to prevent and mitigate the effects of the American Samoa longline fishery on protected species (sea turtles, marine mammals, and seabirds).

Protected Species Workshop (PSW):

- Each year, longline vessel owners and operators (captain) must complete a PSW provided by the NMFS Pacific Islands Regional Office (PIRO). The workshops (offered in the classroom and on line) teach fishermen about mitigation, handling, and release techniques for sea turtles, seabirds, and marine mammals. Fishermen must carry and use specific equipment, and follow certain procedures for handling and releasing sea turtles, seabirds, and marine mammals that may be caught incidentally while fishing.
- A valid PSW certificate is required to renew an American Samoa longline permit.

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

Sea Turtle Interaction Mitigation:

- Regulations require all hooks must be placed at least 100 m deep on vessels. This is accomplished by requiring a minimum float line length of 30 m, together with a minimum of 70 m of blank mainline (no hooks) between each float line and the first branchline in either direction along the mainline.
- Regulations also prohibit longline vessels from retaining more than 10 swordfish per trip as a means to discourage targeting of swordfish, which are generally found shallower than 100 m.

Sea Turtle and Seabird Handling and Mitigation Measures:

- Adhere to regulations for safe handling and release of sea turtles
- Have on board the vessel all required turtle handling and dehooking gear specified in regulations.

1.1.4 Potential Changes to Fishery Regulations

Management of the American Samoa longline fishery is dynamic due to the cross-jurisdictional and pelagic nature of the fishery, as well as the participation by the U.S. in international fisheries management organizations. Proposed management revisions recommended by the Council, are described in this section to explain how management and operation of the fishery could change if the Secretary of Commerce (Secretary) approves the Council's recommendations. The proposed action analyzed in the BE includes these potential regulatory changes.

1. <u>Modification of the American Samoa Longline Limited Access Program</u>

At its 150th meeting (March 2011; American Samoa), the Council recommended several actions to eliminate or minimize programmatic barriers that it believes is hindering active participation in the small vessel longline fleet. The recommendations include:

a. replacing the four vessel classes with two, where Class A and B vessels would be considered "small" and Class C and D vessels would be considered "large.";
b. restricting permit ownership to U.S. citizens and nationals only and eliminating permit criteria for having documented history of participation to be eligible for owning a permit, but would maintain the priority ranking system based on earliest documented history of fishing participation in vessel class size;
c. allowing permit transfers only to U.S. citizens or nationals, and eliminating requirements to have documented participation in American Samoa longline fishery to be eligible to receive a transferred permit; and
d. lowering the "small" vessel class minimum harvesting requirement to 500 lb of PMUS caught with longline gear in the Exclusive Economic Zone (EEZ) around American Samoa within a 3-year period, maintaining the existing 5,000 lb harvesting requirement of PMUS caught with longline gear in the EEZ around American Samoa for the "large" vessel class.

The Council and NMFS are still developing this proposed action, but NMFS does not foresee a large change in the number of small vessels able to fish within the LVPA. NMFS expects the fishery may operate up to the level seen in 2007 when 29 vessels deployed 5,920 sets and approximately 17,554,000 hooks.

2. Remove Trip Limits for Swordfish

At its 157th meeting (June 2013), the Council took action and recommended removing the 10 swordfish per trip retention limit, deeming it an unnecessary measure to ensure compliance with the 100 m longline hook setting requirement implemented in 2011, and that it may cause unnecessary waste of swordfish resources.

3. American Samoa Longline Albacore Catch Limit

At its 162nd meeting (March 2015), the Council recommended the specification of an annual longline catch limit of 5,425 metric tons of albacore within the EEZ around American Samoa for 2015 and 2016.

4. U.S. Territory Bigeye Longline Specifications

At its 162nd meeting (March 2015), the Council recommended the specification of a 2,000-mt total annual bigeye longline catch limit and 1,000-mt transferable longline bigeye limit per each U.S. participating territory for 2015 and 2016. On October 14, 2015, NMFS published the final 2015 catch limits for longline fisheries of the Commonwealth of the Northern Mariana Islands (80 FR 61767). NMFS has not yet specified the 2015 bigeye tuna catch limits for longline fisheries of Guam or American Samoa.

5. Exemptions from the Large Vessel Prohibited Areas for Longline Vessels

At its 162nd meeting (March 2015), the Council recommended exempting American Samoa limited entry permitted longline vessels 50 ft (15.2 m) and longer (large vessels) from certain areas of the American Samoa LVPA to improve fishing efficiency. The LVPA longline exempted area would be defined as the area seaward of 12 nm from Tutuila, Manua Islands, and Swains Island. The proposed temporary exemption would be authorized for an indeterminate period, but the Council will review the LVPA exemption on an annual basis for the following topics, at a minimum: catch rates of participants, small vessel participation, and fisheries development initiatives. The Council believes increasing areas available to the large vessels in the longline fleet may reduce trip lengths and potential catch competition between active vessels, as well as potentially improve economic efficiency by reducing fuel costs. The proposed action includes the Council's recommendation to exempt large longliners from areas of the LVPA seaward of 12 nm from Tutuila, Manua Islands, and Swains Island. NMFS published a proposed rule for this action in the *Federal Register* on August 25, 2015 (80 FR 51527).

2 Consultation History

NMFS previously issued an Opinion on the proposed regulatory amendments to the Pelagics Fishery Management Plan (Pelagics FMP) on February 23, 2004 (2004 Opinion) (NMFS 2004a), which included the Hawaii shallow-set longline, the Hawaii deep-set longline, the American Samoa longline, and the regional non-longline pelagic fisheries. The 2004 Opinion (NMFS 2004a) included an Incidental Take Statement (ITS) estimating that six sea turtle interactions (cumulatively resulting in one mortality) for greens, loggerheads, olive ridley sea turtle, or hawksbill sea turtle species combined would occur annually in the American Samoa longline fishery and the regional non-longline pelagic fisheries combined. The ITS of six sea turtles was exceeded based on the number of green sea turtles that were observed in the fishery and on September 16, 2010, NMFS completed a no-jeopardy Opinion (2010 Opinion; NMFS 2010a) under ESA Section 7 on the implementation of Amendment 5 to the Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific (Pelagics FEP; WPFMC 2009a). The Council developed Amendment 5, which established measures to reduce interactions between the fishery and green sea turtles. Specifically, the regulations implementing Amendment 5 require American Samoa-based longline vessels to deploy all longline hooks to fish at least 100 m deep. Additional regulations included requirements for a minimum of 15 branchlines between each float, and a maximum of 10 swordfish retained on each trip. The Secretary of Commerce approved Amendment 5 and NMFS issued final regulations on August 24, 2011, that were effective on September 23, 2011 (76 FR 52888).

In the 2010 Opinion, NMFS determined that the proposed action is likely to adversely affect green sea turtles, hawksbill sea turtles, leatherback sea turtles, and olive ridley sea turtles, but not likely to jeopardize the continued existence or recovery of these species. NMFS anticipated and authorized a three-year incidental take statement (ITS) of 45 green sea turtles, one hawksbill sea turtle, one leatherback sea turtle, and one olive ridley sea turtle in the fishery.

The sequence of events leading up to the development of this Opinion are provided below.

On May 8, 2015, SFD of NMFS PIRO sent a memorandum toPRD of NMFS PIRO, requesting reinitiation of formal consultation on effects of the ongoing operation of the American Samoa longline fishery on ESA-listed sea turtles and marine mammals (NMFS 2015a). 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; 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: From 2011–2014, the observer program reported five observed fishery interactions with leatherback sea turtles and five with olive ridley sea turtles. These interactions exceeded the ITS set in the 2010 Opinion for leatherback sea turtles and olive ridley sea turtles.

On September 10, 2014, NMFS published a final rule (79 FR 53852) that listed 20 new species of reef-building corals as threatened under the ESA. Of those, NMFS believes seven occur in waters under U.S. jurisdiction in the Pacific, with six in American Samoa. On July 3, 2014, NMFS published a final rule that listed four Distinct Population Segments (DPSs) of scalloped hammerhead shark under the ESA (79 FR 38213). The threatened Indo-West Pacific DPS is the only scalloped hammerhead shark DPS that occurs in the action area that may be affected by the American Samoa longline fishery.

In the May 8, 2015 BE (NMFS 2015a) accompanying the request for reinitiation, SFD concluded the proposed action may affect, but is not likely to adversely affect the six listed reef-building corals found in American Samoa. In addition, they stated that there is no new information on humpback and sperm whales; therefore, the letter of concurrence on those two species are still valid. SFD concluded the proposed action may affect, and is likely to adversely affect green sea turtles, leatherback sea turtles, olive ridley sea turtles, hawksbill sea turtles, the South Pacific loggerhead sea turtle DPS, and the Indo-West Pacific scalloped hammerhead shark DPS.

On May 8, 2015, in a record to the file, the Regional Administrator (RA) of NMFS PIRO issued findings and decisions pursuant to section 7(a)(2), 7(d), and 7(a)(4) of the ESA, 16 U.S.C. § 1536(d). The RA concluded that the continuing operation of the American Samoa longline fishery during the consultation period would not violate the prohibition in ESA section 7(d) against making irreversible or irretrievable commitment of resources that preclude the formulation or implementation of reasonable and prudent alternatives to avoid the likelihood of jeopardy to listed species or adverse modification of critical habitat. In addition, NMFS determined that during the period of consultation the continued operation of the American Samoa longline fishery would not jeopardize the continued existence of any ESA-listed species under NMFS jurisdiction and would not violate ESA section 7(a)(2).

On June 22, 2015, while the consultation was ongoing, NMFS determined that the American Samoa longline fishery exceeded the level of incidental take of leatherback sea turtles anticipated in the May 8, 2015, ESA sections 7(a)(2) and 7(d) analysis. The effects analysis in the May 8, 2015, memorandum (NMFS 2015b) estimated that the fishery could take up to 12 leatherback sea turtles in 2015, or six leatherback sea turtles during the six-month consultation period. NMFS based this estimate on the highest historical level of take observed in the fishery in one year, which at that time was two observed interactions. NMFS uses an expansion calculation of the observed takes with protected species based on the percent observer coverage to obtain a fleet-wide estimate of total fishery takes. Based on an 18.75 percent observer coverage, an expansion factor of 5.33 (rounded up to 6) was applied resulting in an estimated take of 12 interactions annually, or six during the estimated six-month consultation period (18.75 percent x 5.33 = 100 percent observer coverage). Using a mortality rate of 53 percent, derived from NMFS post-hooking mortality criteria (Ryder et al., 2006), NMFS estimated that these six takes would result in 3.18 mortalities (6*0.53=3.18). To determine the number of adult females that would be affected, NMFS used a 65:35 female-to-male ratio for Western Pacific leatherback sea turtles (Van Houtan 2013), which reduces the 3.18 mortality estimate to 2.067 female mortalities (3.18*0.65=2.067). To discount for natural mortality, the adult nester equivalent (ANE) was then calculated to be 0.049 for this population using exact demographic matching, described by Van Houtan (2013). These numbers are analogous to the fishery causing a single adult female mortality every 10.11 years. This level of impact is approximately 0.0025 percent of the breeding population (NMFS 2015b).

In the second quarter of 2015 (April 1 through June 30, 2015), the fishery had three observed takes of leatherback sea turtles: one in May and two in June. All three turtles, likely juveniles, were taken in the EEZ around American Samoa, and all were confirmed dead by the observer. Based on an expansion factor of 5.57 (observer coverage was 17.95 percent at the end of the second quarter), NMFS estimates the fishery has taken 17 leatherback sea turtles thus far in 2015, exceeding the previous anticipated take projection of 12 leatherback sea turtles annually and six during the period of consultation. Based on observed leatherback sea turtle takes since 2011, and applying the NMFS' posthooking mortality criteria (Ryder et al., 2006), NMFS revised its take-associated mortality rate from 53 percent to 70.6 percent. Thus, we estimate the fishery would take 27 individuals during the period of formal consultation, 20 of which would result in mortality (27*0.706 = 19.06) (NMFS 2015b). To discount for males, we use a 65/35 female-to-male ratio for Western Pacific leatherback sea turtles (Snover 2008), which drops the 19.06 mortality estimate to 12.39 female mortalities. To discount for natural mortality, the ANE is then calculated to be 0.639 for this population using exact demographic matching, described by Van Houtan (2013). These numbers are analogous to the fishery causing a single adult female mortality every 1.566 years. This level of impact is approximately 0.043 percent percent of the female breeding population, or 1 in 2,335 nesters (NMFS 2015b). This additional level of impact, when considered together with the impacts of the Hawaii longline fisheries, is unlikely to have a detectable influence on population trends and is not expected to impact the survival or recovery of the species.

Accordingly, NMFS determined that continuation of the American Samoa longline fishery during the reinitiation period would not violate ESA section 7(a)(2). Finally, NMFS determined that continuation of the American Samoa longline fishery during the period of consultation does not constitute an irreversible or irretrievable commitment of resources under ESA section 7(d) (NMFS 2015b).

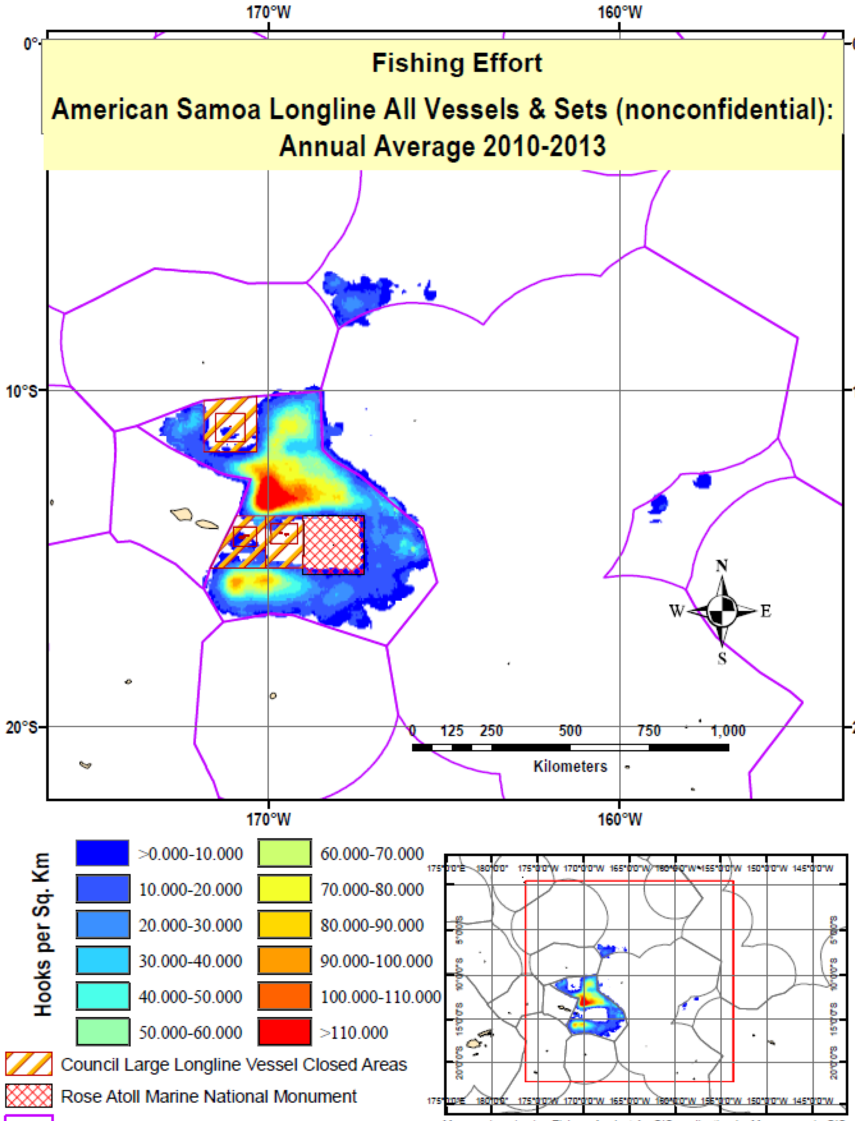
PIRO/PRD provided a draft biological opinion to PIRO/SFD and the Council, with a request for comments, on October 15, 2015. Comments were received from SFD on October 22, 2015.Comments were received from the Council on October 23, 2015.

3 Description of the Proposed Action

The proposed action is the continued operation of the American Samoa pelagic longline fishery, as currently managed under the Pelagics FEP, and the existing regulatory regime as described in section 1 of this Opinion. Although participation and effort has varied and declined in recent years, NMFS expects that the level of participation, in terms of fleet-wide sets and hooks deployed, could return to historic levels. For this reason, NMFS expects the fishery may operate up to the level seen in 2007 when 29 vessels deployed 5,920 sets and approximately 17,554,000 hooks. NMFS also anticipates the American Samoa longline fishery will continue to fish sustainably, and use proven bycatch mitigation measures to manage impacts to ESA-listed marine mammals and sea turtles as required under regulations in 50 CFR parts 229 and 665.

4 Action Area

The action area for this proposed action includes all areas where vessels permitted by the American Samoa longline fishery operate fishing gear, and areas that such vessels travel through on their fishing trips. This generally includes the EEZ around American Samoa, the EEZs of countries adjacent to American Samoa and on the high seas (Figure 2). The fishery operates longline gear at depths of approximately 100–300 m. Based on fishing patterns since NMFS began observer coverage in April 2006, the fishery may make longline sets between 155° W and 180° W and from 1° S to 32° S with the majority of fishing occurring within the EEZ around American Samoa (NMFS 2010a; NMFS Observer Program, unpublished). The proposed action includes the Council's recommendation to exempt large longliners from areas of the LVPA seaward of 12 nm from Tutuila, Manua Islands, and Swains Island. NMFS has published a proposed rule for this action (80 FR 51527, August 25, 2015).



Map produced using Fishery Analyst ArcGIS application by Mappamondo GIS
Source: PIFSC FRMD/IFMP (MKL) 10/26/14

Figure 2. Locations of longline fishing effort by the American Samoa longline fleet, 2010–2013. Map also shows the longline vessel closed areas (LVPAs) as the right slanting lined areas. Red-lined boxes within these areas would remain closed to all large vessels under the proposed action. Note: The figure depicts non-confidential levels of effort, that is, where three or more vessels fished.

5 Status of Listed Species

SFD's May 8, 2015 BE determined that the proposed action may adversely affect the six ESA-listed marine species shown in Table 1a. In addition, this Opinion will also address the green sea turtle Distinct Population Segments (DPS) that NMFS proposed for listing on March 2015. The BE further determined that the six species of reef corals shown in Table 1b were not likely to be adversely affected. There is no critical habitat in the action area, and, as such, the action will have no effect on critical habitat.

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

Species Common Name	Species Scientific Name	Listing Status	Date Listed	Federal Register Citation
Table 1a. Species likely to be adversely affected by the proposed action.				
Green sea turtle	*Chelonia mydas*	Threatened	07/28/1978	43 FR 32800
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	07/28/1978	43 FR 32800
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened	07/28/1978	43 FR 32800
South Pacific Loggerhead turtle DPS	*Caretta caretta*	Endangered	09/22/2011	76 FR 58868
Indo-West Pacific Scalloped Hammerhead shark DPS	*Sphyrna lewini*	Threatened	07/03/2014	79 FR 38213
Proposed Green sea turtle DPSs in the Action Area that are likely to be adversely affected				
Central West Pacific		Endangered	03/23/2015	80 FR 15271
East Indian-West Pacific		Threatened	03/23/2015	80 FR 15271
Southwest Pacific		Threatened	03/23/2015	80 FR 15271
Central South Pacific		Endangered	03/23/2015	80 FR 15271
East Pacific		Threatened	03/23/2015	80 FR 15271
Table 1b. Species Not likely to be adversely affected by the proposed action as described in this opinion and two additional letters of concurrence.				
	Acropora globiceps	Threatened	09/10/2014	79 FR 53852
	A. jacquelineae	Threatened	09/10/2014	79 FR 53852
	A. retusa	Threatened	09/10/2014	79 FR 53852
	A. speciosa	Threatened	09/10/2014	79 FR 53852
	Euphyllia paradivisa	Threatened	09/10/2014	79 FR 53852
	Isopora crateriformis	Threatened	09/10/2014	79 FR 53852
*Humpback Whale	*Megaptera novaeangliae*	Endangered	12/02/1970	35 FR 18319
*Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970	35 FR 18319

*These two species were previously consulted on and PRD concurred that they were not likely to be adversely affected in the July 27, 2010 and August 27, 2008 letters of concurrence.

Species and Critical Habitat Not Likely to be Adversely Affected

In order to determine that a proposed action is not likely to adversely affect listed species, NMFS must find that the effects of the proposed action are expected to be insignificant, discountable, or beneficial as defined in the joint FWS-NMFS Endangered Species Consultation Handbook: (1) insignificant effects relate to the size of the impact and should never reach the scale where take occurs; (2) discountable effects are those that are extremely unlikely to occur; and (3) beneficial effects are positive effects without any adverse effects (FWS and NMFS 1998). We applied this standard, as well as considered the probable duration, frequency, and severity of potential interactions, during the analysis of effects of the proposed action on ESA-listed marine species to determine if and which species are "not likely to be adversely affected". The potential stressors from this action on ESA listed corals are impacts from vessel groudings, and exposure to vessel wastes (NMFS 2015a).

Reef corals

The likely distribution of *Acropora globiceps* is from the oceanic west Pacific to the central Pacific and east to Pitcairn Islands. Surveys also document it in American Samoa. The species occurs on upper reef slopes, reef flats, and adjacent habitats in depths ranging from 0 to 8 m. Colonies of *A. globiceps* have finger-like branches. Branch size and appearance depend on degree of exposure to wave action, but branches are always located closely together. Colonies exposed to strong wave action have pyramid-shaped branchlets. Colonies are either blue (which may photograph purple) or cream in color. Relative localized abundance refers to how commonly surveys detect the species in a localized area. On an abundance scale of 1 (low) to 5 (high), *A. globiceps* has a mean relative localized abundance rating of 1.95 and is characterized as "uncommon." The absolute abundance (a rough qualitative minimum estimate of the total number of colonies of a species that currently exist throughout its range) of *A. globiceps* is likely at least tens of millions of colonies.

The likely distribution of *Acropora jacquelineae* is mostly within the Coral Triangle area (the Philippines to Timor Leste and east to the Solomon Islands). There are also confirmed records of this species in Eastern Micronesia, and two coral scientists have identified it in American Samoa. *A. jacquelineae* is found in numerous subtidal reef slope and back-reef habitats, including but not limited to, lower reef slopes, walls and ledges, mid-slopes, and upper reef slopes protected from wave action, and its depth range is 10 to 35 m. Colonies of *A .jacquelineae* look like flat plates or tables that can grow up to one meter across. Viewed from above, the plates are covered with a mass of fine, delicately-curved polyps, giving an almost moss-like appearance. Colonies are grey-brown or pinkish in color. Characterized as "uncommon", *A. jacquelineae* has a mean relative localized abundance of 1.44. Based on information in Richards et al., (2008), *A. jacquelineae* had the 14th lowest population of the 15 rare *Acropora* species they studied. They report a population estimate of 31,599,000 colonies, and an effective population size (i.e., group of genetically unique individuals) of 3,476,000 colonies.

The likely distribution of *Acropora retusa* is in the western Indian Ocean, the east coast of India, and Vietnam east to the Pitcairn Islands and occurs in American Samoa. *A. retusa* occurs in shallow reef slope and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons. Its depth range is one to five meters. Colonies of *A. retusa* look like flat plates with short, thick, finger-like branchlets. Colonies are typically brown or green in color. Characterized as "rare," *A. retusa* has a mean abundance rating of 1.21. The absolute abundance of *A. retusa* is likely at least millions of colonies.

The likely distribution of *Acropora speciosa* is from Indonesia to the Marshall Islands in the western and central Pacific and it occurs in American Samoa. It also occurs in the Maldives in the Indian Ocean and at least one site in French Polynesia. Characterized as “uncommon”, *A. speciosa* grows in protected environments with clear water and high diversity of *Acropora* (Veron 2000) and steep slopes or deep, shaded waters. Its depth range is 12 to 40 meters, and it occurs in mesophotic habitat (40–150 m) (79 FR 53852). Colonies of *A. speciosa* form thick cushions or bottlebrush branches. They have large, stretched out polyps on the end of the branches that create the bottlebrush appearance. Colonies are cream or light brown in color with delicately colored branch tips. *A. speciosa* has a mean abundance rating of 1.60. Based on information from Richards et al., (2008), *A. speciosa* had the ninth lowest population of the 15 rare *A.* species they studied. They provide a population estimate of 10,942,000 colonies, and an effective population size of 1,204,000 colonies.

The likely distribution of *Euphyllia paradivisa* is mostly in the Coral Triangle area (the Philippines to Timor Leste and east to the Solomon Islands) and it occurs in American Samoa. *E. paradivisa’s* habitat includes environments protected from wave action on at least upper reef slopes, mid-slope terraces, and lagoons in depths ranging from two to 25 m depth. Colonies of *E. paradivisa* are made up of separate bunches of branching polyps compacted together that have large tentacles extended during the day and night. These tentacles resemble a mass of fish eggs or frog eggs, hence one of its common names (frogspawn). Colonies are pale greenish-grey or pink (in rare instances) with lighter tentacle tips. Characterized “rare,” *E. paradivisa* has a mean relative localized abundance rating of 1.5. The absolute abundance of *E. paradivisa* is likely at least tens of millions of colonies.

The likely distribution of *Isopora crateriformis* is within the Coral Triangle area (the Philippines to Timor Leste and east to the Solomon Islands), plus some of the Western Pacific including New Caledonia, the Samoas, and the Marshall Islands. This species is most commonly found in shallow, high-wave energy environments, from low tide to at least 12 m deep, and has been reported from mesophotic depths (less than 50 m depth). *I. crateriformis* is one of the most common species on upper reef slopes of southwest Tutuila, American Samoa. Throughout its range, the predominant habitat is reef flats and lower reef crests, and it occurs in adjacent habitats such as upper reef slopes. *I. crateriformis* look like flattened solid encrusting plates (i.e., grows flat over hard surfaces) and are sometimes referred to as “cowpies” (79 FR 53852). Colonies are brown in color and can sometimes be over one meter in diameter. Characterized “rare,” *I. crateriformis* has a mean relative localized abundance rating of 1.4. However, this rating could be an underestimate, as scientists conduct most coral abundance surveys on reef slopes, which can significantly underestimate the abundance of species such as *I. crateriformis* that are more common on reef flats than reef slopes. *I. crateriformis* also is more abundant in American Samoa than in other parts of its range. The absolute abundance of *I. crateriformis* is likely at least millions of colonies.

Potential Occurrence of ESA-listed Coral Habitat in American Samoa

Certain corals form reefs on solid substrate within a varied range of suitable environmental conditions that allow the deposition rates of corals and other reef calcifiers to exceed the rates of physical, chemical, and biological erosion (NMFS 2014c). Rohmann et al., (2005) estimate there is approximately 53 km^2 of potential coral reef ecosystem located around American Samoa in less than 10 fathoms (fm) (~18 m or 60 ft) and approximately 464 km^2 in less than 100 fm (~182 m or 600 ft). In American Samoa, coral reef habitat is in nearshore waters from 0–3 nm from the shore, although some coral reef habitat is further offshore.

Species-specific information on the exact location of these ESA-listed coral is unavailable. Pacific Islands Fisheries Science Center Coral Reef Ecosystem Division (PIFSC) staff and Council staff provided maps and analyses for the potential occurrence of ESA-listed coral in depths shallower than 50 m (the deepest confirmed range of a listed coral species in American Samoa), in relation to the boundary of territorial waters and the EEZ around American Samoa (WPFMC 2014a). PIFSC and the Council used bathymetric data from the Pacific Island Benthic Habitat Mapping Center (PIBHMC) to derive the estimate of the total area less than 50 m depth around American Samoa. The major geologic features of the EEZ in the Territory of American Samoa are five high volcanic islands, one coral atoll (Rose Atoll), one isolated coral islet (Swains Island), and several seamounts. Of these features, the PIBHMC provides bathymetric data to the public for all islands/islets, Rose Atoll, and most of the shallow seamounts (PIBHMC 2014). The estimations provided by the PIFSC and the Council were based on approximations of the territorial/federal boundary, which may have resulted in potential errors and may explain the slight differences in results of potential coral habitat.

In addition, PIFSC collected bathymetry data in the South Bank in 2010 and has preliminarily processed the data. The unpublished South Bank multibeam data must undergo further post-processing before NMFS considers the data as reliable as published PIBHMC data.

Besides estimations of potential occurrence of habitat, PIFSC extracted substrate information outside of territorial waters (0–3 nm) where the data intersected with the 50 m isobath. PIFSC used two sources of the substrate information: Benthic Habitat Mapping of American Samoa, Guam and the Commonwealth of the Northern Mariana Islands (NOAA 2004) and PIFSC preliminary hard and soft bottom seafloor substrate map derived from an unsupervised classification of gridded backscatter and bathymetry derivatives at the US. Territory of Guam, Tinian Island, and Saipan Island, Commonwealth of Northern Mariana Islands, and Tutuila Island, American Samoa (PIBHMC 2008).

Figure 3 shows the map of American Samoa bathymetry and delineates the territorial waters and the EEZ. Based on the PIFSC depth analysis using the PIBHMC data, 97 percent of potential habitat for ESA-listed reef coral in American Samoa is within territorial waters (0–3 nm).

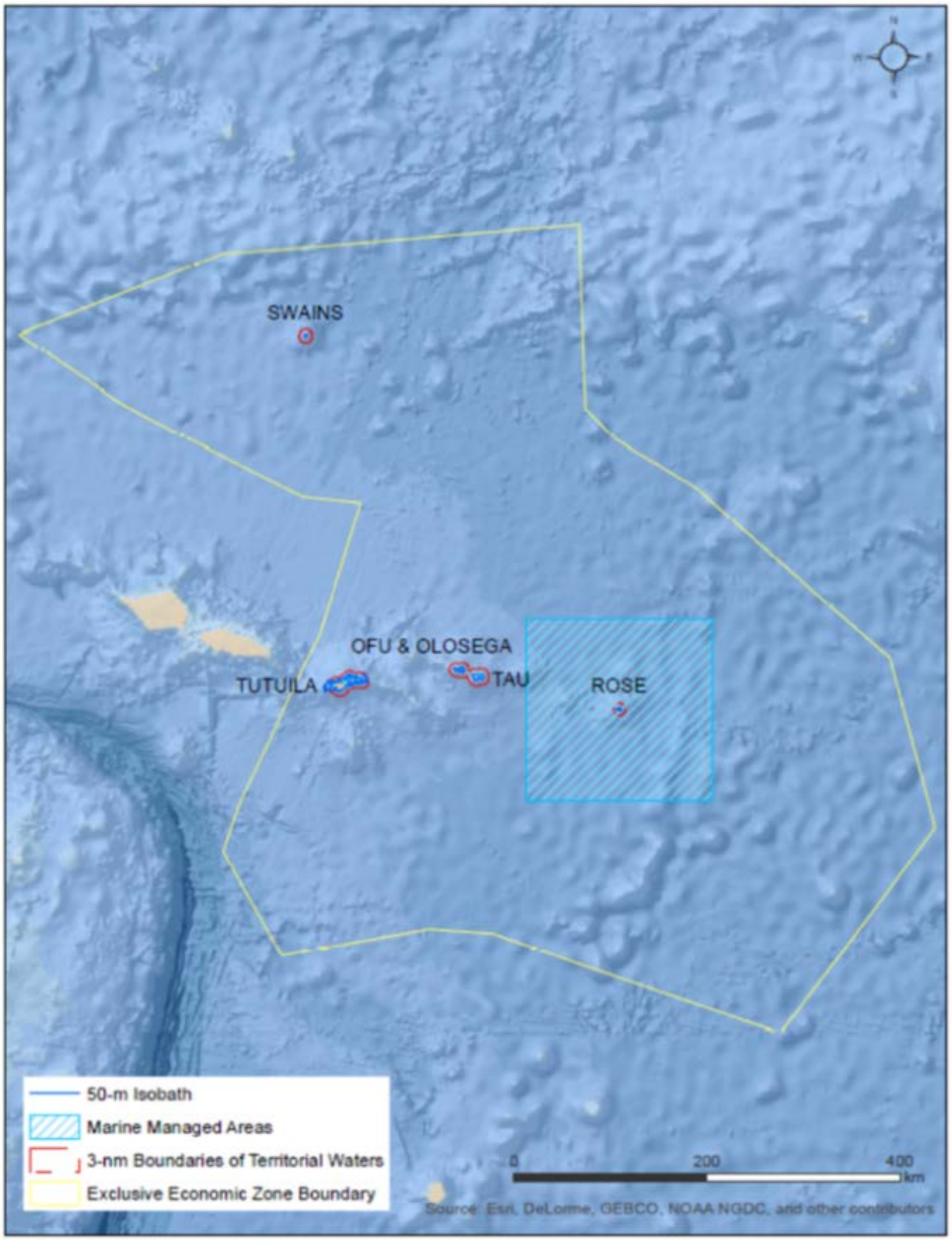
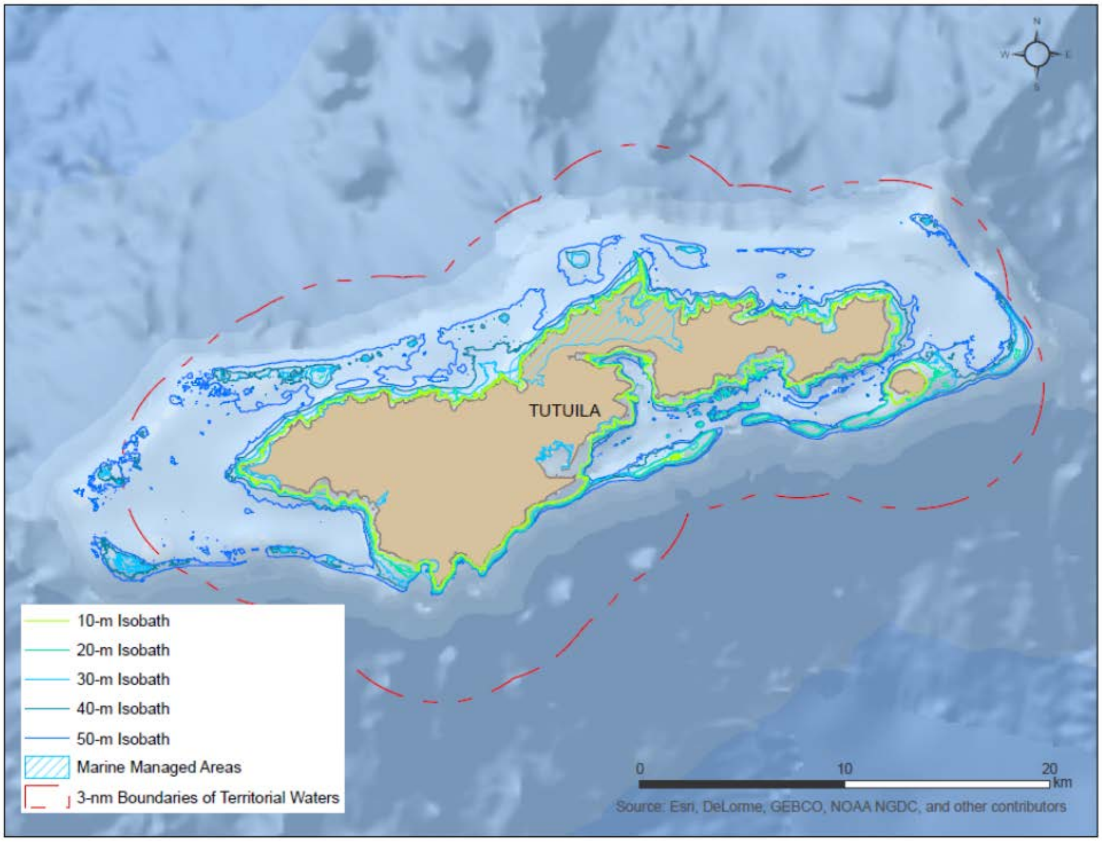


Figure 3. American Samoa Territorial Waters Boundary, EEZ boundary, and 50 m Isobath

The analyses using PIBHMC data resulted in very similar estimates of total potential habitat: the PIFSC analysis resulted in 4.99 km^2, and the Council analysis resulted in 4.54 km^2 of potential habitat shallower than 50 m in the EEZ. The substrate data provided by PIFSC revealed that 4.12 km^2 of this area was hard and 0.35 km^2 of this area was soft (PIFSC Coral Reef Ecosystem Division, unpublished data). Nearly all of the areas with depths shallower than 50 m in the EEZ are located on the west bank of Tutuila.

Tutuila is the only main island in American Samoa that has any significant potential habitat for corals less than 50 m the EEZ (Figure 4). The results show that all potential coral habitat in the EEZ around Tutuila occurs at or deeper than 22 m (Figure 4; WPFMC 2014a). The unpublished South Bank multibeam data indicates there may be 24.69 km^2 of potential habitat at South Bank that warrant further study (PIFSC Coral Reef Ecosystem Division, unpublished data).



Source: Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

Figure 4. Map of Tutuila Showing Territorial Waters Boundary and Isobaths in 10 m Increments

To access preferred fishing grounds, pelagic fishing vessels could transit areas where ESA-listed reef corals may occur. Fishing vessels actively avoid coral reef structures to avoid damage to their hulls, so transiting fishing vessels are not likely to cause damage to shallow tropical and subtropical reefs. Pelagic longline vessels do not deploy gear in transit and do not typically fish in waters above coral reefs. Additionally, pelagic fishing activities do not involve anchoring, so there is no potential for anchor damage during fishing activities. Based on Figure 4 there is limited habitat less than 50 m depth within the EEZ outside of 3 nm. Even with the proposed

LVPA longline vessel exemption seaward of 12 nm from Tutuila, Manua Islands, and Swains Island, longline vessels are not likely to adversely affect ESA-listed coral in American Samoa. For American Samoa, longline hook deployment must occur at least 100 m deep, and thus deployment would not occur at depths shallower than 50 m where ESA-listed corals occur. Because this fishery occurs deeper than ESA-listed coral depth and fishermen would avoid coral reef structures during transit in territorial and federal waters, the likelihood of exposing coral to pelagic fishing gear or transiting vessels is extremely unlikely, and therefore discountable.

Federal laws and regulations strictly regulate the discharge of oil, garbage, waste, plastics, and hazardous substances into ocean waters under a variety of Acts, including the Clean Water Act, Oil Pollution Act of 1990, the Act to Prevention Pollution from Ships, MARPOL 1973/1978, and the Ocean Dumping Act. Violations of these laws may result in severe civil penalties, criminal fines, and imprisonment. Although disposal of plastics at sea is prohibited at both the federal and international level, discharges of other legally allowable vessel wastes have the potential to impact ESA-listed reef corals. However, due to the spatial separation between fishing operations and ESA-listed corals, exposure of ESA-listed corals or coral reef habitat to hydrocarbon-based chemicals such as fuel oils, gasoline, lubricants, and hydraulic fluids that may enter the marine environment during fishing operations is unlikely. While fishing operations may cause small volumes of hydrocarbon-based chemicals to enter the marine environment, wind and waves would likely disperse the chemicals widely, such that exposure of ESA listed corals is unlikely. Consequently, we expect the proposed action would have discountable effects on ESA-listed corals or coral reef habitat. Therefore, NMFS concludes that the proposed action is not likely to adversely affect the coral species listed in Table 1b and as a result, they are not considered further in this Opinion.

Species Likely to be Adversely Affected

This section presents biological and ecological information for green sea turtles, leatherback sea turtles, olive ridley sea turtles, hawksbill sea turtles, South Pacific loggerhead turtles, and the Indo-West Pacific scalloped hammerhead shark DPS affected by the proposed action relevant to formulating the Opinion including species-specific descriptions of distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts, and other relevant information (FWS & NMFS 1998). Factors affecting those species within the action area are described in more detail in the Environmental Baseline. No critical habitat has been designated for any of these listed species in the Action Area and therefore none is considered in this analysis. Four species addressed in this section have global distributions, and are listed globally at the species level. Two are listed as DPS and are addressed at that level. Table 1b lists each of the species likely to be adversely affected by the proposed action. The green sea turtle is listed by its current global listing and five proposed DPSs likely to occur within the action area. This Opinion analyzes the effects of the proposed DPSs in the action area and species as currently listed under the ESA.

5.1 Green sea turtles

Information in this section is summarized primarily from the 2010 Opinion (NMFS 2010), the 2014 Opinion (NMFS 2014a), the green turtle 5-year status review (NMFS and FWS 2007a), the proposed listing of eleven DPSs of green sea turtles (80 FR 15272, March 23, 2015), the 2015 green turtle status review (Seminoff et al.,2015) and other sources cited below. We begin this section of the Opinion by describing the species' status relative to its global listing, and subsequently discuss the status for each DPS that occurs in the action area.

5.1.1 Green Turtle (globally-listed, threatened)

The green sea turtle was listed as threatened on July 28, 1978 (43 FR 32800), except for breeding populations found in Florida and the Pacific coast of Mexico, which were listed as endangered.

5.1.1.1 Distribution and Abundance

Green sea turtles (*Chelonia mydas*) have circumglobal distribution (Figure 5), occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters occurring in the western, central, and eastern Atlantic, the Mediterranean, the western, northern, and eastern Indian Ocean, southeast Asia, and the western, central, and eastern Pacific (NMFS & FWS 2007a; Seminoff et al.,2015). Their movements within the marine environment are not fully understood, but it is believed that green sea turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore, 1989). The primary nesting rookeries (i.e., sites with ≥ 500 nesting females per year) within the Pacific Ocean and relevant to the five DPSs of this consultation are located in Australia, Malaysia, Indonesia, Philippines, Costa Rica, Ecuador, and Mexico (NMFS and FWS 2015).

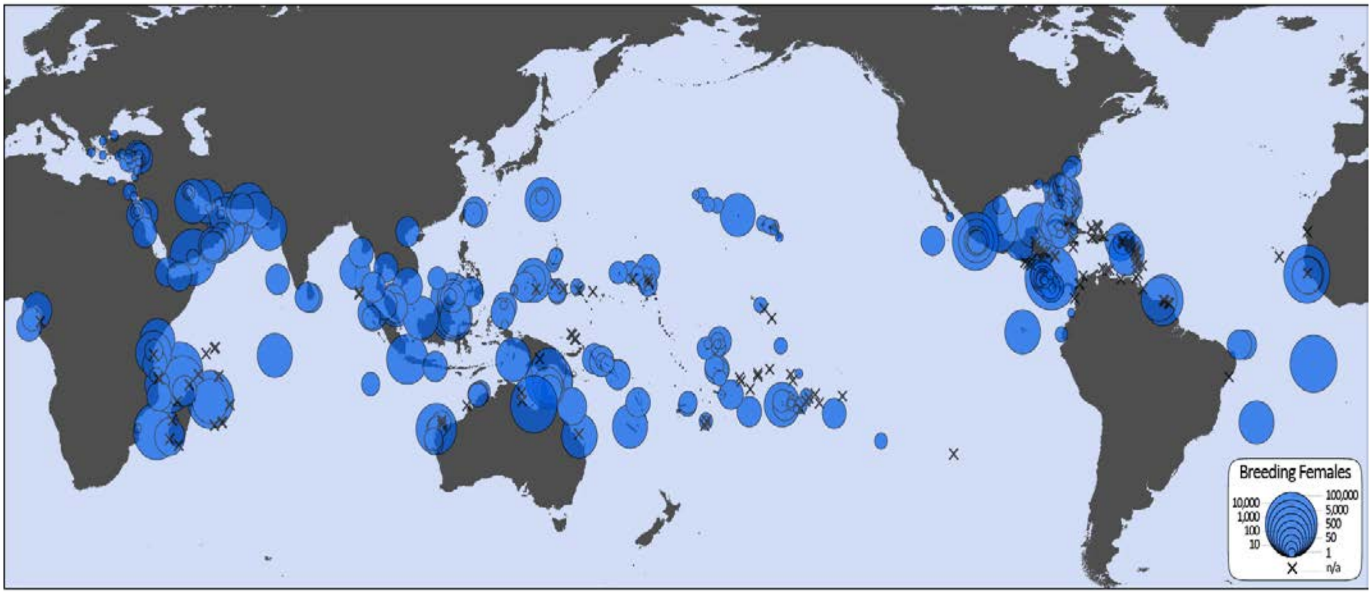


Figure 5. Green Turtle Global Nesting Distribution.

To date, 27 of the 28 green sea turtles incidentally caught in the American Samoa longline fishery from April 2006-June 2015 were sampled for genetic analysis in an effort to identify stock origin of sea turtle interactions. Results of mitochondrial DNA sequencing are available from many of the sampled animals and reveal the following: (1) two individuals with a haplotype (CmP80) representing nesting aggregations of the Great Barrier Reef area, the Coral Sea, and New Caledonia; (2) five individuals with a haplotype (CmP22) representing nesting aggregations of the Marshall Islands, Yap and American Samoa; (3) seven individuals with haplotype (CmP65) found so far in the nesting aggregation in the Marshall Islands, American Samoa, and French Polynesia; (4) two individuals with haplotypes (CmP31) of unknown nesting stock only found in the coral sea, and New Caledonia; (5) one individual with a haplotype (CmP20) commonly found in nesting aggregations in Guam, Palau, Marshall Islands, Yap, Northern

Mariana Islands, Taiwan and Papua New Guinea; (6) five individuals (CmP47) with a haplotype found in nesting aggregations in Yap, northern and southern GBR, New Caledonia, Coral Sea, Timor Sea, and east Indian Ocean; (7) one individual with a haplotype (CmP97) which has only been found foraging in Moreton Bay, Fiji, and the Galapagos and; (8) one individual with a haplotype (CmP166) which has only been found foraging in Moreton Bay (Peter Dutton, NMFS, pers. comm.). A Bayesian mixed stock analysis indicated that the turtles originated mainly from rookeries in the following proposed DPSs; Central South Pacific DPS (mean=50 percent; 95 percent CI=30-71 percent), Southwest Pacific DPS (mean=33 percent; 95 percent CI=14-53 percent), and East Pacific DPS (mean=12 percent; 95 percent CI=3-26 percent). Dutton (NMFS, pers. Comm) estimates that the mixed stock analysis included small contributions from the Central West Pacific (3 percent) and the East Indian-West Pacific (2 percent).

5.1.1.2 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 coastal areas. Average size at recruitment to neritic habitats for Pacific green sea turtles ranges from 35-50cm CCL (Balazs 1980; Limpus et al., 2003). Twenty-six of the 28 green sea turtles observed caught by the American Samoa longline fishery in April 2006-June 2015 were within this size range and the other two were slightly larger (see Section 7 below for more information about the 28 observed turtles). Adults forage in shallow coastal areas, primarily on algae and seagrass. Unlike some other sea turtle species, upon maturation green turtle adults do not typically undertake trans-oceanic migrations to breeding sites. However, long migrations may still occur between foraging and nesting areas, such as those undertaken by Hawaiian green sea turtles between the main Hawaiian Islands and French Frigate Shoals (NMFS & FWS 2007a). Almost all observed interactions of green sea turtles in the American Samoa longline fishery have been juveniles between 24 and 50 cm straight carapace length (SCL) that had not yet recruited to nearshore habitat. Hence, green turtle vulnerability to longline fishing appears to be utilization of pelagic habitats, especially during the juvenile life history stage.

During their pelagic phase, juvenile green sea turtles feed omnivorously on a range of planktonic material including crustaceans, jellyfish and ctenophores. Green sea turtles take tuna hooks baited with squid or fish, as demonstrated by bycatch of green sea turtles in several tuna longline fisheries in the Pacific (Beverly and Chapman, 2007). For example, both juvenile and adult green sea turtles are caught in the Hawaii deep-set longline fishery, although at a much lower rate than previous years (NMFS 2005, 2014a). Very little is known of juvenile or adult green turtle pelagic foraging behavior, such as foraging depth. The deepest dives recorded for green sea turtles are from adults migrating from the main Hawaiian Islands to the Northwestern Hawaiian Islands. Several turtles dove to >100 m depth in pelagic areas, where they may have been feeding on plankton, resting, or avoiding predators (Rice and Balazs 2008).

While all green sea turtles observed caught so far in the American Samoa longline fishery have been juveniles, the Hawaii deep-set longline fishery interacts with both juvenile and adult green sea turtles. As described above, adult green sea turtles may undertake migrations between nesting and foraging habitat, during which time they may cross large expanses of pelagic habitat where these fisheries operate; therefore, adults may be vulnerable to the proposed action.

Longline and other vessels can potentially strike green sea turtles. However, because their density is low in the action area, we consider this risk slight.

5.1.1.3 Threats to the Species

Global threats to green sea turtles are listed and discussed in the 5-year status reviews (NMFS & FWS 2007a; Seminoff et al., 2015). Major threats according to these documents are alteration of nesting and foraging habitat, fishing bycatch, boat strike, marine debris, and direct harvest, which are briefly described below. Impacts that may occur from climate change also appear to be having an effect on this species, and are addressed below.

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 turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Adult green sea 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 sea turtles (NMFS & FWS 2007a).

Green sea turtles are also susceptible to nearshore artisanal and recreational fisheries gear (Nitta and Henderson 1993; Chaloupka et al., 2007). These fisheries use a 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 sea turtles (NMFS & FWS 2007a). Industrial fisheries also interact with green sea turtles, especially juveniles, like in the Hawaii-based deep-set and American Samoa longline fisheries. The Hawaii shallow-set fishery rarely interacts with green sea turtles and, since 2004, only seven have been incidentally caught. All seven were released alive (NMFS 2015e). The Hawaii deep-set fishery occasionally interacts with green sea turtles and from 2005- June 2015 there were eight observed, which is estimated to be 32 total green interactions in the deep-set fishery and from this the estimated mortality is 30 (rounded from 29.61) (NMFS 2015d). The deep-set fishery currently has an incidental take statement for up to nine anticipated green turtle interactions and nine anticipated mortalities from the globally threatened species over a three-year period (NMFS 2014a). The California Oregon drift gillnet fishery has an incidental take statement for up to two anticipated green turtle interactions and one anticipated estimated mortality from the globally threatened species every five years. Since 2001 no green sea turtles have been captured in the California Oregon drift gillnet fishery and only one has been observed since 1990 (NMFS 2013a).

Harvest of green sea turtles for their meat, shells, and eggs has been a major factor in the past declines of green sea turtles, and continues to be a major threat globally (Humber et al., 2014). Despite increasing levels of protection, the direct take of turtles has continued legally in many regions and countries as a cultural use by traditional coastal populations, or small-scale fisheries supplying local markets with meat and sometimes shell. Humber et al. (2014) found that currently 42 countries still permit the direct take of turtles and collectively take in excess of 40,000 turtles per year of which the majority (>80 percent) are green sea turtles. This legal take occurs mostly in the wider Caribbean and Pacific Islands. Ten countries account for >90 percent of legal take, with the largest consumers being Papua New Guinea, Australia and Nicaragua. Although, within the 42 countries included in this study, there has been a significant decrease in take since the 1980s. On the Pacific Coast of Mexico in the mid-1970s, more than 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 sea turtles annually (NMFS and USFWS 2007b, Lam et al., 2012). Evidence from current seizure records and market surveys highlight a consistent illegal trade route to mainland China from the Coral Triangle region of South-east Asia (mainly the Philippines, Malaysia, and Indonesia). TRAFFIC, the wildlife monitoring network, reported 128 seizures involving the East Asian countries between 2000 and 2008, with a trade volume of over 9,180 marine turtle [primarily green and hawksbill sea turtle] products including whole specimens (2,062 turtles), crafted products (n = 6,161 pieces) and raw shell (Lam et al., 2012).

Green sea 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 sea 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 cannot 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).

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 et al., 2002). Although currently unquantified, the effect of marine debris on Pacific turtles during pelagic life stages is likely severe given the increase in plastics and other pollution entering the marine environment in the past 20-30 years (Arthur et al., 2009, Doyle et al., 2011, Stewart et al., 2011, NMFS and USFWS 2007a, Hutchinson 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 the events generated 25 million tons of debris, but there is no reliable estimate of how much or what kind of debris entered the water. 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 dispersed and is no longer monitored because it is no longer visible by satellite. Projections of when the debris will reach shore can only be predicted using models that take into account oceanic and wind conditions (NOAA Marine Debris Program).

5.1.1.4 Conservation of the Species

Green sea 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 French Frigate Shoals nesting area since the 1950's have resulted in increased trends of both nesting and foraging turtles in Hawaii (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 sea turtles began to increase 17 years later in 1996 after reaching a low point in the late 1980s through mid-1990s. Grupo Tortuguero (GT), a grassroots community-based network, is active in fifty coastal communities of Baja California, Mexico and mainland Mexico. Over the past 20 years, the GT (comprised of hundreds of local volunteers, many of whom are former poachers), has worked to protect and promote an appreciation for and pride in sea turtles. As a result of GT's efforts to provide education and raise awareness to promote conservation activities, eastern Pacific green sea turtles are on the road to recovery (Delgado-Trejo and Alvarado-Díaz, 2012). Furthermore, 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, leatherback sea turtle, and Olive ridley sea turtles also benefit green sea turtles, such as improvements made in the Hawaii-based longline fisheries since 2004 (NMFS and FWS 2007d).

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

Conservation and recovery of green sea 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 FWS 2007a).

Proposed Green Turtle DPSs

On March 23, 2015, NMFS and the FWS published a proposed rule finding that the green sea turtle is composed of 11 DPSs (Figure 6) that qualify as a “species” for listing. The Services propose to remove the current range-wide listing and, in its place, list eight DPSs as threatened and three as endangered. Green sea turtles most likely to occur in the range of the American Samoa fishery are the DPSs that occur in the Pacific Ocean. PIRO’s observer program has only collected genetic samples from the following proposed DPSs caught by the American Samoa longline fishery: the Central South Pacific, the Central West Pacific, the East Indian-West Pacific, the Southwest Pacific, and the Eastern Pacific. While the Central North Pacific (e.g., Hawaii) DPS occurs in the Pacific Ocean, evidence suggests it occupies a limited range and is unlikely to occur within the action area. Further, we have no genetic samples from the Central North Pacific DPS from this fishery. As a result, it is NMFS conference opinion that the Central North Pacific DPS is not likely to be exposed to the American Samoa longline fishery and it is therefore excluded from further consideration in this Opinion.

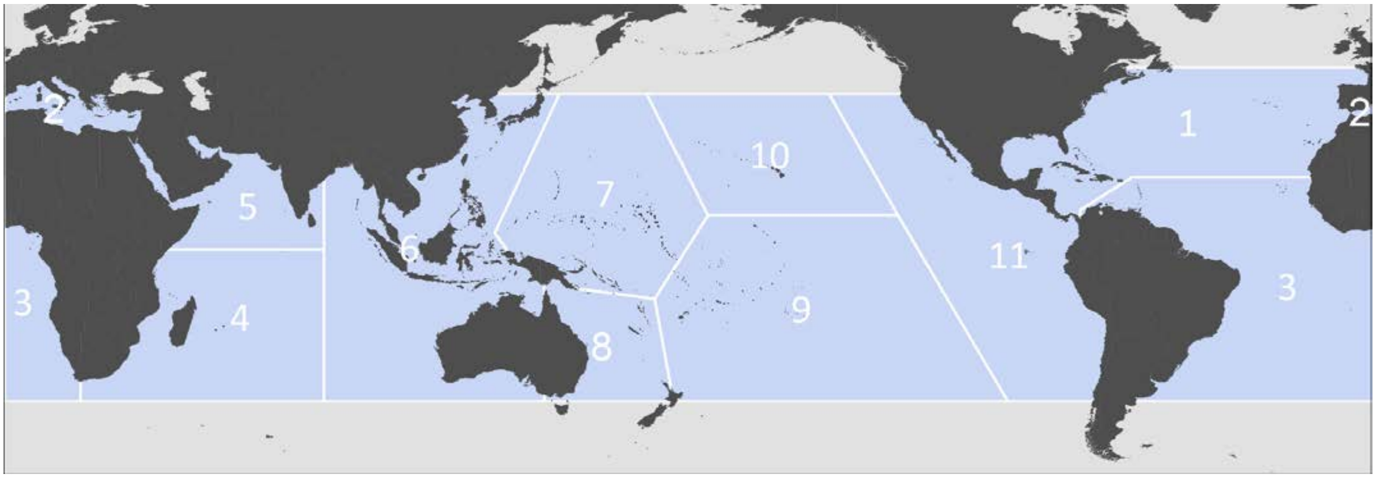


Figure 6. Proposed Green Turtle DPSs. 1) North Atlantic; 2) Mediterranean; 3) South Atlantic; 4) Southwest Indian; 5) North Indian; 6) East Indian-West Pacific; 7) Central West Pacific; 8) Southwest Pacific; 9) Central South Pacific; 10) Central North Pacific; 11) East Pacific.

5.1.2 Central South Pacific DPS (proposed endangered)

On March 23, 2015, NMFS and the FWS (Services) published a proposed rule finding that the Central South Pacific DPS is endangered, due to their low nesting abundance and exposure to increasing threats.

5.1.2.1 Distribution and Abundance of the Central South Pacific DPS

The range of the Central South Pacific DPS extends north and east of New Zealand to include a longitudinal expanse of 7,500 km- from Easter Island, Chile in the east to Fiji in the west, and encompasses American Samoa, French Polynesia, Cook Islands, Fiji, Kiribati, Tokelau, Tonga, and Tuvalu. Central south Pacific Ocean greens nest sporadically across American Samoa, Cook Islands, Fiji, French Polynesia, Kiribati, Tokelau, Tonga, Tuvalu, and United Kingdom Overseas Territory (Figures 5 & 6). Nesting occurs sporadically throughout the geographic distribution of the DPS at low levels. The estimated number of nesting females for this area is 2,677 (Seminoff et al., 2015).

Green turtle temporal population trends in the Central South Pacific are unavailable because no nesting sites have five contiguous years of standardized monitoring that span entire nesting seasons. Partial and inconsistent monitoring from the largest nesting site in this aggregation, Scilly Atoll, suggests significant nesting declines from persistent and illegal commercial harvesting (Petit). Nesting abundance is stable to increasing at Rose Atoll, Swains Atoll, Tetiaroa, Tikehau, and Maiao. However, these sites are of moderate to low abundance and in sum represent less than 16 percent of the population abundance at Scilly Atoll alone. Nesting abundance is stable to increasing at Tongareva Atoll (White and Galbraith 2013). Community-based monitoring activities at Tongareva Atoll in 2014 and 2015 resulted in 292 and 161 nests, respectively, with peak nesting typically between November to February (White 2015). Although trend data is currently lacking, the Tongareva rookery is successful and likely sustainable, given a lack of land-based predators and high hatch success (97 percent). The uncertainty surrounding trends, and the general dearth of long-term monitoring and data from this nesting aggregation, presents significant challenges to any trend analyses.

5.1.2.2 Life History Characteristics Affecting Vulnerability of the Central South Pacific DPS

Green sea turtles departing nesting grounds in this DPS travel throughout the South Pacific Ocean. Post-nesting green sea turtles tagged in the early 1990s from Rose Atoll returned to foraging grounds in Fiji and French Polynesia (Craig et al., 2004). Nesters tagged in French Polynesia migrated west after nesting at various sites in the western South Pacific (Tuato'o-Bartley et al., 1993). In addition to nesting beaches, green sea turtles are found in coastal waters (White 2013; White and Galbraith 2013), but in-water information in this population is particularly limited.

Green sea turtles nest on Rose Atoll in American Samoa (Balazs 2009). From 1971-1996, 46 adult female green sea turtles were flipper tagged at Rose Atoll after they nested, but only three were recaptured; two in Fiji and one in Vanuatu, all dead (Balazs et al., 1994). Satellite transmitters tracked migrations of seven post-nesting green sea turtles at Rose Atoll in 1993–1995. Most turtles migrated 1,600 km to foraging areas in Fiji, whereas one turtle migrated to Raiatea in French Polynesia (Craig et al., 2004). In addition to the above 53 green sea turtles tagged at Rose Atoll, 513 were tagged at Scilly Atoll in French Polynesia between 1972 and 1991. Of these, 14 were recovered in Fiji (6 turtles), Vanuatu (3), New Caledonia (2) Wallis Island (1), Tonga (1) and Cook Islands (1). Thus, of the 17 recovered turtles that were flipper-tagged in American Samoa or French Polynesia, eight were recovered in Fiji. Of the seven turtles that were satellite tagged in American Samoa, six went to Fiji. Green sea turtles in American Samoa and French Polynesia likely migrate to Fiji after nesting to forage in Fiji's abundant, shallow seagrass and algae habitats (Craig et al., 2004). More recently, eight satellite tracks deployed by the PIFSC in December 2013 on post-nesting green sea turtles from Rose Atoll and two post-nesting green sea turtles tagged at French Polynesia in early 2015 also all traveled west either to or past Fiji (PIFSC, 2014 unpublished; Te Mana O Te Maona, 2015 unpublished). These migrating adult green sea turtles pass through the action area where they may be vulnerable to the American Samoa longline fishery.

In Samoa, degradation of habitat through coastal development and natural disasters as cited in SPREP (SPREP 2012) remains a threat (J. Ward, Ministry of Natural Resources and Environment, Samoa, pers. comm., 2013 as cited in NMFS & FWS 2015). In Kiribati, historical destruction (bulldozing) of the vegetation zone next to the nesting beach on Canton Island in the Phoenix Islands occurred during World War II and may have negatively affected the availability of a portion of nesting beach area (Balazs 1975). The remoteness of these islands and minimal amount of study of sea turtles in this area makes recent information on nesting beach condition and threats difficult to obtain. In the Cook Islands, the major nesting site for green turtles, Tongareva Atoll, is uninhabited and there are not likely threats related to development or human disturbance (White 2012b). However, elsewhere in the Cook Islands, sand extraction (for building purposes) and building developments are reported as potential threats to sea turtles; for instance, the best potential site at Tauhunu motu on Manihiki appears to be no longer used for nesting (White 2012a). Weaver (1996) notes that sea turtles are negatively affected in Fiji by modification of nesting beaches. Coastal erosion in Tonga and Tuvalu is reported as a major problem for turtle nesting (Alefaio and Alefaio 2006; Bell et al., 2010).

5.1.2.3 Threats to the Central South Pacific DPS

Threats to Central South Pacific green sea turtle DPS are listed and discussed in the proposed rule (NMFS & FWS 2015). Major threats according to these documents are alteration of nesting and foraging habitat, fishing bycatch, boat strike, marine debris, and direct harvest, which are briefly described below. Impacts that may occur from climate change also appear to be having an effect on this species, and are addressed below.

Destruction and alteration of green turtle nesting and foraging habitats are occurring throughout the range. NMFS and USFWS (1998) noted that degradation of coral reef habitats on the south side of Tutuila Island, American Samoa is occurring due to sedimentation from erosion on agricultural slopes and natural disasters. Ship groundings are also potential threats to habitat in American Samoa. For example, a ship grounded at Rose Atoll in 1993, damaging reef habitat and spilling 100,000 gallons of fuel and other contaminants (FWS, 2014). In the nearby neighboring country of Samoa, coastal and marine areas have been negatively impacted by pollution (Government of Samoa, 1998). Sea turtles have been negatively affected by alteration and degradation of foraging habitat and to some extent pollution or degradation of nearshore ecosystems in Fiji (Batibasaga et al., 2006). Jit (2007) also suggests that sea turtles in Fiji are threatened by degradation of reefs and seagrass beds. Given that turtles outside of Fiji appear to use this foraging habitat, negative effects to this foraging area have important implications for the entire DPS. Tourism development on the eastern coast of Viti Levu could negatively impact sea turtle foraging sites (Jit, 2007). In Tonga, marine habitat is being affected by anthropogenic activities. Heavy sedimentation and poor water quality have killed patch reefs; high nutrients and high turbidity are negatively impacting seagrasses; and human activities are negatively impacting mangroves (Prescott et al., 2004).

Incidental capture in artisanal and commercial fisheries is a significant threat to the survival of green sea turtles throughout the Central South Pacific DPS. The primary gear types involved in these interactions include longlines and nets. Incidental capture in line, trap, or net fisheries presents a threat to sea turtles in American Samoa (Tagarino, 2011). Subsistence gill nets have been known to occasionally catch green turtles. Industrial fisheries also interact with green sea turtles, especially juveniles, like the American Samoa longline fishery. The American Samoa longline fishery is estimated to have interacted with an average of 24 green sea turtles (22 estimated mortalities) annually within the action area between 2006 and June 30, 2015 (NMFS 2015c). Based on genetic samples NMFS estimates that 50 percent of the turtles caught in the American Samoa longline fishery are from the Central South Pacific DPS (Dutton pers. Comm.).

In Fiji, green turtles are killed in commercial fishing nets; however, the exact extent and intensity of this threat is unknown (Rupeni et al. 2002). Jit (2007) and McCoy (2008) report that green turtle bycatch is occurring in longline tuna fisheries in Fiji. The exact level of interaction with green turtles is unclear. In the Cook Islands, longline fishery regulations require fishers to adopt the use of circle hooks and to follow ‘‘releasing hooked turtles’’ guidelines (Goodwin, 2008), although it is unclear how effective these regulations are. McCoy (2008) suggests that sea turtle bycatch is occurring in tuna fisheries in the Cook Islands; however, no information is provided on possible extent of sea turtle take or the species that are possibly taken.

Human consumption has had a significant impact on green turtles in the Central South Pacific DPS. Hirth and Rohovit (1992) report that exploitation of green turtles for eggs, meat, and parts has occurred throughout the South Pacific Region, including American Samoa, Cook Islands, Fiji Islands, French Polynesia, and Kiribati. Allen (2007) notes that in Remote Oceania (which includes this DPS) sea turtles were important in traditional societies but, despite this, have experienced severe declines since human colonization approximately 2,800 years ago. At western contact, some of the islands supported sizable human populations resulting in intense pressures on local coastal fisheries. At Scilly Atoll in French Polynesia local residents (approximately 20 to 40 people) are allowed to take 50 adults per year from a nesting population that could be as low as 300–400 (M. S. Allen 2007; Balazs et al., 1995). Balazs et al. (1995) reported that declines in nesting green turtles at the important areas of Scilly, Motu-one, and Mopelia, among the highest density nesting sites in the DPS, have occurred due to commercial exploitation for markets in Tahiti, as well as exploitation due to human habitation. Illegal harvest of sea turtles has been reported for French Polynesia by Te Honu Tea (2008). Brikke (2009) conducted a study on Bora Bora and Maupiti islands and reported that sea turtle meat remains in high demand and that fines are rarely imposed. Directed take in the marine environment has been a significant source of mortality in American Samoa, and turtle populations have seriously declined (Tuato'o-Bartley et al., 1993; NMFS and USFWS, 1998). Although take of sea turtle eggs or sea turtles is illegal (the ESA applies in this territory), turtles from American Samoa migrate to other countries (e.g., Fiji, Samoa, French Polynesia) where turtle consumption is legal or occurs illegally (Craig, 1993; Tuato'o-Bartley et al., 1993). Turtles have been traditionally harvested for food and shells in the country of Samoa, and over-exploitation of turtles has negatively affected local populations (Government of Samoa, 1998). Unsustainable harvest (direct take for meat) remains a major threat to green turtles in Samoa (J. Ward, Government of Samoa, pers. comm. 2013 as cited in NMFS & FWS 2015). In Fiji, Weaver (1996) identified the contemporary harvest and consumption of turtles by humans for eggs, meat, and shells as a significant threat for sea turtles. This includes commercial harvest, as well as subsistence and ceremonial harvest. In Kiribati (e.g., Phoenix Islands), an unknown number of turtles are caught as bycatch on longlines and eaten (Obura and Stone 2002). Poaching has been reported for Caroline Atoll, but to what extent it currently occurs is unknown (Teeb'aki, 1992). In Tonga, Bell et al. (1994) report that collection of eggs for subsistence occurs. Prescott et al. (2004) and Havea and MacKay (2009) also note that it is still a practice on islands where turtles nest. Bell et al. (2009) report that in Tonga sea turtles are harvested and live turtles are often seen transported from outer islands to the main island, Tongatapu. It is unclear if this harvest is sustainable, especially given the increased catch rates in Tungua for the commercial market (Havea and MacKay, 2009). In Tuvalu, harvest of sea turtles for their meat has been cited as a major threat (Alefaio and Alefaio 2006; Ono and Addison 2009). In the Cook Islands, turtles are sometimes killed during nesting at Palmerston and Rakahanga, while nesting and fishing on Nassau, and while nesting at Manihiki, Tongareva, and probably at other atolls (White 2012). In Tokelau, Balazs (1983) reported human take of both sea turtle eggs from nests and adult males and females while copulating, nesting, or swimming (by harpoon).

Green sea 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 sea 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 cannot 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).

Climate change has the potential to greatly affect green turtles. Potential impacts of climate change on green turtles include loss of beach habitat from rising sea levels, repeated inundation of nests, skewed hatchling sex ratios from rising incubation temperatures, and abrupt disruption of ocean currents used for natural dispersal (Fish et al., 2005, 2008; Hawkes et al., 2009; Poloczanska et al., 2009). Impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC, 2007). A recent study of 27 atoll islands in the central Pacific (including Kiribati and Tuvalu), demonstrated that 14 percent of islands decreased in area over a 19–60 year time span (Webb and Kench 2010). This occurred in a region considered most vulnerable to sea-level rise (Nicholls and Cazenave 2010) during a period in which sea-levels rose 2 mm per year. Catastrophic natural environmental events, such as cyclones or hurricanes, may affect green turtles in the Central South Pacific Ocean, and may exacerbate issues such as decreased available habitat due to sea level rise. These types of events may disrupt green turtle nesting activity (Van Houtan and Bass, 2007), even if just on a temporary scale.

Direct or indirect disposal of anthropogenic waste introduces potentially lethal materials into green turtle foraging habitats. Green turtles will ingest plastic, monofilament fishing line, and other marine debris (Bjorndal et al., 1994), and the effects may be lethal or non-lethal, resulting in varying effects that may increase the probability of death (Balazs, 1985; Carr, 1987; McCauley and Bjorndal 1999). Marine debris presents a threat to green turtles in American Samoa (Aeby et al., 2008; FWS 2014; Tagarino et al., 2008). It is potentially hazardous to adults and hatchlings and is present at Rose Atoll (FWS 2014). It is also a threat at nearby inhabited islands. Pago Pago Harbor in American Samoa is seriously polluted, and uncontrolled effluent contaminants have impaired water quality in some coastal waters (Aeby et al., 2008). Effects to coastal habitat (e.g., reefs) from sedimentation related to development and runoff are significant potential threats in American Samoa, and human population pressures place strains on shoreline resources (Aeby et al., 2008). Ship groundings (e.g., at Rose Atoll in 1993) that damage reef habitat and spill fuel and other contaminants, degradation of coastal waters due to siltladen runoff from land and nutrient enrichment from human discharges and wastes, and contamination by heavy metals and other contaminants are threats to green turtles in American Samoa (NMFS and FWS 1998; FWS 2014). In Fiji, Weaver (1996) identified potential threats to sea turtles from heavy metals and industrial waste, organic loadings in coastal areas, plastic bags, and leachate poisoning of seagrass foraging areas. In the Cook Islands, White (2012) noted possible issues with oil, tar, or toxic chemicals and terrestrial run-off into lagoons at Rarotonga, and Bradshaw and Bradshaw (2012) note pollution (e.g., accumulation of plastics on the beach) on Mauke (M.White, unpubl. data, www.honucookislands.com).

5.1.2.4 Conservation of the Central South Pacific DPS

Numerous countries have reserves (French Polynesia, Kiribati, Samoa, and the U.S. Pacific Remote Islands Marine National Monument), national legislation, and/or local regulations protecting turtles. These include the foreign Cook Islands, Fiji, French Polynesia, Kiribati, Pitcairn Islands, Samoa, Tonga, Tuvalu, and the U.S. territories of Wake, Baker, Howland and Jarvis Islands, Kingman Reef and Palmyra Atoll. In some places such as Tokelau and Wallis and Futuna, information on turtle protection was either unclear or could not be found. At least 17 international treaties and/or regulatory mechanisms apply to the conservation of green turtles in the Central South Pacific DPS. Green turtles in American Samoa are fully protected under the ESA. Green turtles are also protected by the Fishing and Hunting Regulations for American Samoa (24.0934), which prohibit the import, export, sale, possession, transport, or trade of sea turtles or their parts and take (as defined by the ESA) and carry additional penalties for violations at the local government level (Maison et al., 2010). Additionally, an American Samoa Executive Order in 2003 established the territorial waters of American Samoa as a sanctuary for sea turtles and marine mammals, in 2003; American Samoa declared its submerged lands a Whale and Turtle Sanctuary. It is not known how effective implementation of these protections is in American Samoa. The NOAA National Marine Sanctuary of American Samoa is comprised of six protected areas, covering 35,175 km2 of nearshore coral reef and offshore open ocean waters across the Samoan Archipelago. Additionally, Rose Atoll Marine National Monument was established in 2009 and encompasses the Rose Atoll National Wildlife Refuge. These protected areas should provide some level of protection for green turtles and their habitat; however the effectiveness of these monuments for this species is unknown.

5.1.3 Southwest Pacific DPS (proposed Threatened)

On March 23, 2015, NMFS and the FWS (Services) published a proposed rule finding that the Southwest Pacific DPS is threatened, due to continued threats, described below, that are likely to endanger the DPS within the foreseeable future.

5.1.3.1 Distribution and Abundance of the Southwest Pacific DPS

The range of the Southwest Pacific DPS extends from the western boundary of Torres Strait, to the eastern tip of Papua New Guinea (PNG) and out to the offshore coordinate of 13° S., 171° E.; the eastern boundary runs from this point southeast to 40° S., 176° E.; the southern boundary runs along 40° S. from 142° E. to 176° E.; and the western boundary runs from 40° S., 142° E north to Australian coast then follows the coast northward to Torres Strait. Southwest Pacific Ocean green sea turtles nest in areas of eastern Australia, Coral Sea, New Caledonia, and Vanuatu. Green turtle nesting is widely dispersed throughout the Southwest Pacific Ocean (Figures 5 & 6). There are approximately 12 total nesting sites, which occurs at moderate to high levels throughout the DPS. The abundance estimate for this DPS is 83,058 (Seminoff et al., 2015). The bulk of this DPS nests within Australia's Great Barrier Reef World Heritage Area (GBR) and eastern Torres Strait. The northern GBR and Torres Strait support some of the world's highest concentrations of nesting (Chaloupka et al., 2008c). Nesting sites also occur on the Coral Sea Islands, New Caledonia, and Vanuatu. The largest known nesting area for green sea turtles in New Caledonia is the d'Entrecasteaux atolls, which are located 258 km north of Grande Terre and include Surprise, LeLeixour, Fabre, and Huon Islands (Maison et al., 2010). Vanuatu hosts over 189 nesting sites on 33 islands (Maison et al., 2010).

Roughly 90 percent of the nesting activity occurs at Raine Island and Moulter Cay, with appreciable nesting also occurring at Number Seven and Number Eight Sandbanks and Bramble Cay (Limpus 2009). Estimates of annual nesters at Raine Island vary from 4,000 – 89,000 (Seminoff et al., 2004; NMFS and FWS, 2007; Chaloupka et al., 2008c; Limpus 2009). Female nesting abundance in the northern GBR is not directly counted throughout the nesting season. This is largely because of the remoteness of the site and the sheer numbers of turtles that may nest on any given night, which makes accurate counting very difficult. A mark-recapture approach (Limpus et al., 2003) is used at Raine Island to estimate the number of adult female green sea turtles in the waters surrounding Raine Island during the sampling period. Females are painted during nightly tally counts, and then marked and unmarked adult female turtles are counted in the surrounding internesting habitats the following day using a structured survey protocol. The number of turtles nesting in the GBR area of Australia differs widely from year to year and is well correlated with an index of the Southern Oscillation (Limpus and Nicholls, 2000). For example, the estimate of annual nesters at Raine Island during a medium density nesting season is about 25,000 (Limpus 2009), while in a high density season (1999–2000) the estimate of nesters at Raine Island increases to 78,672 ± 10,586. Heron Island is the index nesting beach for the southern GBR, and nearly every nesting female on Heron Island has been tagged since 1974 (Limpus and Nicholls 2000). The mean annual nester abundance varied between 26 and 1,801 during 1999–2004 (Limpus 2009).

5.1.3.2 Life History Characteristics Affecting Vulnerability of the Southwest Pacific DPS

Green sea turtles departing nesting grounds in this DPS travel throughout the South Pacific Ocean. Genetic studies on samples from incidentally caught turtles in the American Samoa longline fishery show turtles from this DPS. All of the turtles that have been caught by the American Samoa longline fishery are juveniles, which is the life stage that is susceptible to the proposed action.

5.1.3.3 Threats to the Southwest Pacific DPS

Threats to Southwest Pacific green sea turtle DPS are listed and discussed in the proposed rule (NMFS & FWS 2015). The threats to this Southwest Pacific DPS include directed harvest, incidental bycatch in fisheries, shark control programs, boat strikes, port dredging, debris, activities associated with national defense, disease, predation, toxic compounds, and climate change.

Destruction and modification of green turtle nesting habitat in the Southwest Pacific DPS result from beach erosion, beach pollution, removal of native vegetation, and planting of non-native vegetation, as well as natural environmental change (Limpus, 2009). Coastal development and construction, placement of erosion control structures and other barriers to nesting, and vehicular traffic minimally impact green turtles in this DPS (Limpus, 2009). Artificial light levels have increased significantly for green turtles in minor nesting sites of the northern GBR and remained relatively constant for the mainland of Australia (part of southern GBR) south of Gladstone

(Kamrowski et al., 2014). Most of the nests at the documented nesting sites within this DPS occur within the protected habitat, but there is still concern about the viability of nesting habitat (Limpus 2009).

Southwest Pacific DPS turtles are vulnerable to harvest throughout Australia and neighboring countries such as New Caledonia, Fiji, Vanuatu, Papua New Guinea, and Indonesia (Limpus 2009). Cumulative annual harvest of green turtles that nest in Australia may be in the tens of thousands, and it appears likely that historical native harvest may have been in the same order of magnitude (Limpus 2009). The Australian Native Title Act (1993) gives Aboriginal and Torres Strait Islanders a legal right to hunt sea turtles in Australia for traditional, communal, non-commercial purposes (Limpus 2009). Although indigenous groups, governments, wildlife managers and scientists work together with the aim of sustainably managing turtle resources (Maison et al., 2010), traditional harvest remains a threat to green turtle populations. However, quantitative data are not sufficient to assess the degree of impact of harvest on the persistence of this DPS.

Incidental capture in artisanal and commercial fisheries is a threat to the survival of green turtles in the Southwest Pacific Ocean. The primary gear types involved in these interactions include trawl fisheries, longlines, drift nets, and set nets. These are employed by both artisanal and industrial fleets, and target a wide variety of species including prawns, crabs, sardines, and large pelagic fish. Nesting turtles of the Southwest Pacific DPS are vulnerable to the Queensland East Coast Trawl Fisheries and the Torres Strait Prawn Fishery, and to the extent other turtles forage west of Torres Strait, they are also vulnerable (Limpus 2009). In 2000, the use of TEDs in the Northern Australian Prawn Fishery became mandatory, due in part to several factors: (1) Objectives of the Australian Recovery Plan for Marine Turtles, (2) requirements of the Australian Environment Protection and Biodiversity Conservation Act for Commonwealth fisheries to become ecologically sustainable, and (3) the 1996 U.S. import embargo on wildcaught prawns taken in a fishery without adequate turtle bycatch management practices (Robins et al., 2002b). Australian and international longline fisheries capture green turtles. Precise estimates of international capture of Southwest Pacific Ocean DPS green turtles by the international longline fleet are not available, but they are thought to be larger than the Australian component (DEWHA 2010). In addition to threats from prawn trawls, green turtles may face threats from other fishing gear (summarized from Limpus, 2009). Take of green turtles in gill nets (targeting barramundi, salmon, mackerel, and shark) in Queensland and the Northern Territory has been observed but not quantified. Untended ‘‘ghost’’ fishing gear that has been intentionally discarded or lost due to weather conditions may entangle and kill many hundreds of green turtles annually. The American Samoa longline fishery is estimated to have interacted with an average of 24 green sea turtles (22 estimated mortalities) annually within the action area between 2006 and June 30, 2015 (NMFS 2015c). Based on genetic samples NMFS estimates that 33 percent of the turtles caught in the American Samoa longline fishery are from the Southwest Pacific DPS (Dutton pers. Comm.).

Green turtles are captured in shark control programs, but protocols are in place to reduce the impact. The Queensland Shark Control Program is managed by the Queensland Department of Primary Industries and Fisheries (Limpus 2009) and has been operating since 1962 (Gribble et al., 1998). In 1992, their operations began to be modified to reduce mortality of nontarget species

(Gribble et al., 1998). Observed green turtle annual mortality during 1998–2003 was 2.7 per year (Limpus 2009). Green turtles have been captured in the New South Wales shark-meshing program since 1937, but total capture for all turtle species from 1950 through 1993 is roughly five or fewer turtles per year (Krogh and Reid 1996). Post-release survival does not appear to have been monitored in any of the monitoring programs.

The magnitude of mortality from boat strikes may be in the high tens to low hundreds per year in Queensland (Limpus 2009). This threat affects juvenile and adult turtles and may increase with increasing high-speed boat traffic in coastal waters. The magnitude of mortality from port dredging in Queensland may be in the order of tens of turtles or less per year (Limpus 2009).

Toxic compounds and bioaccumulative chemicals threaten green turtles in the Southwest Pacific DPS. Poor health conditions (debilitation and death) have been reported in the southern Gulf of Carpentaria for green turtles, many of which had unusual black fat (Kwan and Bell 2003; Limpus 2009). Heavy metal concentrations have also been reported in Australia (Gladstone and Dight 1994; Reiner 1994; Gordon et al., 1998; Limpus 2009), but the health impact has not been quantified. The magnitude of mortality from ingestion of synthetic material in Queensland is expected to be at least tens of turtles annually (Limpus 2009).

Green turtle populations could be affected by the effects of climate change on nesting grounds (Fuentes et al., 2011) as well as in marine habitats (Hamann et al., 2007; Hawkes et al., 2009). Potential effects of climate change include changes in nest site selection, range shifts, diet shifts, and loss of nesting habitat due to sea level rise (Hawkes et al., 2009; Poloczanska et al., 2009). Climate change will likely also cause higher sand temperatures leading to increased feminization of surviving hatchlings (i.e., changes in sex ratio), and some beaches will likely experience lethal incubation temperatures that will result in losses of complete hatchling cohorts (Glen and Mrosovsky 2004; Fuentes et al., 2010; Fuentes et al., 2011). While sea turtles have survived past eras that have included significant temperature fluctuations, future climate change is expected to happen at unprecedented rates, and if turtles cannot adapt quickly they may face local to widespread extirpations (Hawkes et al., 2009). Impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC, 2007). In a study of the northern GBR nesting assemblages, Bramble Cay and Milman Islet were vulnerable to sea-level rise, and almost all sites in the study were expected to be vulnerable to increased temperatures by 2070 (Fuentes et al., 2011). Similar data are not available for other nesting sites. The Southwest Pacific DPS contains some atolls, as well as coral reef areas that share some ecological characteristics with atolls. Barnett and Adger (2003) state that coral reefs, which are essential to the formation and maintenance of the islets located around the rim of an atoll, are highly sensitive to sudden changes in sea-surface temperature. Thus, climate change impacts could have long-term impacts on green turtle ecology in the Southwest Pacific DPS, but it is not possible to project the impacts at this point in time.

5.1.3.4 Conservation of the Southwest Pacific DPS

Regulatory mechanisms are in place throughout the range of the DPS that address the direct capture of green turtles within this DPS. There are regulations, within this DPS, that specially address the harvest of green turtles while a few regulations are limited in that they only apply to certain times of year or allow for traditional use. Australia, New Caledonia and Vanuatu, the only countries with nesting aside from the Coral Sea Islands, which are a territory of Australia, have laws to protect green turtles. National protective legislation generally regulates intentional killing, possession, and trade (Limpus 2009; Maison et al., 2010). In addition, at least 17 international treaties and/or regulatory mechanisms apply to the conservation of green turtles in the Southwest Pacific DPS. The majority of nesting beaches (and often the associated internesting habitat) are protected in Australia, which is the country with the vast majority of the known nesting. In Australia, the conservation of green turtles is governed by a variety of national and territorial legislation. Conservation began with 1932 harvest restrictions on turtles and eggs in Queensland in October and November, south of 17° S., and by 1968 the restriction extended all year long for all of Queensland (Limpus 2009). Other conservation efforts include sweeping take prohibitions, implementation of bycatch reduction devices and safer dredging practices, improvement of shark control devices, and safer dredging practices, and the development of community based management plans with Indigenous groups. Australia has undertaken extensive marine spatial planning to protect nesting turtles and internesting habitat surrounding important nesting sites. The GBR's listing on the United Nations Educational, Scientific and Cultural Organization's World Heritage List in 1981 has increased the protection of habitats within the GBR World Heritage Area (Dryden et al., 2008).

In New Caledonia, 1985 fishery regulations contained some regional sea turtle conservation measures, and these were expanded in 2008 to include the EEZ, the Main Island, and remote islands (Maison et al., 2010). In Vanuatu, new fisheries regulations in 2009 prohibit the take, harm, capture, disturbance, possession, sale, purchase of or interference, import, or export of green turtles (Maison et al., 2010).

5.1.4 Central West Pacific DPS (proposed Endangered)

On March 23, 2015, NMFS and the FWS (Services) published a proposed rule finding that the Central West Pacific DPS is Endangered, due to continued threats, described below.

5.1.4.1 Distribution and Abundance of the Central West Pacific DPS

The range of the Central West Pacific DPS encompasses the Republic of Palau (Palau), Federated States of Micronesia (FSM), New Guinea, Solomon Islands, Marshall Islands, Guam, the Commonwealth of the Northeren Mariana Islands (CNMI), and a portion of Japan. Green turtle nesting occurs at least at low levels throughout the geographic distribution of the population, with isolated locations having high nesting activity. Currently, there are approximately 51 nesting sites and 6,518 nesting females in the Central West Pacific. There are a number of unquantified nesting sites, possibly with small numbers; however, specifics regarding these sites are unknown. The largest nesting site is in the FSM, and that particular site hosts approximately 22 percent of the total annual nesting females for this DPS. The highest numbers of females nesting in this DPS are located in Gielop and Iar Island, Ulithi Atoll, Yap, FSM (1,412); Chichijima (1,301) and Hahajima (394), Ogasawara, Japan; Bikar Atoll, Marshall Islands (300); and Merir Island, Palau (441) (NMFS and FWS, 1998; Bureau of Marine Resources 2005; Barr 2006; Palau Bureau of Marine Resources 2008; Maison et al., 2010; NMFS and FWS 2015).

There are numerous other populations in the FSM, Solomon Islands, and Palau, and approximately 22 nesting green sea turtles in Guam, and 57 nesting green sea turtles in the

CNMI. Historical baseline nesting information in general is not widely available in this region, but exploitation and trade of green sea turtles throughout the region is well-known (Groombridge and Luxmoore 1989).

Green sea turtles departing nesting grounds in this DPS travel throughout the western Pacific Ocean. Results of three post-nesting green sea turtles from Palau in 2006 showed they remained nearby or traveled to the Aru Islands in Indonesia – roughly 1,100 km away (Klain et al., 2007 in NMFS & FWS 2015). Five postnesting green sea turtles leaving Erikub Atoll in the Marshall Islands in 2007 traveled to the Philippines, Kiribati, FSM, or remained in the Marshallese EEZ (Kabua et al., 2012 in NMFS & FWS 2015). Turtles tagged in Yap (FSM) were recaptured in the Philippines, Marshall Islands, Papua New Guinea, Palau, and Yap (Palau BMR 2008; Cruce 2009). A turtle tagged on Gielop Island, Yap in 1991 was recaptured in Muroto Kochi prefecture, Japan in 1999 (Miyawaki et al., 2000). A nesting female tagged on Merir Island, Palau was captured near the village of Yomitan Okinawa, Japan (Palau BMR, 2008). Hundreds of nesting females tagged in Ogasawara Island were recaptured in the main islands of Japan, the Ryukyu Archipelago (Okinawa), Taiwan, China, and Philippines (H. Suganuma, Everlasting Nature of Asia, pers. comm., 2012 in NMFS & FWS 2015; Ogasawara Marine Station, Everlasting Nature of Asia. unpublished data in NMFS & FWS 2015). A turtle tagged in Japan was recorded nesting in Yap, FSM (Cruce 2009 in NMFS & FWS 2015).

In addition to nesting beaches, green sea turtles occupy coastal waters in low to moderate densities at foraging areas throughout the DPS. Aerial sea turtle surveys show that an in-water population exists around Guam (DAWR 2011 in NMFS & FWS 2015). In-water green turtle density in the Marianas Archipelago is low and mostly restricted to juveniles (Pultz et al., 1999; Kolinski et al., 2005, 2006; Palacios 2012). In-water information in this DPS overall is particularly limited.

There is insufficient long-term and standardized monitoring information to describe abundance and population trends adequately for many areas of the Central West Pacific DPS. The limited available information suggests a nesting population decrease in some portions of the DPS like the Marshall Islands, or unknown trends in other areas such as Palau, Papua New Guinea, the Marianas, Solomon Islands, or the FSM (Maison et al., 2010).

5.1.4.2 Life History Characteristics Affecting Vulnerability of the Central West Pacific DPS

Green sea turtles departing nesting grounds in this DPS travel throughout the South Pacific Ocean. Genetic studies done on incidentally caught turtles in the American Samoa longline fishery are from this DPS. All of the turtles are juveniles, which is the life stage that is susceptible to the proposed action.

5.1.4.3 Threats to the Central West Pacific DPS

Threats to Central West Pacific green sea turtle DPS are listed and discussed in the proposed rule (NMFS & FWS 2015). The threats to this Central West Pacific DPS include directed harvest, incidental bycatch in fisheries, destruction and modification of nesting habitat, debris, activities associated with national defense, disease, predation, toxic compounds, and climate change.

In the Central West Pacific Ocean, some nesting beaches have become severely degraded from a variety of activities. Destruction and modification of green turtle nesting habitat results from coastal development and construction, placement of barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach pollution, removal of native vegetation, and presence of non-native vegetation. In the FSM, construction of houses and pig pens on Oroluk beaches in Pohnpei State interferes with turtle nesting by creating barriers to nesting habitat (NMFS and FWS, 1998; Buden, 1999). Nesting habitat destruction is also a major threat to Guam turtles and has resulted mainly from construction and development due to increased tourism (NMFS and FWS 1998; Project GloBAL, 2009a). Coastal construction is a moderate problem on Majuro Atoll in the Republic of the Marshall Islands (NMFS and FWS 1998); however, it is unknown to what extent nesting beaches are being affected. On the outer atolls of the Marshall Islands, beach erosion has been aggravated by airfield and dock development, and by urban development on Majuro and Kwajalein Atolls. In the Republic of Palau, increasing nesting habitat degradation from tourism and coastal development has been identified as a threat to sea turtles (Eberdong and Klain 2008; Isamu and Guilbeaux 2002), although the extent and significance of the impacts are unknown.

Incidental capture in artisanal and commercial fisheries is a threat to the survival of green turtles in the Central West Pacific. Sea turtles may be caught in longline, pole and line, and purse seine fisheries. Within the Marshall Islands, Palau, the FSM, and the Solomon Islands, a purse-seine fishery for tuna and a significant longline fishery operate, and sea turtles have been captured in both fisheries with green turtle mortality occurring (Oceanic Fisheries Programme 2001; McCoy 2003; Hay and Sablan-Zebedy 2005; McCoy 2007a; McCoy 2007b; Western and Centra Pacific Fisheries Commission 2008). Numerous subsistence and small-scale commercial fishing operations occur along Saipan’s western coast and along both the Rota and Tinian coasts (CNMI Coastal Resources Management Office 2011). Incidental catch of turtles in Guam’s coastal waters by commercial fishing vessels likely also occurs (NMFS and FWS, 1998). In 2007, 222 fishing vessels (200 purse-seiners and 22 longliners) had access to Papua New Guinea waters (Kumoru 2008). Although no official reports have been released on sea turtle bycatch within these fisheries (Project GloBAL 2009b), sea turtle interactions with both fisheries have been commonly observed (Kumoru 2008). However, the level of mortality is unknown. The American Samoa longline fishery is estimated to have interacted with an average of 24 green sea turtles (22 estimated mortalities) annually within the action area between 2006 and June 30, 2015 (NMFS 2015c). Based on genetic samples NMFS estimates that 3 percent of the turtles caught in the American Samoa longline fishery are from the Central West Pacific DPS (Dutton pers. Comm.).

Directed take of eggs is a known ongoing problem in the Central West Pacific in the CNMI, FSM, Guam, Kiribati (Gilbert Islands chain), Papua, Papua New Guinea, Marshall Islands, and Palau (Eckert 1993; Guilbeaux 2001; Hitipeuw and Maturbongs 2002; Philip 2002). In addition to the collection of eggs from nesting beaches, the killing of nesting females continues to threaten the stability of green turtle populations. Ongoing harvest of nesting adults has been documented in the CNMI (Palacios 2012), FSM (Cruce 2009), Guam (Cummings 2002), Papua (Hitipeuw and Maturbongs, 2002), Papua New Guinea (Maison et al., 2010), and Palau (Guilbeaux 2001). Mortality of turtles in foraging habitats is also problematic for recovery efforts. Ongoing intentional capture of green turtles in their marine habitats has been documented in southern and eastern Papua New Guinea (Limpus *et al.*, 2002) and the Solomon Islands

(Broderick 1998; Pita and Broderick, 2005). Green turtles have long been harvested for their meat in the Ogasawara Islands, and records show a rapid decline in the sea turtle population between 1880 and 1920 (Horikoshi *et al.*, 1994; Ishizaki 2007). Currently, sea turtle harvest is strictly regulated with a harvest limit of 135 mature turtles per year (Ishizaki 2007).

The impacts of vessel strikes in the Central West Pacific are unknown, but not thought to be of great consequence, except possibly in Palau where high speed skiffs constantly travel throughout the lagoon south of the main islands (NMFS and FWS 1998). However, green turtles have been documented as occasionally being hit by boats in Guam (Guam Division of Aquatic and Wildlife Resources 2012).

In the FSM, debris is dumped freely and frequently off boats and ships (including government ships). Landfill areas are practically nonexistent in the outer islands and have not been addressed adequately on Yap proper or on Chuuk and Pohnpei. The volume of imported goods (including plastic and paper packaging) appears to be increasing (NMFS and FWS 1998). In Palau, entanglement in abandoned fishing nets has been identified as a threat to sea turtles (Eberdong and Klain 2008). In the Marshall Islands, debris and garbage disposal in coastal waters is a serious problem on Majuro Atoll and Ebete Island (Kwajalein Atoll), both of which have inadequate space, earth cover, and shore protection for sanitary landfills. This problem also exists to a lesser extent at Daliet Atoll (NMFS and FWS 1998). A study of the gastrointestinal tracts of 36 dead green turtles in the Ogasawara Islands of Japan in 2001 revealed the presence of marine debris (*e.g.*, plastic bag pieces, plastic blocks, monofilament lines, Styrofoam pieces) in the majority of the turtles (Sako and Horikoshi 2003).

Over the long term, Central West Pacific turtle populations could be affected by the alteration of thermal sand characteristics (from global warming), resulting in the reduction or cessation of male hatchling production (Caminas 2004; Hawkes *et al.*, 2009; Kasparek *et al.*, 2001; Poloczanska *et al.*, 2009). Further, a significant rise in sea level would restrict green turtle nesting habitat in the Central West Pacific. Coastal erosion has been identified as a high risk in the CNMI due to the existence of concentrated human population centers near erosion-prone zones, coupled with the potential increasing threat of erosion from sea level rise (CNMI Coastal Resources Management Office 2011). In the FSM, Yap State's low coralline atolls are extremely vulnerable to rises in sea levels and will be adversely affected if rises occur (NMFS and FWS 1998). These risks are high for all beaches in the Central West Pacific. Interestingly, Barnett and Adger (2003) identified projected increases in sea-surface temperature, and not sea level rise, as the greatest long-term risk of climate change to atoll morphology and thus to atoll countries like those in the Central West Pacific. They state that coral reefs, which are essential to the formation and maintenance of the islets located around the rim of an atoll, are highly sensitive to sudden changes in sea-surface temperature. Thus, climate change impacts could have profound long-term impacts on green turtle nesting in the Central West Pacific, but it is not possible to project the impacts at this point in time. Natural environmental events such as cyclones and hurricanes may affect green turtles in the Central West Pacific DPS. These storm events have been shown to cause severe beach erosion with likely negative effects on hatching success at many green turtle nesting beaches, especially in areas already prone to erosion. Shoreline erosion occurs naturally on many islands in the atolls of the Marshall Islands due to storms, sea level rise from the El Nino– Southern Oscillation, and currents (NMFS and FWS 1998). Some erosion of nesting beaches at Oroluk was reported in 1990 after passage of Typhoon Owen (NMFS and FWS 1998). However, effects of these natural events may be exacerbated by climate change. While sea turtles have survived past eras that have included significant temperature fluctuations, future climate change is expected to happen at unprecedented rates, and if turtles cannot adapt quickly they may face local to widespread extirpations (Hawkes et al., 2009). Impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC 2007).

5.1.4.4 Conservation of the Central West Pacific DPS

Regional and national legislation to conserve green turtles (often all sea turtles) exists throughout the range of the DPS. National protective legislation generally prohibits intentional killing, harassment, possession, trade, or attempts at these. The following countries have laws to protect green turtles: CNMI, FSM, Guam, Japan (Ogasawara Islands), Kiribati, Marshall Islands, Nauru, Palau, Papua, Papua New Guinea, Solomon Islands, and United States (Wake Island). In addition, at least 17 international treaties and/or regulatory mechanisms apply to the conservation of green turtles in the Central West Pacific DPS. These are implemented to various degrees throughout the range of the DPS. There are some national regulations, within this DPS, that specially address the harvest of green turtles while a few regulations are limited in that they only apply to turtles of certain sizes, times of years, or allow for harvest for tradition use.

In 2008, the Western and Central Pacific Fisheries Commission issued a Conservation and Management Measure (2008–03; *https://www.wcpfc.int/doc/cmm-2008- 03/conservation-and-management-sea- turtles)* to reduce sea turtle mortality during fishing operations, collect and report information on fisheries interactions with turtles, and encourage safe handling and resuscitation of turtles. This measure requires purse seine vessels to avoid encircling turtles and to release entangled turtles. It also requires longline vessels to use line cutters and dehookers to release turtles.

5.1.5 East Pacific DPS (proposed Threatened)

On March 23, 2015, NMFS and the FWS (Services) published a proposed rule finding that the East Pacific DPS is threatened, due to continued threats, described below, that are likely to endanger the DPS within the foreseeable future.

5.1.5.1 Distribution and Abundance of the East Pacific DPS

The range of the East Pacific DPS extends from the California/Oregon border southward along the Pacific Coast of the Americas to central Chile. This DPS encompasses the Revillagigedos Archipelago, Mexico and the Galápagos Archipelago, Ecuador. An estimated 3,319–3,479 eastern Pacific females nested annually (NMFS and FWS 2007a), 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). 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., 2010a, NMFS and FWS 2007a). Based on nesting beach data, the current adult female nester population for Colola, Michocan is 11,588 females, which makes this the largest nesting aggregation in the East Pacific, comprising nearly 58 percent of the total adult female population. The total for the entire Eastern Pacific nesting aggregation is estimated at 20,112 nesting females (Seminoff et al., 2015).

5.1.5.2 Life History Characteristics Affecting Vulnerability of the East Pacific DPS

Green sea turtles departing nesting grounds in this DPS travel throughout the South Pacific Ocean. Genetic studies done on incidentally caught turtles in the American Samoa longline fishery are from this DPS. All of the turtles are juveniles, which is the life stage that is susceptible to the proposed action.

5.1.5.3 Threats to the East Pacific DPS

Threats to East Pacific green sea turtle DPS are listed and discussed in the proposed rule (NMFS & FWS 2015). The threats to this East Pacific DPS include directed harvest, incidental bycatch in fisheries, destruction and modification of nesting habitat, debris, activities associated with national defense, disease, predation, toxic compounds, and climate change.

The largest threat on nesting beaches in the East Pacific DPS is reduced availability of habitat due to heavy armament and subsequent erosion. In addition, while nesting beaches in Costa Rica, Revillagigedos Islands, and the Gala´pagos Islands are less affected by coastal development than green turtle nesting beaches in other regions around the Pacific, several of the secondary green turtle nesting beaches in Me´xico suffer from coastal development. For example, effects of coastal development are especially acute at Maruata, a site with heavy tourist activity and foot traffic during the nesting season (Seminoff 1994). Nest destruction due to human presence is also a threat to nesting beaches in the Galapa´gos Islands (Za´rate *et al.,* 2006). However, such threats vary by site (Za´rate, 2012).

Incidental capture in artisanal and commercial fisheries is a significant threat to the survival of green turtles throughout the Eastern Pacific Ocean. The primary gear types involved in these interactions include longlines, drift nets, set nets, and trawl fisheries. These are employed by both artisanal and industrial fleets, and target a wide variety of species including tunas, sharks, sardines, swordfish, and mahi mahi. In the Eastern Pacific Ocean, particularly areas in the southern portion of the range of this DPS, significant bycatch has been reported in artisanal gill net and longline shark and mahi mahi fisheries operating out of Peru (Kelez *et al.,* 2003; Alfaro-Shigueto *et al.,* 2006) and, to a lesser extent, Chile (Donoso and Dutton 2010). The fishing industry in Peru is the second largest economic activity in the country and, over the past few years, the longline fishery has rapidly increased. During an observer program in 2003/2004, 588 sets were observed during 60 trips, and 154 sea turtles were taken as bycatch. Green turtles were the second most common sea turtle species in these interactions. In many cases, green turtles are kept on board for human consumption; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale. Koch *et al.* (2006) reported green turtle bycatch-related dead strandings numbering in the hundreds in Bahia Magdalena. In Baja California Sur, Mexico, from 2006–2009 small-scale gill-net fisheries caused massive green turtle mortality at Laguna San Ignacio, where Mancini *et al.* (2012) estimated that over 1,000 turtles were killed each year in nets set for guitarfish. Bycatch in coastal areas occurs principally in shrimp trawlers, gill nets and bottom longlines (Orrego and Arauz 2004). However, since 1996, all countries from Mexico to Ecuador declared the use of TEDs as mandatory for all industrial fleets to meet the requirements to export shrimp to the

United States under the U.S. Magnuson- Stevens Fishery Conservation and Management Act (Helvey and Fahy 2012). Since then, bycatch has not been thoroughly evaluated but it is widely believed that most fishers either improperly implement TEDs or remove them entirely from their trawls. The American Samoa longline fishery is estimated to have interacted with an average of 24 green sea turtles (22 estimated mortalities) annually within the action area between 2006 and June 30, 2015 (NMFS 2015c). Based on genetic samples NMFS estimates that 12 percent of the turtles caught in the American Samoa longline fishery are from the East Pacific DPS (Dutton pers. Comm.).

In some countries and localities within the range of the East Pacific DPS, harvest of green turtle eggs is legal, while in others it is illegal but persistent due to lack of enforcement. The impact of egg harvest is exacerbated by the high monetary value of eggs, consistent market demand, and severe poverty in many of the countries in the Eastern Pacific Region where sea turtles are found. Egg harvest is a major conservation challenge at several sites in Costa Rica, including Nombre de Jesus and Zapotillal Beaches, where 90 percent of the eggs were taken by egg collectors during one particular study (Blanco 2010). Egg harvest is also believed to occur at unprotected nesting sites in Mexico, Guatemala, El Salvador, and Nicaragua (NMFS and FWS 2007a). Indeed, green turtles are hunted in many areas of northwest Mexico despite legal protection (Nichols *et al.,* 2002; Seminoff *et al.,* 2003). Mancini and Koch (2009) describe a black market that killed tens of thousands of green turtles each year in the Eastern Pacific Region. Sea turtles were, and continue to be, harvested primarily for their meat, although other products have served important non-food uses. Sea turtle oil was for many years used as a cold remedy and the meat, eggs and other products have been highly-valued for their aphrodisiacal qualities, beliefs that strongly persist in the countries bordering the East Pacific DPS.

Effects of climate change include, among other things, sea surface temperature increases, the alteration of thermal sand characteristics of beaches (from warming temperatures), which could result in the reduction or cessation of male hatchling production (Hawkes *et al.*, 2009; Poloczanska *et al.,* 2009), and a significant rise in sea level, which could significantly restrict green turtle nesting habitat. While sea turtles have survived past eras that have included significant temperature fluctuations, future climate change is expected to happen at unprecedented rates, and if turtles cannot adapt quickly they may face local to widespread extirpations (Hawkes *et al.,* 2009). Impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC, 2007). However, at the primary nesting beach in Michoacan, Mexico (Colola), the beach slope aspect is extremely steep and the dune surface at which the vast majority of nests are laid is well-elevated. This site is likely buffered against short-term sea level rise as a result of climate change. In addition, many nesting sites are along protected beach faces, out of tidal surge pathways. For example, multiple nesting sites in Costa Rica and in the Galapagos Islands are on beaches that are protected from major swell coming in from the ocean.

5.1.5.4 Conservation of the East Pacific DPS

Protection of green turtles is provided by local marine reserves throughout the region. In addition, sea turtles may benefit from the following broader regional efforts: (1) The Eastern Tropical Pacific Marine Corridor Initiative supported by the governments of Costa Rica, Panama, Colombia, and Ecuador, which is a voluntary agreement to work towards sustainable use and conservation of marine resources in these countries' waters; (2) the Eastern Tropical Pacific Seascape Program managed by Conservation International that supports cooperative marine management in the Eastern Tropical Pacific, including implementation of the Marine Corridor Initiative; (3) the IATTC and its bycatch reduction efforts that are among the world's finest for regional fisheries management organizations; (4) the IAC, which is designed to lessen impacts on sea turtles from fisheries and other human impacts; and (5) the Permanent Commission of the South Pacific (Lima convention), which has developed an Action Plan for Sea Turtles in the Southeast Pacific. There are indications that wildlife enforcement branches of local and national governments are stepping up their efforts to enforce existing laws, although successes in stemming sea turtle exploitation through legal channels are few and far between.

The following countries have laws to protect green turtles: Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, and the United States. In addition, at least 10 international treaties and/or regulatory mechanisms apply to the conservation of green turtles in the East Pacific DPS.

Since 1996, all countries from Mexico to Ecuador declared the use of TEDs as mandatory for all industrial fleets to meet the requirements to export shrimp to the United States under the U.S. Magnuson- Stevens Fishery Conservation and Management Act (Helvey and Fahy 2012).

5.1.6 East Indian-West Pacific DPS (proposed Threatened)

On March 23, 2015, NMFS and the FWS (Services) published a proposed rule finding that the East Indian-West Pacific DPS is threatened, due to continued threats, described below, that are likely to endanger the DPS within the foreseeable future.

5.1.6.1 Distribution and Abundance of the East Indian-West Pacific DPS

Green turtle nesting is widely dispersed throughout the East Indian-West Pacific DPS, with important nesting sites occurring in Northern Australia, Indonesia, Malaysia (Sabah and Sarawak Turtle Islands), Peninsular Malaysia, and the Philippine Turtle Islands (Figures 5 & 6). The largest nesting site lies within Northern Australia, which supports approximately 25,000 nesting females, calculated from the 5,000 nesting female's order of magnitude (Limpus 2009). Currently, the East Indian-West Pacific DPS hosts 58 reported nesting sites (in some cases nesting sites are made up of multiple beaches based on nesting survey information) with six of these sites supporting more than 5,000 nesting females each (including the 25,000 nesters in Northern Australia). Green turtle populations within this DPS have experienced increases at some nesting sites and decreases at others. Nonetheless, populations are substantially depleted from historical levels.

The in-water range of the East Indian-West Pacific DPS is similarly widespread with shared foraging sites throughout the DPS. Tagged green sea turtles that nest in Western Australia have been resighted in Arnhem Land and as far north as the Java Sea near Indonesia (Baldwin et al., 2003; Limpus et al., 2007). The extensive coastline and islands of Indonesia support a large range of nesting and foraging habitat for green sea turtles (Halim and Dermawan 1999). Waayers and Fitzpatrick (2013) found that in the Kimberly region of Australia, the green turtle appears to have a broad migration distribution and numerous potential foraging areas. A satellite-tagged female green turtle at Redang, Malaysia, travelled near Koh Samui, Thailand (Liew 2002). Green turtle foraging grounds occur around the Andaman and Nicobar Islands (Andrews et al., 2006). The estimated total nester abundance for this DPS is approximately 77,009 (Seminoff et al., 2015).

5.1.6.2 Life History Characteristics Affecting Vulnerability of the East Indian-West Pacific DPS

Green sea turtles departing nesting grounds in this DPS travel throughout the South Pacific Ocean. Genetic studies done on incidentally caught turtles in the American Samoa longline fishery are from this DPS. All of the turtles are juveniles, which is the life stage that is susceptible to the proposed action.

5.1.6.3 Threats to the East Indian-West Pacific DPS

Threats to East Indian-West Pacific green sea turtle DPS are listed and discussed in the proposed rule (NMFS & FWS 2015). The threats to this East Indian-West Pacific DPS include directed harvest, incidental bycatch in fisheries, destruction and modification of nesting habitat, debris, activities associated with national defense, disease, predation, toxic compounds, and climate change.

In the East Indian-West Pacific DPS, the majority of green turtle nesting beaches are extensively eroded. Nesting habitat is degraded due to a variety of human activities largely related to tourism. Coastal development and associated artificial lighting, sand mining, and marine debris affect the amount and quality of habitat that is available to nesting green turtles. Most of the beaches in Vietnam have a large amount of marine debris, which includes glass, plastics, polystyrenes, floats, nets, and light bulbs. This debris can entrap turtles and impede nesting activity. In Australia, the majority of green turtle nesting along the beaches of the Gulf of Carpentaria occurs outside of the protection of the National Park. Other minor nesting sites lie within the protected lands of the Indigenous Protected Areas (Limpus 2009). In Western Australia, the impacts to nesting and hatchling green turtles by independent turtle watchers as well as off-road vehicles has increased in the Ningaloo region as the number of visitors has increased over the years (Waayers 2010). Nesting turtles and hatchlings are routinely disturbed by people with their cars and flashlights (Kelliher *et al.,* 2011). Burn-off flares associated with oil and gas production on the Northwest shelf of Australia are in sufficiently close proximity to the green turtle nesting beaches to possibly cause hatchling disorientation (Pendoley 2000). Green turtles forage in the seagrass beds around the Andaman and Nicobar Islands in India. Some of these seagrass beds in the South Andaman group are no longer viable foraging habitat because of siltation and degradation due to waste disposal, a byproduct of the rapid increase in tourism (Andrews 2000). Green turtles that forage off the waters of the Bay of Bengal in south Bangladesh also face depleted foraging habitat from divers collecting seagrass for commercial purposes and by anchoring of commercial ships, ferries, and boats in this habitat (Sarkar 2001). In the nearshore waters of Thailand, seagrass beds are partially protected since fishing gear such as trawls are prohibited (Charuchinda *et al.,* 2002). In the waters surrounding the islands of Togean and Banggai in Indonesia, the use of dynamite and potassium cyanide are common, and this type of fishing method destroys green turtle foraging habitat (Surjadi and Anwar 2001).

Incidental capture in artisanal and commercial fisheries is a significant threat to the survival of green turtles in the East Indian-West Pacific DPS. Green turtles may be caught in drift and set gill nets, bottom and mid-water trawling, fishing dredges, pound nets and weirs, and haul and purse seines. Bycatch in fisheries using gears such as trawlers, drift nets, and purse seines is thought to be one of the main causes of decline in the green turtle population in Thailand and Malaysia. The rapid expansion of fishing operations is largely responsible for the increase in adult turtle mortality due to bycatch (Settle 1995). The most used fishing gears in the waters of Thailand are trawling and drift gill nets. Heavy fishing is the main threat to foraging sea turtles (Chan *et al.*, 1988; Chantrapornsyl 1993; Liew 2002). Gill nets and set bag nets are the two major fishing gears used in the Bay of Bengal, and green turtles are likely captured during these fishing operations (Hossain and Hoq 2010). Along the coast of Andaman and Nicobar Islands, the main type of fishery is gill nets and purse seines with thousands of turtles killed annually by fisheries operations including the shark fishery (Chandi *et al.*, 2012; Shanker and Pilcher 2003). In 1994, Bhaskar estimated at least 600 green turtles were killed as a result of the shark fishery in this area. Over the last decade, there has been an increase in the large predator fishing industry. Green turtle mortality can be expected to be much higher than that estimated in the 1990s as a result of these curret operations (Namboothri *et al.*, 2012). Trawl fishing is also common in Bangladesh. No green turtle stranding information is available to determine the fishery threat level to the green turtle population; however, it is expected to be high as TEDs are not used and the population has declined (Ahmed *et al.*, 2006; Khan *et al.*, 2006). On the Turtle Islands in the Philippines, there have been an increased number of dead turtles as a result of fishing activities, such as shrimp trawlers and demersal nets (Cruz 2002). One of the main threats to green turtles in Vietnam and Indonesia is the incidental capture from gill and trawl nets and the opportunistic capture by fishers. Hundreds of green turtles are captured by fisheries per year in Vietnam (Ministry of Fisheries 2003; Hamann *et al.*, 2006; Dethmers 2010). In Indonesia, green turtles were recorded as one of the main species caught in the longline fisheries. Trawl gear is still allowed in the Arafura Sea, posing a major threat to green turtles (Dethmers 2010). Shrimp trawl captures in Indonesia are high because of the limited use of TEDs (Zainudin *et al.*, 2008). The American Samoa longline fishery is estimated to have interacted with an average of 24 green sea turtles (22 estimated mortalities) annually within the action area between 2006 and June 30, 2015 (NMFS 2015c). Based on genetic samples NMFS estimates that 2 percent of the turtles caught in the American Samoa longline fishery are from the East Indian-West Pacific DPS (Dutton pers. Comm.).

Current legal and illegal collection of eggs and harvest of turtles occur throughout the East Indian-West Pacific DPS and persists as a significant threat to this DPS. The harvest of nesting females continues to threaten the stability of green turtle populations in many areas affecting the DPS by reducing adult abundance and reducing egg production. Local islanders in Indonesia have traditionally considered turtles, especially green turtles, as part of their diet (Hitipeuw and Pet-Soede, 2004). Illegal egg harvesting continues, but there is an increased effort to fully protect green turtles from harvest on the islands of Bilang-Bilangan and Mataha in Indonesia (Reischig *et al.*, 2012). In Australia, green turtles are harvested by Aboriginal and Torres Strait Islanders for subsistence purposes. There is a widespread use of motorized aluminum boats in contrast to the traditional dugout canoes powered by paddles or sail. The total harvest of green turtles by indigenous people across northern and Western Australia is probably several thousand annually (Kowarsky 1982; Henry and Lyle 2003).

Pollution from oil spills, as well as from agricultural and organic chemicals, is a major threat to the waters used by green turtles in the Bay of Bengal (Sarkar 2001). The result of human population growth in China has been an increased amount of pollutants in the coastal system. Discharges from untreated sewage have occurred in Xisha Archipelago (Li *et al.*, 2004). Concentrations of nine heavy metals (iron, manganese, zinc, copper, lead, nickel, cadmium, cobalt, and mercury) and other trace elements were found in liver, kidney, and muscle tissues of green turtles collected from Yaeyama Islands, Okinawa, Japan (Anan *et al.*, 2001). The accumulation of cadmium found in the green turtles is likely due to accumulations of this heavy metal in the plant materials on which they forage (Sakai *et al.*, 2000). In the Gulf of Carpentaria, Australia, discarded fishing nets have caused a high number of turtle deaths with the majority being green turtles (Chatto *et al.*, 1995).

Effects of climate change include, among other things, increased sea surface temperatures, the alteration of thermal sand characteristics of beaches (from warming temperatures), which could result in the reduction or cessation of male hatchling production (Hawkes *et al.*, 2009; Poloczanska *et al.*, 2009), and a significant rise in sea level, which could significantly restrict green turtle nesting habitat. While sea turtles have survived past eras that have included significant temperature fluctuations, future climate change is expected to happen at unprecedented rates, and if turtles cannot adapt quickly they may face local to widespread extirpations (Hawkes *et al.*, 2009). Impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC, 2007). Natural environmental events, such as cyclones and hurricanes, may affect green turtles in the East Indian-West Pacific DPS. Typhoons have caused severe beach erosion and negatively affect hatching success at green turtle nesting beaches in Japan, especially in areas already prone to erosion.

5.1.6.4 Conservation of the East Indian-West Pacific DPS

There are numerous ongoing conservation efforts in this region. Hatcheries have been set up throughout the region to protect a portion of the eggs laid and prevent complete egg harvesting. In addition, bycatch reduction efforts have been made in some areas, protected areas are established throughout the region, and monitoring, outreach and enforcement efforts have made progress in sea turtle conservation. In India, since 1978, the Centre for Herpetology/Madras Crocodile Bank Trust has conducted sea turtle surveys and studies in the islands. In a bilateral agreement, the Governments of the Philippines and Malaysia established The Turtle Island Heritage Protected Area (TIHPA), made up of nine islands (six in the Philippines and three in Malaysia). The TIHPA is one of the world’s major nesting grounds for green turtles. Management of the TIHPA is shared by both countries. One of the nesting beaches for this DPS, Australia’s Dirk Hartog Island, is part of the Shark Bay World Heritage Area and recently became part of Australia’s National Park System. This designation may facilitate monitoring of nesting beaches and enforcement of prohibitions on direct take of green turtles and their eggs. Conservation efforts on nesting beaches have included invasive predator control.

In order to reduce the threat of illegal trade, the Vietnamese Government, with assistance from IUCN, WWF, TRAFFIC the wildlife trade monitoring network, and the Danish Government, formulated a Marine Turtle Conservation Action Plan in 2010 to expand awareness to fishers and enforcement officers, and to confiscate sea turtle products (Stiles 2009; Ministry of Fisheries 2004).

TEDs are now in use in Thailand, Malaysia, the Philippines, Indonesia and Brunei, expanded by initiatives of the South East Asian Fisheries Development Center (Food and Agriculture Organization of the United Nations, 2004). In 2000, the use of TEDs in the Northern Australian Prawn Fishery was made mandatory. Prior to the use of TEDs, this fishery took between 5,000 and 6,000 sea turtles as bycatch annually, with a mortality rate estimated to be 40 percent (Poiner and Harris, 1996). Since the mandatory use of TEDs has been in effect, the annual bycatch of sea turtles in the Northern Australian Prawn Fishery has dropped to fewer than 200 sea turtles per year, with a mortality rate of approximately 22 percent (based on recent years).

5.2 Leatherback sea turtles

Information in this section is summarized primarily from the leatherback sea turtle 5-year status review (NMFS and FWS 2013a), the May 2007 leatherback sea turtle focus issue of the journal Chelonian Conservation and Biology, the Turtle Expert Working Group's (TEWG) report on Atlantic leatherback sea turtle (TEWG 2007), the 2012 Opinion (NMFS 2012a), the 2014 Opinion (NMFS 2014a), the Pacific Leatherback sea turtle Assessment Working Group (PLAWG) convened by PIFSC and SWFSC (PLAWG 2012), and other sources cited below.

5.2.1 Distribution and Abundance

Leatherback sea turtles have the widest distribution of any sea turtle and can be found from the equator to subpolar regions in both hemispheres. Although listed globally, it is difficult to characterize the global status and trend of leatherback sea turtle on a global scale because the species consists of many discrete populations that may increase or decrease independently of one another. The leatherback sea turtle 5-year status review (NMFS and FWS 2013a) 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 (NMFS and FWS 2013a, TEWG 2007, PLAWG 2012). The discovery of the world's fourth-largest leatherback sea turtle nesting area on the Atlantic coast of Panama and Columbia (Patino-Martinez et al., 2008) supports the TEWG's conclusion that leatherback sea turtle nesting is increasing in parts of the Atlantic and Caribbean (TEWG 2007).

In the Pacific, tagging studies have shown that leatherback sea turtles can traverse entire ocean basins when foraging. Leatherback sea turtles 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 sea turtle population is not homogeneous because natal homing of female leatherback sea turtles to nesting beaches maintains regional population structure. Leatherback sea turtle 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 sea turtle 5-year status review (NMFS and FWS 2013a) and the Turtle Expert Working Group's report on Atlantic leatherback sea turtles (TEWG 2007), and outcomes of the Pacific Leatherback sea turtle Assessment Working Group (PLAWG 2012). 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. All leatherback sea turtle interactions with the Hawaii shallow-set longline fishery have been of western Pacific population origin (Dutton unpublished) and all but one of the leatherback sea turtles observed caught in the deep-set fishery have been from the western Pacific. In 1995 there was a juvenile leatherback sea turtle caught south of the main Hawaiian Islands that was from the E. Pacific population. Three leatherback sea turtles caught incidentally in the American Samoa longline fishery have been sampled and found to have been from the western Pacific subpopulation (Dutton personal communication, June 4, 2015).

The Western Pacific leatherback sea turtle subpopulation nests primarily in Indonesia, Papua New Guinea (PNG), Solomon Islands, and to a lesser extent in Vanuatu (Dutton et al., 2007). The marine habitat for this subpopulation extends north into the Sea of Japan, northeast and east into the North Pacific to the west coast of North America, west to the South China Sea and Indonesian Seas, and south into the high latitude waters of the western South Pacific Ocean and Tasman Sea (Benson et al., 2011). This western Pacific leatherback sea turtle metapopulation harbors the last remaining nesting aggregation of significant size in the Pacific (Dutton et al., 2007, Hitipeuw et al., 2007) with approximately 75 percent of regional nesting occurring along the northwest coast of Papua Barat, Indonesia (also known as the Bird’s Head Peninsula) (Hitipieuw et al., 2007). Genetic results to date have found that nesting aggregations that comprise the western Pacific population all belong to a single population (Dutton et al., 2007), and in 2007 this population was estimated to consist of approximately 2700–4500 breeding females (Dutton et al., 2007). Recent research indicates a continual and significant long term nesting decline of 5.9 percent per year at the primary western Pacific beaches in Indonesia, Jamursba medi and Wermon, since 1984 with a 75 percent overall population reduction (Tapilatu et al., 2013). The once large nesting population in Terrengannu, Malaysia, is now functionally extinct (Chan and Liew 1995; NMFS and FWS 2013a).

The Bird’s Head region consists of four main beaches, three that make up the Jamursba-Medi beach complex and a fourth, which is Wermon beach (Dutton et al., 2007). Currently, an estimated 500 female leatherback sea turtles nest annually at these primary nesting sites of the Bird’s Head Peninsula (Tapilatu et al., 2013). Satellite tagging studies of leatherback sea turtles from this metapopulation indicate that turtles that nest during different times of the year have different migration patterns. Boreal summer nesting turtles (April through September) have tropical and temperate northern hemisphere foraging regions, while boreal winter (October through March) nesters traverse to tropical waters and temperate regions of the southern hemisphere (Benson et al., 2011). Turtles nesting in Papua Barat, Indonesia during the boreal 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 Bird’s Head 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 longline fisheries during migrations. Among foragers tagged in coastal waters off California (n = 27 female and 10 male adults), the majority moved north and spent time in areas off northern California and Oregon, before moving towards the equatorial eastern Pacific, then eventually westward presumably towards western Pacific Ocean nesting beaches (Benson et al., 2011).

Since 2004, all leatherback sea turtles sampled as bycatch in the Hawaii longline fisheries are from the western Pacific population, based on genetic analyses. Only one of the leatherback sea turtles sampled as bycatch in the deep-set fishery was from the eastern Pacific population, and this interaction occurred in 1995 south of the MHI at 14°N latitude and 157° W longitude (NMFS 2014a). Tagging studies have shown that eastern Pacific post-nesting females migrate southward to the south Pacific after nesting in Costa Rica (Shillinger et al., 2008, 2011), whereas western Pacific females migrate northward to the North Pacific after nesting in Papua Barat (Benson et al., 2007a, b; Benson et al., 2011). A study of 46 tagged leatherback sea turtles from Playa Grande, Costa Rica tracked over 12,095 cumulative tracking days demonstrated that eastern Pacific leatherback sea turtles mainly migrate south and to the east of the Hawaii longline fisheries after nesting and never entered (nor came close to) the American Samoa action area (Shillinger et al., 2008). Similarly, winter nesting leatherback turtles tagged from Wermon beach Indonesia, PNG, and Solomon Islands migrated into the southern hemisphere post-nesting (Benson et al., 2011). Given the south/eastward migration of winter nesting (Nov to March) of this subpopulation of leatherback sea turtles, exposure to the American Samoa longline fishery is likely, although the tracks of 45 leatherback sea turtles were outside the action area (Benson et al., 2011). Bycatch data in Peruvian and Chilean coastal artisanal fisheries indicate leatherback sea turtles are present in coastal areas (Alfaro-Shigueto et al., 2011; Donoso et al., 2000;) and genetic analyses of juvenile and adult leatherback sea turtles caught in fisheries off Peru and Chile also show a proportion originate from the western Pacific Ocean rookeries (NMFS and USFWS 2013a).

Bird’s Head Component of the Western Pacific Population

Jamursba-Medi makes up approximately 38 percent of total estimated nesting for the western Pacific population (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. There is also some additional nesting at beaches of the Manokawari region of the Birds Head Peninsula. 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 Jamursba-Medi are built up again and leatherback sea turtles nest there at that time (Hitipieuw 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). Recent published information indicates a long-term nesting decline at Jamursba-Medi by 29 percent from 2005 to 2011 and a 78 percent decline over the 27 year period since 1984 (Tapilatu et al., 2013). However, a study done in 2011, using the same nesting data in a climate-based population viability assessment that considers bottom-up climate forcing at two life stages, neonates and breeding females, shows a future increase in the population due to favorable climate conditions (Van Houtan 2011).

Wermon beach produced approximately 30 percent of all western Pacific nests from 1999-2006 (Dutton et al., 2007). Peak leatherback sea turtle 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, Tapilatu et al., 2013). 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), yet Tapilatu et al., (2013) did not confirm evidence of cross utilization of beaches.

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 declining by a rate of 5.5 percent per year (Tapilatu et al., 2013). The total number of nests per year for the Jamursba-Medi leatherback sea turtle nesting population ranged between a high of 6,929 nests in 1996 and a low of 1,596 nests in 2011 (Hitipeuw et al., 2007, Tapilatu et al., 2013). Tapilatu et al., (2013) estimated the clutch frequency at Jamursba-Medi to be 3-10 nests per season with a mean of 5.5 +/- 1.6. This is in line with other clutch frequency ranges from Costa Rica (5.6 +/- 1.2 nests per female; Reina et al., 2002) and Mexico (5.5 +/- 1.9 nests per female; Sarti Martinez et al., 2007). Based on nest counts, approximately 290 females nested at Jamursba-Medi during the 2011 April to September boreal summer nesting season. Given the number of nests laid, between 1,195-1,575 and 275-363 females nested per year between the 1996 high and 2011 low at Jamursba-Medi. 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), although Tapilatu et al., (2013) report 1,497 nests laid at Wermon in 2005. Since 2005, nesting has declined by 11.6 percent per year at Wermon to 1,096 nests laid in 2011, representative of 189-249 females, or a 62 percent decline since monitoring began in 2002 (Tapilatu et al., 2013).

There may have been a learning curve to overcome by the community-based rangers in the early years. The apparent decline in nesting activity may have resulted from ranger learning and changes in survey effort, or may represent an actual decline in nesting activity, or is representative of typical annual sea turtle nesting variability. Continued long-term standardized monitoring at Wermon will help quantify 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). In the Manokwari region, West Papua, Indonesia, nesting occurs year round and the number of nests recorded from 2008 through 2011 ranged from 84 to 135 (Suganuma et al., 2012); however, survey effort was limited and not consistent across years. The total number of adult females in the Bird's head region is estimated to be 1,949 based on summer nests (April –September) by Van Houtan (2013) (from Tapilatu et al., 2013). In 2011, an analysis of nesting data was done using two different models for a population viability assessment (PVA) for the Jamursba Medi nesting aggregation, a classical model and a climate-based model (Van Houtan 2011, NMFS 2012). The classical PVA calculated population growth and its variability from time series of nest counts, and this model resulted in a population decrease over the next 100 years for the Jamursba-Medi component. The second approach was the climate-based PVA that considers bottom-up climate forcing at two life stages, neonates and breeding females. The Climate-based PVA forecasted a population increase within one generation (25 years) (Van Houtan 2011, NMFS 2012a). Although the model is considered highly accurate based on its ability to account for historical population changes, because of the difficulty predicting Pacific Decadal Ocillation (PDO), the model cannot forecast population trends beyond one generation. While both the classical and climate-based approaches have limitations, the climate-based model is considered more rigorous in applying actual data, and therefore is more useful for predicting population trends and is useful in a qualitative analysis but cannot be relied up on solely.

Non-Bird's Head Component of the Western Pacific Population

Besides the Bird's Head region, Dutton et al., (2007) reported leatherback sea turtle 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 leatherback sea turtles nesting in 1999-2006 occurred at these 27 sites. Of the total western Pacific nesting metapopulation, 20 percent of nesting activity from 1999-2006 occurred in PNG, with the Huon Coast contributing approximately 15 percent of total western Pacific population nesting activity (Dutton et al., 2007). Within PNG, the Huon Coast hosts an estimated 50 percent of leatherback sea turtle 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 sea turtle nests during the peak nesting period with a high level (83-100 percent) of nest harvest and relatively frequent harvest of adult leatherback turtles (Kinch et al., 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 three years, with substantial variation ranging from one to seven years (Pilcher 2010a). During the 2010-11 nesting season, 79 leatherback turtles nested laying 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 of 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 - 2007 nesting season, and since then nesting activity has been stable or slightly increasing (Pilcher 2011). During the 2010-11 nesting season, 527 nests were recorded between October and May, the highest number of nests recorded since 2000 (Pilcher 2011). Night-time surveys between late-November through mid-February of the same nesting season resulted in 79 identified nesting females, of which 30 were remigrants (turtles from previous seasons), 15 were new turtles never tagged before, and 34 were renesting events of turtles already identified previously in the season (Pilcher 2011). However, monitoring activities again halted during the 2013-2014 nesting season due to community discord and disagreements, and monitoring has not resumed. Of nests laid in PNG during the 2012-2013 nesting season, 22 percent were lost to erosion, poaching or did not hatch. Overall, however, total nest counts for these years reflect a decline of approximately 93 percent in nesting activity since 1980 estimates (Pilcher 2009, 2013).

The Solomon Islands support leatherback sea turtle 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 representing approximately 8 percent of the total western Pacific leatherback sea turtle metapopulation at that time. 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 leatherback sea turtles 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 (MacKay 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, although it is likely that local consumption of turtles and eggs has reduced nesting populations over the last few decades (Bellagio Steering Committee 2008, NMFS 2008a).

Leatherback sea turtles have 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 sea turtle nesting has declined in recent years. There appears to be low levels of scattered nesting on at least four or five beaches with approximately 50 nests laid per year (Dutton et al., 2007). The primary leatherback sea turtle nesting site in Vanuatu is at Votlo on Epi Island where nesting beach surveys have been conducted since 2002-03. During the

2010-2011 nesting season 41 nests were laid at Votlo, although only eight nests hatched (Petro 2011).

Summary for Western Pacific Population

Population estimates for sea turtles are problematic due to a lack of demographic information. No population estimates are available for the Pacific leatherback sea turtle populations, only nesting information, which is used as population indices. In 2007, the total number of adult females in the Jamursba-Medi population numbered an estimated 2,110 to 5,735 individuals, and at that time that the Jamursba–Medi component represented approximately 38 percent of the population (Dutton et al., 2007). Recent research indicates that nesting trends in Papua Barat, Indonesia have declined and that approximately 500 females are nesting annually in the Bird's Head region at Jamursba-Medi and Wermon beaches. The total number of adult females in the Bird's Head region is estimated as 1,949 based on summer nests (April –September) (Van Houtan 2014, Tapilatu et al., 2013), which represents about 75 percent of the nesting activity in the Western Pacific. NMFS estimates that there are approximately 2,739 nesting females in the region (Van Houtan 2015).

5.2.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Leatherback sea turtle life history is characterized by juvenile and adult life history stages occurring primarily in the oceanic zone. Adult leatherback sea turtles range more widely across oceanic habitat than any other sea turtle, including into subpolar waters (NMFS 2004a, 2005a, 2006a; NMFS and FWS 2013a). 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, 2011). Much less is known about juvenile and sub-adult leatherback sea turtles, which is the life stage most affected by the American Samoa longline fishery (Van Houtan 2015). Given that the action area is oceanic, foraging and migrating western Pacific leatherback sea turtles are most susceptible to the proposed action.

Satellite-tagged nesting females from beaches in the Western and Eastern Pacific illustrate their post-nesting migration routes. Western Pacific leatherback sea turtles nesting during the northern summer (Jun-Aug) in Papua migrate northeast to productive temperate waters off of the west coast of the U.S (Benson et al., 2007a, 2011). In contrast, leatherback sea turtles nesting during the northern winter (Nov-Mar) in Papua PNG, and Solomon Islands migrate southeast after nesting, towards Australian and New Zealand waters and perhaps through/into the action area (Benson et al., 2007a, 2007b, 2011).

Eastern Pacific leatherback sea turtles are not known to migrate through the action area after nesting – rather, they migrate south to foraging areas off of South America east of the action area (Shillinger et al., 2008). There are also data sets on at-sea distribution that were collected via observers and fishers onboard fishing vessels in the eastern Pacific. The primary dataset available was developed by IATTC and shows a wide distribution of leatherback sea turtles throughout the eastern Pacific, ranging from the Gulf of California, Mexico to Peru (IATTC 2012). However, genetic analyses of juvenile and adult leatherback sea turtles caught in fisheries off Peru and Chile indicate that a proportion (approximately 16 percent of sampled turtles) are from western Pacific rookeries (NMFS and FWS 2013a). Migratory routes of non-breeding adult females, and of adult males, are less understood for western and eastern Pacific leatherback sea turtle, although 10 males were tagged with satellite-linked transmitters at California foraging grounds. Movements were similar to those of female leatherback sea turtles tagged off California (Benson et al., 2011). Migratory routes of non-breeding adult females, and of adult males, are unknown for western and eastern Pacific leatherback sea turtles.

Leatherback sea turtle age at maturity is uncertain. Estimates range widely between 9-15 years and 26-32 years based on skeletochronological analyses (Jones et al., 2011) and inferences from mark-recapture studies (e.g., approx 15 yrs; Dutton et al., 2005). Extrapolations of captive growth curves under controlled thermal and trophic conditions suggested size at maturity could be reached in 7-16 yr (Jones et al., 2011). Thus, a high degree of uncertainty remains about leatherback sea turtle age at maturity in the wild. Likewise, leatherback sea turtle lifespan is unknown.

Adult leatherback sea turtles typically feed on pelagic soft-bodied animals, especially sea jellies, siphonophores, and tunicates. Despite the low nutritive value of their prey, leatherback sea turtles 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. Leatherback sea turtles 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 leatherback sea turtles can dive deeper than any other reptile, most dives are less than 80 m (Shillinger et al., 2011). Migrating leatherback sea turtles 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 2006). Stable isotope analysis can complement satellite data of leatherback sea turtle movements and identify important foraging areas that reflect regional food webs (Seminoff et al., 2012).

Longline and other vessels can potentially strike leatherback sea turtles. However, because their density is low in the action area, we consider this risk slight.

5.2.3 Threats to the Species

Global threats to leatherback sea turtles are spelled out in the 5-year review (NMFS and FWS 2013a). Threats to the western Pacific leatherback sea turtle population are described in more detail in the proceedings of a 2004 leatherback sea turtle workshop (WPFMC 2005), the Proceedings of the Bellagio Sea Turtle Conservation Initiative (Bellagio Steering Committee 2008), and the PLAWG (2012).

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 growing threats to this species, and are described below. Primary impacts to the western Pacific 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 (Roe et al., 2014), 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 FWS 2013a, Bellagio Steering Committee 2008).

The annual survival probability of the PNG nesting population is estimated at 0.85 (95 percent CI: 0.66–0.95) which is lower than that of the Caribbean rookery (0.89) and the French Guiana rookery (0.91) (Pilcher and Chaloupka 2013). This survival probability may imply lower nesting beach fidelity, or might be reflective of higher mortality for the population due to anthropogenic hazards from subsistence hunting (Suarez and Starbird 1996) or incidental capture in fisheries (Lewison et al., 2004, Gilman et al., 2009, Wallace et al., 2010a). Benson et al., (2011) found that post-nesting migrations of the PNG population headed southeast to the Eastern Australian Current and Tasman Front. Fisheries operating out of Australia and New Zealand are thought to result in high bycatch and high mortality rates of western Pacific leatherback sea turtles that migrate there after nesting (MacKay 2014).

Before 2001 in the North Pacific, the Hawaii longline fishery was estimated to capture about 110 leatherback sea turtles annually (McCracken 2000). If we apply the old mortality rate of 32 percent (Gilman 2007a), the result is an estimated mortality of 36 (110*32 percent= 35.2) annually before the shallow-set portion of the fishery was closed in 2001. The 2004 management measures have proven to reduce leatherback sea turtle interaction rates by 83 percent (Gilman et al., 2007a, WPFMC 2009b). Since the shallow-set fishery re-opened in 2004, 18 (rounded from 18.03) estimated leatherback sea turtle mortalities occurred in the shallow-set fishery (NMFS 2015e). All of the leatherback sea turtles caught were released alive; mortality estimates come from applying the NMFS post-hooking mortality criteria (Ryder et al., 2006) to interactions. The Hawaii-deep set fishery also interacts with leatherback sea turtle and has an incidental take statement for up to 72 (from either sex, and all ages) anticipated leatherback sea turtle interactions and 27 anticipated mortalities over a three year period (NMFS 2014a).

In the deep-set fishery from 2005-2015, 45 (rounded up from 44.46) mortalities are estimated to have occurred (NMFS 2015d). Since 2005, the Hawaii-based longline fisheries combined have reduced their estimated mortality to seven annually (NMFS 2015d,e). However, other longline fisheries operating out of other countries are still using traditional methods (J style hooks with squid bait), and are likely killing hundreds of leatherback sea turtles annually in the Pacific. The California Oregon drift gillnet fishery has an incidental take statement for up to 10 anticipated leatherback sea turtle interactions and 7 anticipated estimated mortalities over a 5-year period (NMFS 2013a). Since 1990, 25 leatherback sea turtles were observed taken and 16 of those were considered mortalities in the drift gillnet fishery (NMFS 2013a).

Destruction and alteration of leatherback sea turtle nesting habitats are occurring throughout the species’ global range, especially coastal development, village sprawl, 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 and village sprawl 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 sea turtles, including those for the western Pacific population, occur in remote areas where development as described above is less prevalent although timber harvest, road construction, and village sprawl remain an issue in these remote areas (NMFS and FWS 2013a, Bellagio Steering Committee 2008, PLAWG 2012).

Harvest of leatherback sea turtles 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 (and likely 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 and in foraging habitats (i.e., Kei Islands, Indonesia: Starbird and Suarez 1996; Bellagio Steering Committee 2008). Predation of eggs is a major problem for western and eastern Pacific leatherback sea turtle, for example by feral pigs in Papua Barat and feral dogs in PNG (NMFS and FWS 2013a, Bellagio Steering Committee 2008). Impacts and threats to leatherback sea 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, PLAWG 2012, NMFS and FWS 2013a). 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 in PNG described previously, information indicates continuing impacts to leatherback sea turtles 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). In Vanuatu and Solomon Islands adult leatherback sea turtles are opportunistically hunted for meat in some areas and leatherback sea turtle eggs are occasionally collected from these beaches, and beach erosion is a serious impact to nesting beaches (Bellagio Steering Committee 2008, NMFS 2008a, NMFS and USFWS 2013a).

Marine debris is also a source of concern for leatherback sea turtles due to the reasons described for greens. Leatherback sea turtles can ingest small debris and larger debris can entangle animals leading to death. Manmade materials such as plastics (including plastic bags), micro plastics, and derelict fishing gear (e.g., ghost nets) that may impact leatherbacks 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 (NMFS and USFWS 2013a). While the impact of marine debris on leatherbacks during their pelagic life stage is currently unquantified, it is 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. Schuyler et al. (2015) and Wedemeyer‐Strombel et al. (2015) documented significant amounts of ingested debris in sea turtles sampled, and although olive riddles were found to have the highest risk of ingestion, other species, including leatherbacks, have similar overall risk.

Leatherback sea turtles are probably already beginning to be affected by impacts associated with anthropogenic climate change given low hatch success due to lethal beach temperatures and beach erosion (Tapilatu and Tiwari 2007, Bellagio Steering Committee 2008, PLAWG 2012, NMFS and USFWS 2013a). 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 a study done by Van Houtan (2011), western Pacific leatherback sea turtles from Jamursba-Medi show an increasing trend in the population over the next 22 years. The PDO was used to provide insight into neonate survival and the ocean coastal upwelling index that describes the California Current dynamics was used as a breeding cue for adult females (Van Houtan 2011). This study found that changes in leatherback sea turtle nesting populations over the last approximately 20 years are correlated with ocean oscillations (PDO) due to environmental influences on juvenile recruitment. In the next 22 years, leatherback sea turtles in the western Pacific may increase by 82 percent due to favorable conditions in the PDO in recent years. Predictions are not available beyond 22 years (Van Houtan 2011, NMFS 2012a). The study 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 leatherback sea turtles. Increases in their primary prey source, sea jellies, due to ocean warming and other factors are likely (Brodeur et al., 1999, Attrill et al., 2007, Richardson et al., 2009), although there is no evidence that any leatherback sea turtle populations are currently food-limited. Even though there may be a foraging benefit to leatherback sea turtles 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. However, a different picture is predicted for eastern Pacific leatherback turtles. Modeling of climate projections and population dynamics resulted in an estimated 7 percent per decade decline in the Costa Rica nesting population over the twenty first century. Whereas changes in ocean conditions had a small effect on the population, the increase of 2.5° C warming of the nesting beach was the primary driver of the modeled decline through reduced hatching success and hatchling emergence rates (Saba et al., 2012). Furthermore, climate change may compound the effects of interannual climate variability, as governed by El Niño Southern Oscillation (ENSO). Saba et al., (2007) showed that nesting females in Costa Rica exhibited a strong sensitivity to ENSO where as cool La Niña events correspond with a higher remigration probability and warm El Niño events correspond with a lower remigration probability. As a result, productivity at leatherback sea turtle foraging areas in the eastern Pacific in response to El Niño/La Niña events result in variable remigration intervals and thus variable annual egg production. This phenomenon may render the eastern Pacific leatherback sea turtle population more vulnerable to anthropogenic mortality due to longer exposure to fisheries than other populations (Saba et al., 2007).

Although the causes for decline of the eastern and western Pacific leatherback sea turtle populations are not entirely clear, it is likely the result of historic intensive egg poaching on the nesting beaches, incidental capture of adults and juveniles in high seas fisheries, and natural fluctuations due to changing environmental conditions that influence prey abundance and distribution (Sarti Martinez et al., 2007; Santidrian Tomillo et al., 2007, 2008; Wallace et al., 2010b; Saba et al., 2012). In Costa Rica the emergence of new threats from coastal development on key leatherback sea turtle nesting areas present a serious challenge to efforts to protect leatherback sea turtles in the East Pacific (Wallace and Piedra 2012, Tapilatu et al., 2013, NMFS and USFWS 2013a), and egg consumption by humans and domestic animals (e.g., dogs) persist on Nicaragua nesting beaches where protection is incomplete (Urteaga et al., 2012). However, fisheries bycatch is still considered the major obstacle to population recovery (Wallace and Saba 2009, NMFS and USFWS 2013a, MTSG 2012). Eckert and Sarti (1997) speculated that the swordfish gillnet fisheries in Peru and Chile contributed to the decline of the leatherback sea turtle in the eastern Pacific as the decline in the nesting population at Mexiquillo, Mexico occurred at the same time that effort doubled in the Chilean driftnet fishery; although ongoing leatherback sea turtle bycatch in gillnet and longline fisheries of South America off Peru and Chile continues to impact adults and subadults (Alfaro-Shigueto et al., 2007, 2011; Donoso and Dutton, 2010). A recent assessment of fisheries bycatch impacts on sea turtle populations globally found that bycatch in net gear appears to have the highest population-level impact on the East Pacific subpopulation, followed by longlines (Wallace et al., 2013). Roe et al., (2014) highlight potential longline fishery bycatch hotspots in the Pacific that may affect populations at various stages of their life history. For western Pacific nesting populations, several areas of high risk were identified in the north and central Pacific, but the greatest risk was adjacent to primary nesting beaches in tropical seas of Indo-Pacific islands, in the Sulu, Sulawesi, and South China Seas. There were non in the action area. For eastern Pacific nesting populations, the greatest risk was identified in the South Pacific Gyre.

5.2.4 Conservation of the Species

Considerable effort has been made since the 1980s to document and address leatherback sea turtle 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, which may be too small for adult leatherback sea turtles), 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 2013a). For example, switching to large circle hooks and mackerel bait in 2004 with complimentary fishery-based outreach and education resulted in an approximately 83 percent reduction in the leatherback sea turtle interaction rate in the Hawaii shallow-set longline fishery (Gilman et al., 2007a, WPFMC 2009b). Protected species workshops are required by NMFS annually of all Hawaii longline vessel operators to provide refresher trainings on the proper sea turtle handling guidelines, among other things. 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 have been involved in leatherback sea 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 Sea Turtle Recovery Plan (NMFS and FWS 1998b). Efforts to recover leatherback sea turtles 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. NMFS continues to work toward achieving support and developing fruitful partnerships for leatherback sea turtle 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 sea turtle 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); a conservation strategy that has proven effective in PNG (Pilcher 2006). Prior to 2002, 100 percent of nests laid at Wermon beach were lost as a result of harvest (60 percent) or predation (40 percent) (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 2011b). Community support in the form of scholarships and church repairs has been provided to encourage local participation in leatherback sea turtle conservation. Other community-based initiatives have been supported and coordinated among the groups working in Papua. This includes socioeconomic research to better understand how to build community capacity to support leatherback sea turtle conservation, and workshops convened to help the leatherback sea turtle conservation program to develop stronger ties between the program and communities (Gjertsen and Pakiding 2012). 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 leatherback sea turtles in coastal foraging habitats. Starbird and Suarez (1996) estimated that this traditional fishery captured at least 100 leatherback sea turtles 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 July 2012, Kei Kecil was designated as a marine protected area. It is hoped that the designation, which was supported by a program of USAID aimed at conserving marine resources, will help to address threats posed by forest clearance near nesting beaches, fishing activities, and hunting of turtles for meat (IOSEA 2013).

In PNG, the community-based HCLTCP 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 2013. Through CDI, communities at large experience the benefits of the leatherback sea 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 was reduced and hatchling production has increased over time in associated communities from close to 0 percent to approximately 60-70 percent as a result of the CDI program and concurrent efforts to implement nest protection measures (Pilcher 2009). During the 2010-2011 nesting season, the average hatching success rate was quantified to be 44.0 percent, resulting in an overall conservative estimate of 80,000 hatchlings released since the project's inception (Pilcher 2011, NMFS 2011b). Monitoring activities were hampered by community discord and disagreements during the 2013-2014 nesting season and have not resumed.

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, the Ocean Foundation, and NMFS). 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 and funding. Further, efforts are currently underway to launch assessment and monitoring activities with a community that is reported to have summer nesting activities. Preliminary data from the village of Waisurione on the island of Malaita is reporting approximately 5 nesting females per summer (May – July) nesting season, and villagers are learning to protect nests from dog predation (using bamboo grids) and relocating nests laid in erosion prone areas (Marine Research Foundation, 2015; Williams et al., 2014).

In Vanuatu, while leatherback sea turtle nesting is limited or unknown, especially on more remote islands, NMFS has supported a local NGO, Wan Smolbag, intermittently since 2007 through 2015 to train local villagers to monitor nesting activity, conserve leatherback sea turtle nesting beaches, and educate local communities to protect leatherback sea turtles and their nests from direct harvest of nesting females and their eggs (Petro 2011; Aromalo and MacKay 2015).

In Mexico, most conservation programs aimed at protecting nesting sea turtles have continued since the early 1980s, and there is little information on the degree of poaching prior to the establishment of these programs. Since the Mexican government instituted protective measures, there has been greater nest protection and nest success. The most recent results (2011-2012 nesting season) indicate that nearly 90 percent of clutches laid in key index beaches in Mexico were protected (e.g., relocated to hatcheries), with Barra de la Cruz nesting beach receiving the greatest number of nests and the largest number of nests protected (99 percent or 142 nests). On the priority II beaches during the 2011-12 nesting season, nest protection ranged from 70.6 percent to 78.8 percent (López et al., 2012). This is a significant increase since 1996, when only 12 percent of nests were relocated. From 1982 to 2004 a total of 270,129 leatherback sea turtle hatchlings were released to the wild population (Sarti Martinez et al., 2007). Currently, hope for the future of the population relies on the protection of clutches laid on the priority beaches, the participation of local communities in conservation activities, and increased awareness of the leatherback sea turtle's status among Mexican society.

In Costa Rica a systematic system of poaching was well established by 1975 that resulted in the removal of 90 percent of eggs. Intense poaching lasted until 1991, when Las Baulas park was established (Santidrian-Tomillo et al., 2007). Overall, environmental education and conservation efforts through active law enforcement have greatly reduced leatherback sea turtle egg poaching in Costa Rica (Chaves et al., 1996). However, Santidrian-Tomillo et al., (2008) concluded that the Costa Rican population still suffers from the effects of historic poaching rates, which is compounded by current and unsustainable 22 percent adult mortality rates.

In summary, long-term monitoring and conservation programs at the index nesting beaches in Mexico and Costa Rica have essentially eliminated threats from human consumption of eggs and nesting females, and ongoing efforts at important beaches in Nicaragua are increasing in effectiveness (Urteaga et al., 2012). Nonetheless, the abundance of this subpopulation remains perilously low, and continues to decrease slowly toward extinction (MTSG 2012). Reducing leatherback sea turtle bycatch has become a primary focus for many conservation projects around the world, and some mitigation efforts are showing promise (Watson et al., 2005, Gilman et al., 2009, Wang et al., 2010). However, fisheries bycatch is still considered the major obstacle to population recovery (Wallace and Saba 2009, Wallace et al., 2013, NMFS and USFWS 2013a).

The conservation and recovery of leatherback sea 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 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 FWS 2013a).

5.3 Olive ridley sea turtles

Information in this section is summarized primarily from the 2004 Opinion (NMFS 2004a), the 2005 Opinion (NMFS 2005a), the 2006 Opinion (NMFS 2006), the 2008 Opinion (NMFS 2008a), the olive ridley sea turtle 5-year status review (NMFS and FWS 2014), the 2012 Opinion (NMFS 2012a), and other sources cited below.

5.3.1 Distribution and Abundance

Olive ridley sea turtles 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, including the western Pacific. 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 FWS 2014). The eastern Pacific population includes nesting aggregations on the coast of Mexico, which are listed under the ESA as endangered. All other olive ridley sea turtle populations are listed as threatened. In 2014, NMFS and FWS completed a status review of the olive ridley sea turtle sea turtle. Based on the best available information, the Services concluded the olive ridley sea turtle sea turtle breeding colony populations on the Pacific coast of Mexico may warrant reclassification (NMFS and FWS 2014). No change to the threatened populations is recommended. However, for the current population listings for the olive ridley sea turtle (both endangered and threatened), information indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy.

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 ridley sea turtles is described in the 5-year status review (NMFS and FWS 2014). Olive ridley sea turtles are the most common turtle species that interact with the Hawaii deep-set longline fishery. In the deep-set fishery, 106 interactions have occurred between 1995 and 2014, of which 82 were from the eastern Pacific (77 percent) and 24 were from the western Pacific (23 percent) (Table 2), which is comprised of turtles that are genetically similar to turtles with haplotypes identified in Sri Lanka, Malaysia and India (Dutton pers. comm.). In the shallow-set fishery, fourteen genetic samples have been collected and analyzed since 1995; eight were from the eastern Pacific population and six were from the western Pacific population (NMFS 2014a). The two sampled so far from the five caught in the American Samoa fishery are from the eastern Pacific nesting stocks (Dutton pers comm.).

Eastern Pacific olive ridley sea turtles 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, but have not returned to their pre-1960s abundance estimates. On the Mexican coast, three populations appear stable, two are increasing (Ixtapilla and La Excobilla), and one decreasing, with over one million nests laid annually (NMFS and FWS 2014). In Costa Rica, the Ostional nesting assemblage is one of the largest in the world, second only to La Escobilla, Mexico (Valverde et al., 2012). As with other arribadas, a large variability in the magnitude of mass nesting events in Costa Rica can occur, with arribadas at Ostional ranging between 3,564 and 476,550 egg-laying females during the period 2006–2010 (Valverde et al., 2012). Valverde et al., (2012) estimated the nesting population size by dividing the estimated arribada abundance totals by estimated olive ridley sea turtle sea turtle nesting frequency of 2.21 (Van Buskirk and Crowder 1994 in Valverde et al., 2012). The NMFS and FWS (2014) estimate that females may lay two clutches on average per arribada nesting season, with approximately 100-110 eggs laid per clutch. However, Ballestero et al., (2000) utilized a fixed quadrant method (vs. line transects) to estimate that the nesting population was approximately 588,500 fluctuating between 232,318 and 1,147,969 turtles per arribada between 1988 and 1997. If these estimates are correct, then Valverde et al., (2012) concludes that the Ostional assemblage has decreased in abundance over the past two decades likely as a result of low hatching rates. In contrast to solitary nesting beaches, survivorship is low on high density arribada nesting beaches because of density-dependent mortality (NMFS and FWS 2014). This density-dependent effect negatively impacts nesting populations because in addition to nest disturbance and egg mortality, high nesting density alters the nutrient composition of sand, gas exchange, and ammonica concentration in the sand which results in high concentrations of fungal and bacterial pathogens resulting in lower hatch success thus affecting population growth (NMFS and FWS 2014).

Western Pacific Non-Arribada Beaches

In Indonesia, olive ridley sea turtles nest on beaches in the West Papua Province, in the Manokwari region the number of nests recorded from 2008 through 2011 ranged from 53 to 236, however survey effort was limited and likely not consistent across years (Suganuma et al., 2012). On Jamursba-Medi beach, 77 olive ridley sea turtle nests were documented from May to October 1999, on Hamadi beach, Jayapura Bay in June 1999, an estimated several hundred olive ridley sea turtles were observed nesting (NMFS and FWS 2014). Extensive hunting and egg collection, in addition to rapid rural and urban development, have reduced nesting activities in Indonesia. In eastern Java, olive ridley sea turtle nesting was documented from 1992-1996 that ranged from 101 to 169 nests. In Malaysia, olive ridley sea turtles nest on the eastern and western coasts; however, nesting has declined rapidly in the past decade. The highest density of nesting was once reported in Terrenganu, Malaysia, which once yielded 2,400 nests, but the populations were virtually extirpated by 1999 due to long-term over-harvest of eggs (NMFS and FWS 2014). In Australia, olive ridley sea turtle nesting is scattered throughout northern Australia, with a few thousand females nesting annually (Limpus 2009a). The breeding population in northern Australia may be the largest population remaining in the western Pacific region, although a full evaluation of their distribution and abundance is needed (Limpus 2009a, NMFS and FWS 2014). 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 2009a).

Several methods have been used over time to estimate the number of turtles nesting during an arribada (NMFS and FWS 2014). The olive ridley sea turtle abundance estimates presented in Table 2 and adapted from NMFS and FWS (2014) and other sources were likely derived from multiple methods at the different arribada beaches and in some cases the method used at a specific arribada beach has changed over the years (e.g, La Escobilla). This renders comparisons among arribada beaches problematic and discerning population trends over time complicated. A further complication is that many nesting population estimates from arribada beaches have been calculated as the sum total of all the turtles nesting during arribadas within a given nesting season. However, an individual olive ridley sea turtle may nest on the same beach multiple times during a nesting season and thus the sum total of all the turtles or tracks counted during surveys is not directly equivalent to the number of turtles present in any given nesting population. It is unclear if adjustments have been made to account for multiple nesting events or arribadas, and the number of nesting females in locations is presented as a range in arribada size (e.g., 3,564 to 476,550 at Ostional), therefore the information in Table 2 are provided for a general sense of arribada size and not intended to be exact estimates of the nesting population.

The once large nesting populations of olive ridley sea turtles that occurred in peninsular Malaysia and Thailand have been decimated through long term over-harvest of eggs (Limpus 2009a). 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 2009a).

Table 2. Annual olive ridley sea turtle population estimates at major arribada nesting sites (NMFS and FWS 2014).

Location	Average number per arribada (population status)	Reference
La Escobilla, Mexico	1,021,500 – 1,206,000 nests 1,013,034 females (increasing)	NMFS and FWS 2007d; NMFS and FWS 2014
Ixtapilla, Mexico	2,900 – 10,000 nests (increasing)	NMFS and FWS 2014
Moro Ayuta	10,000 – 100,000 nests (stable)	NMFS and FWS 2014
Ostional, Costa Rica	3,564 to 476,550 females (increasing but declining recently)	Valverde et al., 2012; NMFS and FWS 2014
Playa Nancite, Costa Rica	2,000-12,000 females; 256- 41,149 females (declining)	NMFS and FWS 2007d; NMFS and FWS 2014
Playa Chacocente, Nicaragua	42,500 nests 27,947 females (unknown)	NMFS and FWS 2007d; NMFS and FWS 2014
Playa La Flor, Nicaragua	521,440 females (stable)	NMFS and FWS 2014
Isla Canas, Panama	8,768 females (declining)	NMFS and FWS 2014
Gahirmatha, India (Orissa)	1,000 - 100,000 females and 10,000 - 250,000 (stable or declining)	NMFS and FWS 2007d; IOSEA, 2013; NMFS and FWS 2014
Rushikulya, India	23,561 – 172,402 females (stable)	NMFS and FWS 2014

5.3.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Life history of Pacific olive ridley sea turtle is characterized by juvenile and adult stages occurring in the oceanic zone. Along with leatherback sea turtles, olive ridley sea turtles are the most pelagic of all sea turtle species (NMFS 2004a, 2005a, 2006a, 2008a; NMFS and FWS 2014). Olive ridley sea turtles appear to have the shortest age to maturity at approximately 13 years of age (Zug et al., 2006).

Olive ridley sea turtles occupy marine ecosystems that occur over vast areas and are considered nomadic in the eastern Pacific (Plotkin 2010). They often associate with the highly productive area called the Costa Rica Dome located between 8 to 10°N and 88 to 90°W, which is characterized by a shallow (within 10 m of the surface) thermocline and areas of upwelled waters rich in prey items (Swimmer et al., 2009). Olive ridley sea turtles appear to forage throughout the eastern tropical Pacific Ocean, often in large groups, or flotillas, and are occasionally found associated with floating debris (Arenas and Hall 1992, NMFS and FWS 2014). The direct impact of El Niños on olive ridley sea turtles is unknown, but olive ridley sea turtles appear to change migration pathways in response to shifts in food availability during El Niño (Plotkin 2010).

Polovina et al., (2003, 2004) tracked 10 olive ridley sea turtles caught in the Hawaii deep-set longline fishery. The olive ridley sea turtles identified as originating from the eastern Pacific populations stayed south of major currents in the central North Pacific-southern edge of the Kuroshio Extension Current, North Equatorial Current, and Equatorial Counter Current; whereas, olive ridley sea turtles identified from the western Pacific associated with these major currents, suggesting that olive ridley sea turtles from different populations may occupy different oceanic habitats (Polovina et al., 2003, 2004). Long-term satellite tracking data of 30 eastern Pacific post-nesting olive ridley sea turtles revealed that turtles were widely distributed in the pelagic zone from Mexico to Peru and lacked migratory corridors (Plotkin 2010). These turtles migrated long distances, swam continuously, displayed no fidelity to specific feeding habitats, and were nomadic. Eguchi et al., (2007) estimated the density and abundance of the olive ridley sea turtles from shipboard line-transects which resulted in an estimate of 1,150,000 – 1,620,000 turtles in the eastern tropical Pacific in 1998-2006. During 2010, vessel surveys from the coast to 185 km offshore of the Mexican Central Pacific (MCP: Jalisco, Colima, and Michoacan waters) covered 3,506 km and recorded 749 sightings (Martín del Campo et al., 2014). The weighted average of the three periods (winter, spring and autumn 2010) of olive ridley sea turtles was 177,617 (CI: 150,762-204,471, CV: 17.2 percent, 95 percent), with the highest abundance recorded in winter in the oceanic region of Jalisco (N: 181,150, CI: 117,150-280,110, CV:21.4 percent). Martín del Campo et al., (2014) conclude that olive ridley sea turtles are abundant in coastal and oceanic waters of the Mexican Central Pacific and their numbers are probably still increasing as a result of the protection programs that began in the 1990s.

Olive ridley sea turtles forage on a variety of marine organisms, including tunicates, gastropods, crustaceans, and fishes that tend to migrate with the deep scattering layer. As a result, olive ridley sea turtles typically forage in deep water, often diving within the range that deep-set gear is fished.

Longline and other vessels can potentially strike olive ridley sea turtles. However, because their density is low in the action area, we consider this risk slight.

5.3.3 Threats to the Species

Global threats to olive ridley sea turtles are spelled out in the 5-year status review (NMFS and FWS 2014). Major threats include development on and near nesting beaches, 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.

Impacts to nesting habitat and habitat loss resulting from development, construction, beach armoring, human encroachment, lighting pollution, etc. on the breeding populations in Mexico are lacking, although human-induced habitat impacts are expected to increase as Mexico’s population expands and tourism increases (NMFS and FWS 2014). 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 ridley sea turtles 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 sea turtle 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 Ostional, Costa Rica. Illegal harvest of eggs is common in much of the species' range, such as throughout Central America, Western Pacific, and India (NMFS and FWS 2014).

Ostional beach in northwest Costa Rica is an arribada rookery that supports a large mass-nesting assemblage along with a legal community-based egg-harvest program (Campbell 1998, Campbell et al., 2007). The rationale that supports the Ostional egg harvest is based on analysis of data that showed that a significant number of clutches are destroyed during arribadas by nesting turtles, that the hatching rate at this beach is very low, and that legalizing the harvest may help to limit the previously uncontrolled illegal take of eggs (Alvarado-Ulloa 1990 and Cornelius et al., 1991 in Valverde et al., 2012). The egg harvest functions much as it was suggested by the scientific community: the associates are allowed to harvest eggs for the first 2.5 days of each arribada (the first 2 days for commercialization and the last half a day for local consumption), while keeping the beach clean and reducing the impact of feral predators (Ordonez et al., .1994 in Valverde et al., 2012). Between 2006 and 2010, Valverde et al., (2012) estimated the mean egg harvest was 4,746 eggs, ranging between 1,527 to 8,138 total clutches. In relation to the estimated number of clutches laid, the estimated mean of clutches harvested was 21.2 percent (ranging from 1.5 percent to 102.4 percent- the percentage harvest of 102.4 percent resulted from the mathematical conversion of eggs to nests and the error in the estimated number of clutches laid. As per Valverde et al., (2012), this value suggests nearly complete egg harvest. It is not clear whether the Ostional arribadas underwent a significant change in abundance during the study period, and the number of years covered is too short to establish a long-term trend, however the population appears to have declined when compared with historical data given that the population appears to be suffering from low hatch success (18 percent), high clutch destruction rates, and low recruitment (Valverde et al., 2012).

A major threat to olive ridley sea turtles is likely 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 ridley sea turtles that tens of thousands of dead adults wash up on the coast annually (NMFS and FWS 2014). 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 ridley sea turtles annually (NMFS and FWS 2014). Trawlers in Costa Rica are reported to catch over 15,000 sea turtles annually, and 90 percent of those are olive ridley sea turtles (Arauz et al., 1998). As s a result of litigation brought about by six environmental NGOs, trawl fishing was banned in Costa Rica in September 2013 (Arias 2013). 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, Dapp et al., 2013). From 1999 to 2010, an observer program collected data to assess the impact of the Costa Rican longline fishery and documented an estimated 699,600 olive ridley sea turtles caught, including 92,300 adult females and 23,000 green sea turtles (Dapp et al., 2013). Artisanal gillnet and longline fisheries of Peru and Chile are known to interact with olive ridley sea turtles (Alfaro-Shigueto et al., 2011, Donoso and Dutton, 2010). Small scale fisheries operating in Peru using bottom set nets, driftnets, and longline fisheries were observed between 2000 and 2007. Almost 6,000 sea turtles were estimated to be captured annually, of which 240 were olive ridley sea turtles (Alfaro-Shigueto et al., 2011). Threats to olive ridley sea turtles 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 2009a).

The Hawaii-deep set fishery interacts with olive ridley sea turtles and has an incidental take statement for up to 99 anticipated olive ridley sea turtle interactions and 96 anticipated mortalities over a three-year period (NMFS 2014a). Between 2005 and June 30, 2015 there were 327 olive ridley sea turtle interactions in the deep-set fishery and from this the estimated mortality is 311 (NMFS 2015d). The Hawaii shallow-set fishery rarely interacts with olive ridley sea turtles and since 2004, only four have been incidentally caught. All four were released alive (NMFS 2015e). The California Oregon drift gillnet fishery has an incidental take statement for up to 2 anticipated olive ridley sea turtle interactions and one anticipated estimated mortality every five years (NMFS 2013a). Since 2001 no olive ridley sea turtles have been captured in the California Oregon drift gillnet fishery and only one has been observed since 1990 (NMFS 2013a). There have been five observed (four alive, one dead) olive ridley sea turtles in the American Samoa fishery since 2006. Based on the number observed the total captured is estimated to be 14 and the mortality is four (NMFS 2015c).

As with the other species discussed above, no significant climate change-related impacts to olive ridley sea 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. However, olive ridley sea turtles in the east Pacific Ocean are highly migratory, and seemingly adaptable to fluctuating environmental conditions. They possess the ability to shift from an unproductive habitat to one where the waters are biologically productive, which may minimize the impacts of climate change (Plotkin 2010, NMFS and FWS 2014). As with leatherback sea turtles nesting in the eastern Pacific, olive ridley sea turtle's may also be affected by the occurrence of El Nino events. It is possible that the variation in numbers of turtles in the Ostional arribadas are also affected by changes in productivity in their foraging areas, because olive ridley sea turtle females also need time to amass sufficient nutrients to support their metabolic, migratory, and reproductive activities (Valverde et al., 2012).

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

5.3.4 Conservation of the Species

Since large-scale direct harvest of adult olive ridley sea turtles 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), and trawl fishing which was estimated to catch over 15,000 turtles per year (90 percent of which were olive ridley sea turtles), was banned in Costa Rica in September 2013 (Arias 2013). 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 (Shanker et al., 2003). However, enforcement is reported to be lacking in both areas (Frazier et al., 2007, Shanker et al., 2003).

In India, the Odisha Government has enacted a seven-month ban (November 1 to May 31) restricting fishing near the Gahirmatha marine sanctuary in Kendrapara district along the 20 km stretch of the Dhamra-Rushikulya river mouth to protect nesting olive ridley sea turtles. An estimated 26,000 traditional marine fishermen in coastal Kendrapara and Jagatsinghpur districts are likely to be affected by the measure. Trawl operators are prohibited in the protected zone, and orders are being enforced with nearly 100 trawls and vessels seized and their crew arrested during the ban in 2011 (The Hindu Business Line News 2011).

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 were found to reduce 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 were also successful. 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 in fisheries where these measures were introduced.

The conservation and recovery of olive ridley sea turtles 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 ridley 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 FWS 2014).

5.4 Hawksbill sea turtle Sea Turtles

Information in this section is summarized primarily from the 2004 Opinion (NMFS 2004a), the 2006 Opinion (NMFS 2006a), the 2010 Opinion (NMFS 2010a), the hawksbill sea turtle 5-year status review (NMFS and FWS 2013), and other sources cited below.

5.4.1 Distribution and Abundance

Hawksbill sea turtles occur in at least the Insular and Western Caribbean, Southwestern and Eastern Atlantic, the Southwestern, Northwestern, and Central/ Eastern Indian Ocean, and the Western, Central, and Eastern Pacific. As described in the recent 5-year review (NMFS and FWS 2013b), available trend data for the past 20 years suggest that, while some Caribbean/Atlantic sub-populations may be increasing, nearly all Indian and Pacific sub-populations are decreasing. The American Samoa longline fishery is not known to have interacted with any hawksbill sea turtles, but observer coverage was less than 20 percent on average until 2010, and there is one unconfirmed report of a hawksbill sea turtle interaction in this fishery (NMFS 2010a). Hawksbill sea turtle interactions occasionally occur in other longline fisheries in the Atlantic (Yeung 1999) and Pacific (Robins et al., 2002a), and hawksbill sea turtles are known to nest in American Samoa, primarily in the Manu’a islands of Ofu and Olosenga, and have been sighted in nearshore American Samoa waters. Thus, it is possible that the American Samoa longline fishery may interact with hawksbill sea turtles migrating to or from their nesting beach or resident foraging sites while vessels are transiting through nearshore waters.

They are highly migratory, use different habitats at different stages of their life cycle, and are most commonly associated with healthy coral reefs. Little is known about the hawksbill’s oceanic stage, but it is thought that neonates live in the oceanic zone where water depths are greater than 200 m and influenced by surface gyres (NMFS and FWS 2013b). During the oceanic phase, hawksbill turtles are thought to ingest a combination of plant and animal material associated with surface zones, and juvenile hawksbill turtles have been found associated with *Sargassum* in both the Atlantic and Pacific Oceans (Witherington et al., 2012; NMFS and USFWS 2013b). At about 35 cm carapace length, or 7 to 10 years of age, juveniles recruit to nearshore foraging areas where they begin feeding on benthic sponges, other invertebrates, and algae (NMFS and FWS 2013b). Hawksbill turtles feed on sponges throughout their range but their primary diet differs depending on the region occupied; such as in Hawaii where hawksbill turtles tend to be more omnivorous (NMFS and FWS 2013b). Hawksbill turtles contribute to marine and coastal food webs by transporting nutrients within the oceans, support healthy reefs by controlling sponges and macroalgae, which would otherwise outcompete reef-building corals for space, and occupy a range of habitats that include coral reefs or other hard bottom habitats, seagrass, algal beds, mangrove bays and creeks (NMFS and FWS 2013b). Every few years, adult hawksbill sea turtles make breeding migrations that may span thousands of km between their foraging and nesting areas. In Hawaii, estimated age to maturity occurs between 17 and 22 years (Snover et al., 2013).

As with green sea turtles, hawksbill sea turtles nest broadly in Oceania, with by far the largest nesting concentration occurring on remote islands in the GBR and Australia’s Torres Strait area. But unlike green sea turtles, hawksbill sea turtles are solitary nesters, hampering data collection on nesting female numbers, thus all nesting numbers cited below are rough estimates (NMFS and FWS 2013b) based primarily (with the exception of Australia and Fiji) on personal communications or other sources for which the data precision is not fully verifiable or an imprecise estimate. Hawksbill sea turtle nesting information for nine primary locations within Oceania (excluding Hawaii) includes: GBR, PNG, Solomon Islands, Vanuatu, Fiji, Micronesia (Federated States of Micronesia, Republic of Palau, the Samoan Islands (Western Samoa and American Samoa), and the Mariana Islands (Guam and CNMI). Hawksbill sea turtle nesting may occur elsewhere within this region, but any such nesting is thought to be in very low numbers. Thus, the total number of annual nesting females in Oceania is estimated based on information from the nine locations mentioned above at 5,400 – 6,160 females annually for the last few years, with an overall downward trend (NMFS & FWS 2013b). Nesting information from each of the nine locations is described in more detail below.

Great Barrier Reef (GBR). Approximately 4,000 female hawksbill sea turtles may nest annually on offshore islands in the northern GBR and Torres Strait area (NMFS & FWS 2013b). The Milman Island index population in this area, surveyed since 1990, is declining at a rate of 3 percent annually (NMFS & FWS 2007b). Limpus and Miller (2008) estimate that large numbers of hawksbill sea turtles sourced from Australian rookeries are being harvested in neighboring countries including Indonesia, PNG, Solomon Islands and Fiji to supply meat and/or tortoiseshell for use locally or for export.

Papua New Guinea (PNG). Approximately 500-1,000 female hawksbill sea turtles may nest in PNG annually (NMFS & FWS 2013b), and previous anecdotal assessments indicated decreasing trends (Pritchard 1979; Spring 1982). PNG continues to be a trade hub for hawksbill sea turtles. Based on a survey of eight provinces, Kinch (2007) estimates that approximately 250 hawksbill sea turtles are sold annually in Port Moresby; however, this take may represent only a small fraction of the overall subsistence and semi-commercial take of Hawksbill sea turtles in PNG.

Solomon Islands. Approximately 200-300 hawksbill sea turtles may nest annually in the Solomon Islands, including 100-200 in the Arnavon Islands (NMFS & FWS 2013b). Approximately 400 nesting hawksbill sea turtles were tagged in the Anarvon Islands from when monitoring first began in the 1970's through 1998 (Broderick unpublished, 1998). Broderick then estimated that approximately 1000 hawksbill sea turtles may nest within the Anarvons; however continued exploitation at an unsustainable level has reduced the number of nesting turtles. Meylan and Donnelly (1999) estimated at least a 50 percent decline since 1980, due largely to local consumption and the tortoiseshell trade and the decline is thought to be ongoing (NMFS & FWS 2007b).

Vanuatu. Approximately 300 hawksbill sea turtles may nest annually in Vanuatu (NMFS & FWS 2013b). Nesting occurs at several locations throughout the country, some of which experience heavy hawksbill sea turtle harvest. However, other nesting areas have little or declining harvest, because of successful public awareness programs. While hawksbill sea turtle nesting trends are declining nearly everywhere in the Pacific, in Vanuatu they may be stable or even increasing, but adequate information is not available to determine the actual trend (NMFS & FWS 2013b).

Fiji. Approximately 100-200 hawksbill sea turtles may nest annually in Fiji (NMFS & FWS 2013b). Little data exist for the major nesting areas, with the exception of Namena Lai Lai, where a 50 percent decline in nesting over 20 years was reported in 2007. Commercial harvest of hawksbill sea turtles in Fiji resulted in over 30,000 shells exported during the 1980s (Rupeni et al., 2002). It is likely that overall numbers of nesting female hawksbill sea turtles in Fiji are declining (NMFS & FWS 2007b).

Republic of Palau. Palau's nesting population is comprised of approximately 15-25 females that may next annually at Helen Reef, Hatohobei State (NMFS and FWS 2013b). Eberdong and Klain (2008) documented 150 hawksbill sea turtle nests laid between 2004 and 2006 at Helen Reef, of which 30 percent were poached. The status of the population is unclear but thought to be declining (NMFS and FWS 2013b).

Tonga. In the 1970s, surveys revealed that hawksbill sea turtles nested on over thirty islands throughout the Vava`u and Ha`apai Island groups in Tonga, although this aggregation was perceived as declining precipitously (Wilkinson 1979). Another limited survey in December 2007-January 2008 only recorded nesting activity on two islands but suggests nesting levels may be similar to those in the 1970s (Havea and MacKay 2009). Abundance of annual nesting females is unknown for Tonga but the aggregation is likely small, possibly fewer than 50 individuals per year.

Micronesia (FSM). The Federated States of Micronesia (FSM) likely support approximately 300 nesting hawksbill sea turtles annually (NMFS & FWS 2013b). In FSM, Hawksbill sea turtles are heavily exploited, thus the overall trend for Micronesia is thought to be declining (NMFS & FWS 2013b).

Samoan (Samoa and American Samoa) and Mariana (Guam and CNMI) Islands. In the Samoan Islands, fewer than 30 hawksbill sea turtles are estimated to nest annually, and anecdotal information suggests the population has declined (NMFS and FWS 2013b). There is some uncertainty regarding the number of hawksbill sea turtles nesting in American Samoa as a result of new information from the Manu'a Islands (Ofu, Olosega, and Ta'u islands). Nesting activity in Manu'a has been inferred from occasional tracks found on beaches, but has only recently been confirmed via a beach monitoring project. In January 2008, nine sets of hawksbill sea turtle tracks were recorded on two beaches of Ofu Island and one beach on Olosega Island, and approximately 30 pits were documented at the airport beach area of Ofu Island (DMWR/Wildlife Division, unpublished data). A project was implemented in 2010 to monitor and quantify this nesting activity. This project documented six hawksbill sea turtle nests occurred on two Ofu beaches between October 1, 2011 and March 31, 2012 (Tagarino 2012). During the winter (November to March) of 2014-15, 42 nests were documented laid by five hawksbill sea turtles and 3 green sea turtles on the four index beaches of Ofu (DMWR unpublished). Hawksbill sea turtles occur in the waters off Tutuila and the Manua Group of American Samoa, documented primarily via strandings on Tutuila (DMWR unpublished data). Even though their density is low, hawksbill sea turtles account for about 80 percent of the turtle sightings around Tutuila (Tagarino pers.comm.). NMFS is supporting capacity building in American Samoa for nesting beach monitoring, satellite telemetry and educational outreach. Public education efforts are focused to reduce directed (harvest) and incidental take in commercial longline fisheries are ongoing in American Samoa. The Aleipata islands of Nu'utele and Nu'ulua are the most important hawksbill sea turtle nesting sites in Western Samoa (Bell and Mulipola 1995). Nesting beach monitoring at the Aleipata islands has been relatively inconsistent, although available information suggests that nesting activity has declined since the first monitoring activities in 1971 (Ward and Asotai 2008).

In the Mariana Islands (Guam and CNMI), fewer than 10 hawksbill sea turtles are estimated to nest annually, with nesting trends declining (NMFS & FWS 2013b). In Guam, hawksbill sea turtles have been reported nesting in the past although in very low numbers (Grimm and Farley 2008), and Guam DAWR has recovered a very low proportion of hawksbill sea turtles via their stranding program. In CNMI, DLNR staff have been monitoring beaches since 2004 and no hawksbill sea turtle nests or nesting females have been tagged on Saipan, Tinian, or Rota. The CNMI DLNR program monitors turtles via a marine capture-mark-recapture program. Of 801 total in-water captures to date [June 2015], 52 of those were hawksbill sea turtles and of those, eight were recaptures, representing approximately 6.5 percent of our total captures (CNMI DLNR unpublished).

<u>Summary</u>: Based on the above information, the total number of nesting female hawksbill sea turtles in Oceania is estimated at 5,400-6,160 females annually for the last few years, with an overall downward trend likely, in part, due to continued exploitation (NMFS & FWS 2007b). This status and trend information is summarized below in Table 3. Despite the fact there are more nesting sites in the western and central Pacific compared to the Atlantic or Indian Oceans, the situation for Pacific Ocean hawksbill sea turtles is particularly dire given that a greater proportion of nesting sites are declining and data is highly uncertain sourced from primarily unpublished and imprecise information (NMFS and FWS 2013b).

Table 3. Summary of best currently available nesting information for hawksbill sea turtles in Oceania (NMFS and FWS 2013b).

Location	Annual nesting females	
	Range	Trend
Great Barrier Reef	4,000	Decreasing
Papua New Guinea	~500-1,000	Decreasing*
Solomon Islands	200-300	Decreasing*
Vanuatu	>300	Unknown
Fiji	100-200	Decreasing*
Palau	15-25	Decreasing*
Micronesia	~300	Decreasing*
Samoan Islands	>10-30	Decreasing*
Mariana Islands	5-10	Decreasing*
Total	5,430-6,165	Decreasing

* = Trend information is based on strong documented anecdotal evidence from local residents, not on long term nesting beach monitoring data sets.

5.4.2 Life History Characteristics Affecting Vulnerability to Proposed Action

As with green sea turtles, hawksbill sea turtle life history is characterized by early development in the pelagic zone followed by later development in nearshore habitats. Adults forage on coral reefs, primarily on sponges. Upon maturation adults do not typically undertake trans-oceanic migrations to breeding sites, but hawksbill sea turtles are known to undertake long migrations in the Caribbean between foraging and nesting areas (NMFS & FWS 2007b). In the Western/South Pacific Region, more than a decade of tag recovery data indicate regular hawksbill sea turtle migration between nesting and foraging sites in Queensland and the Solomon Islands (Limpus 2009). One hawksbill sea turtle satellite tagged in 2006 migrated through seven EEZs in the central South Pacific (NMFS 2006, unpublished satellite telemetry data).

The main aspect of hawksbill sea turtle life history affecting their vulnerability to the American Samoa longline fishing might be juvenile pelagic foraging turtles or migrating adult turtles. Little is known of the life history stage of post-hatchling and pelagic juvenile hawksbill sea turtles. It is thought that neonates live in oceanic habitats influenced by surface gyres and associated with floating materials, such *Sargassum* in both the Atlantic and Pacific Oceans (NMFS and FWS 2013b). There is no bycatch in Pacific U.S. longline fisheries to provide information on the relative vulnerability of juvenile hawksbill sea turtles to the various types of longline fishing. Because juvenile hawksbill sea turtles recruit to coastal habitat at <40 cm carapace length, perhaps they are too small to ingest bait and hooks used in the American Samoa longline fishery during their pelagic phase (NMFS & FWS 2007b).

As with green sea turtles, while adult hawksbill sea turtle habitat is primarily nearshore areas far within the longline exclusion areas of the action area, post-nesting adults are known to migrate great distances that take them into pelagic habitat where the American Samoa longline fishery operates. Some hawksbill sea turtle nesting occurs in American Samoa, on the islands of Tutuila and Manu’a Island (Ofu, Olosenga, and Ta’u). To date, four post-nesting hawksbill sea turtles have been fitted with satellite tags: two on Tutuila and two on Ofu. One turtle migrated west several hundred km to Samoa, and three migrated north over > 1,000 km to and past the Cook Islands (Tagarino et al., 2008; DMWR 2015 unpublished). In addition, post-nesting hawksbill sea turtles from the GBR migrated greater than 2,000 km (Miller et al., 1998). This contrasts with post-nesting hawksbill sea turtles in the Hawaiian Archipelago, which migrated less than 100 km (Parker et al., 2009), perhaps because Hawaii is more isolated than in the western and south Pacific where there are multiple atolls and islands within a few hundred km of each other.

As with green sea turtles, adult hawksbill sea turtles that nest in American Samoa likely feed elsewhere in the Central South Pacific, while the juveniles and resident foraging adults found around American Samoa most likely originated at distant nesting beaches. Hawksbill sea turtles occur in the action area and may be affected by the proposed action. However, there are low densities of these turtles in the action area. NMFS has no reported or observed interactions with this species since regular observer coverage started in 2006.

Longline and other vessels can potentially strike hawksbill sea turtles. However, because their density is low in the action area, we consider this risk slight.

5.4.3 Threats to the Species

The 5-year review provides information on global threats to hawksbill sea turtles (NMFS and FWS 2013b). The major threats to the species, according to this document, are alteration of nesting and foraging habitat, and direct harvest, which are briefly described below. While hawksbill sea turtle interactions occur in coastal fisheries, their bycatch rates are much lower than for the other sea turtle species, especially in industrial pelagic fisheries. The impacts associated with climate change also appear to be having an effect on this species, as it is for green sea turtles.

Destruction and alteration of hawksbill sea turtle nesting and foraging habitats are occurring throughout the species' global range, especially coastal development, beach armoring, beachfront lighting, and vehicular/ pedestrian traffic. While under natural conditions beaches can move landward or seaward with fluctuations in sea level, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Because hawksbill sea turtles prefer to nest under vegetation (Horrocks and Scott 1991; Mortimer 1982), they are particularly impacted by beachfront development and clearing of dune vegetation (Mortimer and Donnelly 2008). The loss of native vegetation cover on nesting beaches will increase the number of nests exposed to elevated temperatures due to climate and may impact natural sex ratios (Kamel 2013).

Adult hawksbill sea turtles are primarily spongivores that forage on coral reefs, hence human impacts on their foraging habitat can be devastating. Contamination from runoff degrades coral reefs, and introduced algae species may outcompete and overgrow coral reefs, eventually killing them and the sponges they harbor. In addition, increasing boat traffic increases the likelihood of boat strikes (NMFS & FWS 2007b, 2013b).

Hawksbill sea turtles are harvested for their shells ('tortoiseshell') and eggs. Because of the beauty of their shells, hawksbill sea turtle adults have been harvested more heavily than other sea turtle species. The largest source of mortality identified for south Pacific hawksbill sea turtle is continued harvest for food and tortoiseshell in the broader Coral Sea region (Limpus and Miller 2008). Between 1950 and 1992, approximately 1.3 million hawksbill sea turtle shells were collected to supply tortoiseshell to the Japanese market, the world's largest. Japan stopped importing tortoiseshell in 1993 in order to comply with CITES. However, tortoiseshell trade continues in the Americas and Southeast Asia for both tortoiseshell and the curio trade. As with other sea turtle species, egg harvest has occurred on a large scale in the past, but is somewhat reduced globally. However, egg harvest continues unabated in Asia. In some countries, very few eggs hatch outside protected hatcheries (Mortimer and Donnelly 2008), particularly in Indonesia, Thailand, Malaysia, and Sri Lanka. Predation by non-native predators (pigs, ungulates, rats, feral dogs and cats) is also a threat to nests and nesting females (NMFS and FWS 2013b).

Although anthropogenic climate change is probably affecting hawksbill sea turtles, there are no observations of significant climate change-related impacts to hawksbill sea turtle populations 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 future, climate change-related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storms events as a result of climate change are all potential threats to hawksbill sea turtles for the same reasons described above for green sea turtles. Additionally, because hawksbill sea turtles typically inhabit coral reef communities, they are vulnerable to changes that affect these communities including bleaching events, increased occurrence of disease, and weakening of coral skeletons as a result of global climate change (McWilliams et al., 2005; Langdon et al., 2000; Ohde and Hossain 2004). Warmer water temperatures cause corals to expel algae (zooxanthellae) living in their tissue. The coral turns white (called "bleaching") and may survive the event, but is more susceptible to mortality. Climate change has led to massive coral bleaching events with permanent consequences for local habitats (Donner et al., 2005; NOAA 2013). Depending on the geographic area, hawksbill sea turtles also associate with macroalgae, seagrass pastures, and mangroves. Climate change is anticipated to impact these marine habitats by, for example, altering growth rates, increasing mortality from heat stress and frequency and severity of storms, severely reducing or redistributing existing habitats due to changes to water depth and tides (Harley et al., 2006; Short and Neckles 1999). As with green sea turtles, 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.

Fisheries bycatch in artisanal and industrial fishing gear is also a major impact to hawksbill sea turtles. Although other species such as leatherback sea turtles and loggerhead sea turtles have received most of the attention relative to sea turtle bycatch, hawksbill sea turtles are also susceptible, particularly in nearshore artisanal fisheries gear. These fisheries practices include drift-netting, longlining, set-netting, and trawl fisheries, and their adverse impacts on sea turtles have been documented in marine environments throughout the world (Epperly 2003; Lutcavage et al., 1997; National Research Council 1990; Wallace et al., 2010b). In Malaysia, gill nets, hook and line fishing, purse seiners and trawl fishing boats had the greatest impacts to sea turtles with mortality of some 4,490 marine turtles, a proportion of which are likely hawksbill sea turtles (Pilcher et al., 2008). Hawksbill sea turtles are particularly susceptible to entanglement in gill nets and to capture on fishing hooks of artisanal fishermen (Mortimer 1998). Several fisheries in the Eastern Pacific use explosives, which have killed adult Hhawksbill sea turtles (Gaos et al., 2010).

There is evidence that oil pollution has an impact on hawksbill sea turtles (Meylan and Redlow 2006; Yender and Mearns 2003). In 2010, a major oil spill occurred in the north central U.S. Gulf of Mexico, affecting multiple habitats used by hawksbill sea turtles of various life stages. Assessment of the harm is ongoing as part of the Natural Resources Damage Assessment. In some parts of the world, especially in the Middle East, oil pollution poses a major problem for hawksbill sea turtles (Mortimer and Donnelly 2008). In addition, sea turtle interaction with oils spills may lead to immunosuppression and other chronic health issues (Sindermann et al., 1982). Ingestion of and entanglement in marine debris is also a concern as it can reduce food intake and digestive capacity (Bugoni et al., 2001, Meylan and Redlow 2006).

5.4.4 Conservation of the Species

Numerous conservation programs are being implemented around the world to protect nesting habitat and reduce harvesting and fisheries bycatch of all sea turtle species, and numerous regulatory mechanisms are in place at international, regional, national and local levels to protect sea turtles (Section 5.1.4 above). As per NMFS and FWS (2013b), numerous community-based programs to conserve and protect Hawksbill sea turtlesexist (e.g., South Pacific Regional

Environment Programme, East Pacific Hawksbill sea turtle Initiative, Inter-American Convention for the Protection and Conservation of Sea Turtles). Many of these programs undoubtedly help Hawksbill sea turtle sea turtles, but the species continues to rapidly decline in the Pacific and Indian Ocean areas due, in part, to unsustainable harvest for food and tortoiseshell, predation, habitat loss and climate change (Limpus and Miller 2008; Kinch 2007; Pita and Broderick 2005; NMFS and FWS 2013b). Some sub-populations in the Insular Caribbean appear to be increasing (NMFS & FWS 2007b, 2013b).

5.5 South Pacific Loggerhead Sea Turtle DPS

Information in this section is summarized primarily from the 2009 loggerhead sea turtle status review (NMFS and FWS 2009), the final listing of nine DPS of loggerhead sea turtles (76 FR 58868, September 22, 2011), and other sources cited below.

5.5.1 Distribution and Abundance

Loggerhead sea turtles are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Loggerhead sea turtles are the most abundant species of sea turtle found in U.S. coastal waters. On September 22, 2011, NMFS and the FWS determined that the loggerhead sea turtle is composed of nine DPSs that were listed as threatened or endangered under the ESA (76 FR 58868). NMFS listed the South Pacific Ocean loggerhead sea turtle DPS as endangered. NMFS previously listed loggerhead sea turtles globally as threatened. The 2011 South Pacific loggerhead sea turtle DPS listing describes the population throughout its range, which includes the action area (76 FR 58868, September 22, 2011). However, there are low densities of these turtles in the action area. Since regular observer coverage started in 2006, there have been no reported or observed incidental interactions with this species. Due to South Pacific loggerhead sea turtle migrations between nesting and foraging areas, it is possible that this species ranges into the action area. Based on existing data from molecular studies, migration behavior, and tag recoveries, South Pacific loggerhead sea turtles have been confirmed in coastal waters of Australia, Papua New Guinea, New Caledonia, Solomon Islands, and Peru, but their ecological range falls within the EEZs of 23 Pacific nations (Wallace et al., 2010b; Hamann et al., 2013). For example, in 2013, a south Pacific loggerhead sea turtle (“Ariti”) was released in French Polynesia and transmitted for over a year, traveling through 12 different EEZs as well as high seas international waters. Ariti eventually traveled through the country of Tokelau passing through Nukunonu and Fakaofo atolls, and then entered American Samoa waters and passed 130 km East of Swain's Atoll, American Samoa when the transmitter stopped within 130 km north of Rose Atoll (PIFSC unpublished data).

All loggerhead sea turtles inhabiting the South Pacific Ocean are derived from beaches in Eastern Australia and a lesser known number of beaches in southern New Caledonia, Vanuatu, and Tokelau (Limpus and Limpus 2003; Limpus 2009). Nesting colonies of the South Pacific population of loggerhead sea turtles are genetically distinct from loggerhead sea turtles in the North Pacific and Indian Ocean. In Australia, there are both major and minor loggerhead sea turtles nesting rookeries (Limpus 2009), but long term counts of nesting females are available for 7 index nesting sites that are all located in Queensland (Woongarra Coast, Heron Island, Wreck Island, Tyron Island, Lady Musgrave Island, Northwest Island and Wreck Rock beaches) and have been monitored from the 1970s to 2011 (Limpus et al., 2013). Additionally, there are two primary index foraging areas that have been monitored (via annual tag-capture-recapture sampling) of loggerhead sea turtle populations in eastern Australia in the Southern GBR at Heron & Wistari Reef from 1984-1999 (Limpus and Limpus, 2003) and Moreton Bay (Limpus, 2009).

The size of the annual breeding population (females only) has been monitored at numerous rookeries in Australia since 1968 (Limpus and Limpus 2003), and these data constitute the primary measure of the current status of the DPS. The total nesting population for Queensland was approximately 3,500 females in the 1976–1977 nesting season (Limpus 1985; Limpus and Reimer 1994). Little more than two decades later, Limpus and Limpus (2003) estimated this nesting population at less than 500 females in the 1999–2000 nesting season. There has been a marked decline in the number of females breeding annually since the mid-1970s, with an estimated 50 to 80 percent decline in the number of breeding females at various Australian rookeries up to 1990 (Limpus and Reimer 1994) and a decline of approximately 86 percent by 1999 (Limpus and Limpus 2003).

Comparable nesting surveys have not been conducted in New Caledonia however information from pilot surveys conducted in 2005, combined with oral history information collected, suggest that there has been a decline in loggerhead nesting (Limpus et al., 2006). Based on data from the pilot study, only 60 to 70 loggerhead sea turtles nested on the four surveyed New Caledonia beaches during the 2004–2005 nesting season (Limpus et al., 2006).

Studies of Eastern Australia loggerhead sea turtles at their foraging areas provide some information on the status of non-breeding loggerhead sea turtles of the South Pacific Ocean DPS. Chaloupka and Limpus (2001) determined that the resident loggerhead sea turtle population on coral reefs of the southern GBR declined at three percent per year from 1985 to the late 1990s. The observed decline was hypothesized as a result of recruitment failure, given few anthropogenic impacts and constant high annual survivorship measured at this foraging habitat (Chaloupka and Limpus 2001). Concurrently, a decline in new recruits was measured in these foraging areas (Limpus and Limpus 2003). This decline in annual nesting numbers for eastern Australian loggerhead sea turtles was primarily attributed to the mortality of turtles drowning in prawn trawls of eastern and northern Australia (Limpus and Reimer, 1994).

The Queensland Parks and Wildlife Service responded to bycatch in the trawl fishery by regulating the use of Turtle Excluder Devices (TEDs) in the Northern Prawn Fishery (NPF) in April 2000, East Coast Trawl Fishery in December 2000 and the Torres Strait Prawn Fishery in March 2002 (Limpus et al., 2013). Since 2001, loggerhead sea turtle nesting trends at each of the six index beaches shows a reversal of the downward trend indicating that the use of TEDs have been effective in reducing bycatch mortality and that the eastern Australian nesting population is in a recovery mode with approximately 500 nesting females per year (Limpus et al., 2013; Hamann et al., 2013). The most current 2015 IUCN Red List Assessment provides mean values for the past five years at: Woongarra Coast (392 females/yr), Wreck Island (381 females/yr), and Tyron Island (222 females/yr) (IUCN 2015).

5.5.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Loggerhead sea turtles from these rookeries undertake an oceanic developmental migration, traveling to habitats in the Central and Southeastern Pacific Ocean where they may reside for several years prior to returning to the Western Pacific for reproduction. Loggerhead sea turtles in this early life history stage differ markedly from those originating from western Australia beaches in that they undertake long west-to-east migrations, likely using specific areas of the pelagic environment of the South Pacific Ocean.

Loggerhead sea turtles originating from nesting beaches in the western South Pacific are the only population of loggerhead sea turtles found south of the equator in the Pacific Ocean. As post-hatchlings, they are generally swept south by the East Australian Current (Limpus et al., 1994), spend a large portion of time foraging in the oceanic South Pacific Ocean, and some migrate to the Southeastern Pacific Ocean off the coasts of Peru and Chile as juvenile turtles (Alfaro-Shigueto et al., 2004; Donoso et al., 2000; Boyle et al., 2009). As large juveniles and adults, these loggerheads' foraging range encompasses the Eastern Arafura Sea, Gulf of Carpentaria, Torres Strait, Gulf of Papua, Coral Sea, and Western Tasman Sea to southern New South Wales including the Great Barrier Reef, Hervey Bay, and Moreton Bay. The outer extent of this range includes the coastal waters off Eastern Indonesia Northeastern PNG, Northeastern Solomon Islands, and New Caledonia (Limpus 2009).

The South Pacific DPS of loggerhead sea turtles occupies an ecological setting distinct from other loggerhead sea turtles, including the North Pacific DPS; however, researchers know less about the ecosystem on which South Pacific oceanic juvenile and adult loggerhead sea turtles depend. Sea surface temperature and chlorophyll frontal zones in the South Pacific have been shown to dramatically affect the movements of green sea turtles, (Seminoff et al., 2008) and leatherback sea turtles, (Shillinger et al., 2008), and it is likely that loggerhead sea turtle distributions are also affected by these mesoscale oceanographic features. Loggerhead sea turtles in the South Pacific are substantially impacted by periodic environmental perturbations such as El Niño. In an effort to characterize the pelagic habitat movements of South Pacific loggerhead sea turtles (modeled after similar work characterizing habitat use of North Pacific loggerhead sea turtles), 46 juvenile New Caledonia-reared loggerhead sea turtles were released in pelagic seas in September 2012 (Kobayashi et al., 2014). While this work was unsuccessful in characterizing how, or the route, that juvenile loggerhead sea turtles may migrate it did provide indication regarding how juvenile turtles may use multiple sensory cues and pelagic currents to orient their travels.

Longline and other vessels can potentially strike South Pacific loggerhead sea turtles. However, because their density is low in the action area, we consider this risk slight.

5.5.3 Threats to the Species

Loggerhead sea turtles face threats on both nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead sea turtle populations worldwide is incidental capture in fishing gear. In addition to fishery bycatch, coastal armoring and erosion resulting from the removal of native dune vegetation on nesting beaches continues as a substantial threat. Coastal armoring, if left unaddressed, will become an even more substantial threat as sea level rises.

Incidental capture in artisanal and commercial fisheries is a significant threat to the survival of loggerhead sea turtles throughout the South Pacific. The primary gear types involved in these interactions include longlines, driftnets, set nets, and trawl fisheries. Artisanal and industrial fleets use these gear types, and target a wide variety of species including tunas, sharks, sardines, swordfish, and mahi mahi.

In the Southwestern Pacific, bottom trawling gear has been a contributing factor to the decline in the Eastern Australian loggerhead sea turtle population (Limpus and Reimer 1994). Prior to the use of TEDs in this fishery, the Northern Prawn Fishery annually took between 5,000 and 6,000 sea turtles as bycatch, with a mortality rate of an estimated 40 percent due to drowning, injuries, or being returned to the water comatose (Poiner and Harris 1996). Since the mandatory use of TEDs has been in effect, the annual bycatch of sea turtles in the NPF has dropped to less than 200 sea turtles per year, with a mortality rate of approximately 22 percent (based on recent years). This lower mortality rate also may be based on better sea turtle handling techniques adopted by the fleet. In general, loggerhead sea turtles were the third most common sea turtle taken in this fishery.

Robins et al., (2002a) estimate that Australian pelagic longline fishery operations kill approximately 400 turtles annually. Of this annual estimate, leatherback sea turtles accounted for over 60 percent of this total, while unidentified hardshell turtles accounted for the remaining species. Therefore, the effect of this longline fishery on loggerhead sea turtles is unknown. Loggerhead sea turtles also have been the most common turtle species captured in shark control programs in Australia (Kidston et al., 1992; Limpus 2009). From 1998–2002, 232 loggerhead sea turtles were captured, with 195 taken on drum lines and 37 taken in nets, both with a low level of direct mortality (Limpus 2009).

In the Southeastern Pacific, significant bycatch has been reported in artisanal gillnet and longline shark and mahi fisheries operating out of Peru (Kelez et al., 2003; Alfaro-Shigueto et al., 2006) and, to a lesser extent, Chile (Donoso and Dutton 2006). The fishing industry in Peru is the second largest economic activity in the country, and, over the past few years, the longline fishery has rapidly increased. Currently, nearly 600 longline vessels fish in the winter and over 1,300 vessels fish in the summer. During an observer program in 2003-2004, 588 sets were observed during 60 trips, and 154 sea turtles were taken as bycatch. Loggerhead sea turtles were the species most often caught (73.4 percent). Of the loggerhead sea turtles taken, 68 percent were entangled and 32 percent were hooked. Of the two fisheries, sea turtle bycatch was highest during the mahi-mahi season, with 0.597 turtles/1,000 hooks, while the shark fishery caught 0.356 turtles/1,000 hooks (Alfaro-Shigueto et al., 2008). A separate study by Kelez et al., (2003) reported that approximately 30 percent of all turtles bycaught in Peru were loggerhead sea turtles. In many cases, loggerhead sea turtles are kept onboard for human consumption; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale. Loggerhead bycatch is present in Chilean fleets; however, the catch rate is substantially lower than that reported for Peru (Dutton, NMFS and M. Donoso, ONG Pacifico Laud—Chile, unpublished data).

Directed harvest for loggerheads still occurs in many places (for example, the Bahamas, Cuba, and Mexico) and is a serious and continuing threat to loggerhead recovery. Legislation in Australia outlaws the harvesting of loggerheads by indigenous peoples (Limpus et al., 2006). Despite national laws, in many areas the poaching of eggs and hunting of adult and juvenile turtles is still a problem, and Limpus (2009) suggests that the harvest rate of loggerheads by indigenous hunters, both within Australia and in neighboring countries, is on the order of 40 turtles per year. Preliminary studies suggest that local harvesting in New Caledonia constitutes about five percent of the nesting population (Limpus et al., 2006). Loggerheads also are consumed after being captured incidentally in high-seas fisheries of the Southeastern Pacific (Alfaro-Shigueto et al., 2006), and occasionally may be the product of illegal trade throughout the region.

Nest and hatchling predation likely was a factor that contributed to the historic decline of this DPS. Although current fox predation levels in Eastern Australia are greatly reduced from historic levels, predation by other species still occurs, and predation by feral dogs in New Caledonia has not been addressed. In addition, a high prevalence of the fibropapillomatosis disease exists in Moreton Bay, Australia. Therefore, predation and disease are likely to be a significant threat to the persistence of this DPS.

Destruction and modification of loggerhead sea turtle nesting habitat in the South Pacific result from coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular traffic, beach erosion, beach pollution, removal of native vegetation, and planting of non-native vegetation (NMFS and FWS 1998c; Limpus 2009). Removal or destruction of native dune vegetation, which enhances beach stability and acts as an integral buffer zone between land and sea, results in erosion of nesting habitat. Preliminary studies on nesting beaches in New Caledonia include local oral histories that attribute the decrease in loggerhead sea turtle nesting to the removal of vegetation for construction purposes and subsequent beach erosion (Limpus et al., 2006). Beach armoring presents a barrier to nesting in the South Pacific.

Climate change and sea level rise have the potential to impact loggerhead sea turtles in the South Pacific Ocean, yet the impact of these threats has not been quantified. Natural environmental events, such as cyclones or hurricanes, may affect loggerheads in the South Pacific Ocean. These types of events may disrupt loggerhead nesting activity, albeit on temporary scale. Chaloupka et al., (2008b) demonstrated that nesting abundance of loggerhead sea turtles in Australia was inversely related to sea surface temperatures, and suggested that a long-term warming trend in the South Pacific may be adversely impacting the recovery potential of this population.

5.5.4 Conservation of the Species

Considerable effort has been made since the 1980s to document and reduce loggerhead sea turtle bycatch in Pacific Ocean fisheries, as this is the highest conservation priority for the species. 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. In Pacific Ocean fisheries these include developing gear solutions to prevent or reduce capture (e.g., circle hooks), 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 FWS 2009).

The conservation and recovery of loggerhead sea 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 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 when shallow-setting for swordfish in the convention area. 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. In addition there are requirements to: avoid encircling sea turtles when purse seining, practice careful release methods, carry dip nets, and report sea turtle interactions.

5.6 Indo-West Pacific Scalloped Hammerhead Shark DPS

Information in this section is summarized from the 2014 Status Review Report (Miller et al., 2014), the 2014 Final Rule (NMFS 2014b), the 2014 Opinion (NMFS 2014a) and other sources cited below.

5.6.1 Distribution and Abundance

The scalloped hammerhead shark occurs in coastal warm temperate and tropical seas worldwide. The Indo-West Pacific DPS can be found throughout the entire Indian Ocean and in the western Pacific from Japan and China to New Caledonia, including throughout the Philippines, Indonesia, and off Australia. The scalloped hammerhead shark occurs over continental and insular shelves, as well as adjacent deep waters, but is seldom found in waters cooler than 22° C (Compagno 1984). It ranges from the intertidal and surface to depths of up to 450–512 m (Klimley 1993), with occasional dives to even deeper waters (Jorgensen et al., 2009). It has also been documented entering enclosed bays and estuaries (Compagno 1984). These sharks have been observed making migrations along continental margins as well as between oceanic islands in tropical waters (Kohler and Turner 2001, Duncan and Holland 2006, Bessudo et al., 2011, Diemer et al., 2011). Tagging studies reveal the tendency for scalloped hammerhead sharks to aggregate around and travel to and from core areas or “hot spots” within locations (Holland et al., 1993, Duncan and Holland 2006, Hearn et al., 2010, Bessudo et al., 2011); however they are also capable of traveling long distances (1941 km, Bessudo et al., 2011; 1671 km, Kohler and Turner 2001, Hearn et al., 2010; 629 km, Diemer et al., 2011). These long distance migrations have occurred over continental shelves and seamounts, and have not been seen over deep pelagic waters (NMFS 2014b).

The scalloped hammerhead shark is a high trophic level predator and opportunistic feeder with a diet that includes a wide variety of teleosts, cephalopods, crustaceans, and rays (Compagno 1984, Bush 2003, Júnior et al., 2009, Noriega et al., 2011). In a study on feeding behavior in Kāne'ohe Bay, Bush (2003) found a nocturnal increase in the rate of foraging by juvenile scalloped hammerheads, with sharks consuming a mixture of crustaceans and teleosts. Stomachs of 466 scalloped hammerheads off the coast of Australia revealed the importance of bony fish as a prey item, followed by elasmobranchs, octopus and squid, and baitfish, with a positive correlation between shark length and the proportion of elasmobranchs in stomach contents (Noriega et al., 2011). The scalloped hammerhead shark is viviparous (i.e., give birth to live young), with a gestation period of 9-12 months (Branstetter 1987, Stevens and Lyle 1989), which may be followed by a one-year resting period (Liu and Chen 1999). Females attain maturity around 200-250 cm total length (TL) while males reach maturity at smaller sizes (range 128 – 200 cm (TL); Table 1); however, the age at maturity differs by region. Based on analysis of the available data, the scalloped hammerhead shark can be characterized as a long lived (at least 20 – 30 years), late maturing, and relatively slow growing species (based on Branstetter (1990), where $k < 0.1$/year indicates slow growth for sharks).

Current effective population sizes are available for the scalloped hammerhead shark, but are considered qualitative indicators rather than precise estimates given their reliance on mutation rates and generation times (Duncan et al., 2006). Using two generation times (5.7 and 16.7 years), Duncan et al., (2006) calculated the effective female population (N_f) size of *S. lewini* for the major ocean basins. Based on a 1:1 sex-ratio (Clarke 1971, Chen et al., 1988, Stevens and Lyle 1989, Ulrich et al., 2007, White et al., 2008, Noriega et al., 2011), these calculations have been converted into total (both females and males) effective population size (N_e) by using the formula $N_e = 2(N_f)$. Results of N_e greatly varied within and between ocean basins, with the global N_e estimated at 280,000 using a generation time of 5.7 years, and 94,000 using a generation time of 16.7 years (NMFS 2014b).

Table 4. Estimates of current effective population size (Ne) of scalloped hammerhead sharks. (NMFS 2014b, Adapted from estimates in Duncan et al., 2006)

Ocean Basin	**Population**	**Sample Size (n)**	**Ne (5.7 year generation time)**	**Ne (16.7 year generation time)**
Pacific	Baja	44	22,000,000	7,600,000
	Pac. Panama	8	62,000,000	2,000,000
	Hawaii	44	3,200	1,100
	Philippines	15	64,000	22,000
	Taiwan	20	15,600,000	5,200,000
	E. Australia	32	70,000	24,000
Indian	W. Australia	26	6,800	22,000
	Seychelles	12	16,200	54,004
	S. Africa	25	18,000	60,010
Atlantic	W. Africa	6	300,000	100,000
	East Coast USA	16	36,000,000	12,000,000
All	Total	271	280,000	94,000

In order to estimate the effective population size in the Indo-West Pacific DPS from the total of 280,000 the percentage was calculated from the areas highlighted in gray of the total listed in the table. These areas which are considered part of the Indo-West pacific DPS represent about 12 percent of the effective population size in the table. Therefore for purposes of this analysis the effective population size with a 5.7 generation time is 33,600 (280,000*12 percent) and for the 16.7 year generation time the estimate is 11,280 (94,000*12 percent).

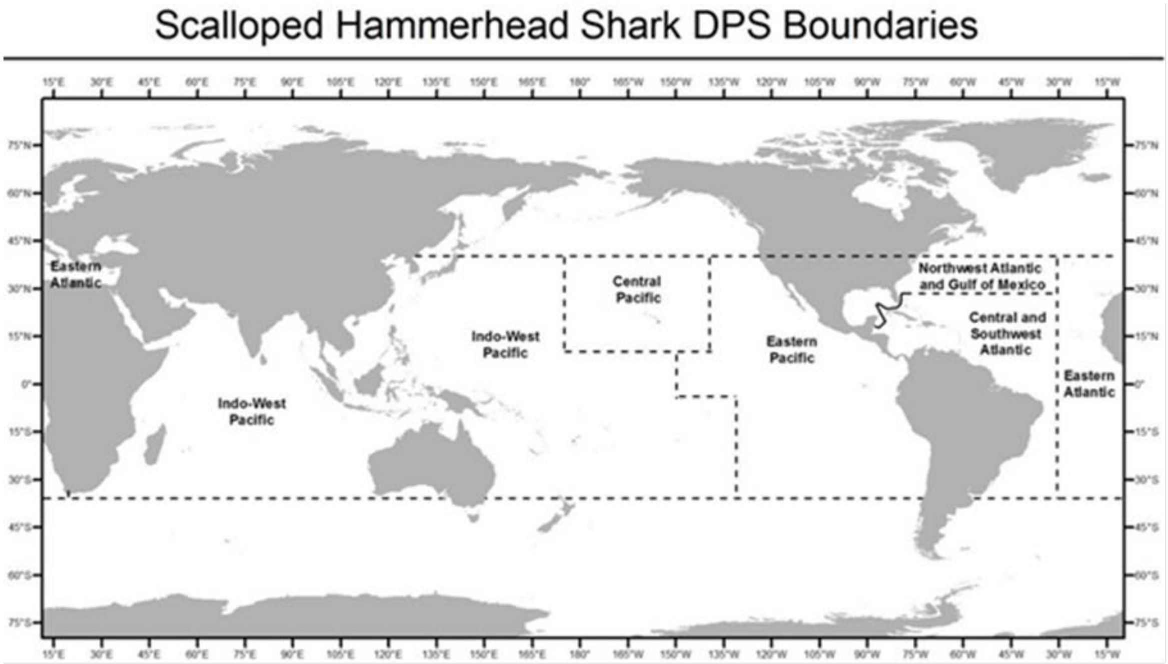


Figure 7. Map of Scalloped Hammerhead DPS boundaries (79 FR 38214; July 3, 2014).

5.6.2 Life History Characteristics Affecting Vulnerability to Proposed Action

Scalloped hammerheads occur over continental and insular shelves, as well as adjacent deep waters. Increased rates of foraging have been documented at night in studies on juveniles. They also have a varied diet, which consists of crustaceans, teleosts, elasmobranchs, octopus, squid, and baitfish (Miller at al 2014). Deep-set longline fishing occurs in their known range and the majority occurs at night when the hammerheads are foraging in pelagic waters. This overlap with longline fishing and their broad diet make it possible for hammerheads to become hooked or entangled in gear while foraging.

5.6.3 Threats to the Species

Overutilization by industrial/commercial fisheries, artisanal fisheries, and illegal fishing of the scalloped hammerhead shark are the most serious threats to the persistence of this DPS. Scalloped hammerhead sharks are both targeted and taken as bycatch in many global fisheries. They are targeted by semi-industrial, artisanal and recreational fisheries and caught as bycatch in pelagic longline fisheries, and purse seine fisheries. There is a lack of information on the fisheries prior to the early 1970s, with only occasional mentions in historical records. Significant catches of scalloped hammerheads have and continue to go unrecorded in many countries outside the U.S. In addition, scalloped hammerheads are likely under-reported in catch records as many records do not account for discards (example: where the fins are kept but the carcass is discarded) or reflect dressed weights instead of live weights. Also, many catch records do not differentiate between the hammerhead species, or shark species in general, and thus species-specific population trends for scalloped hammerheads are not readily available.

Total catches of the hammerhead family have increased since the early 1990s (prior years were not reported), from 377 tonnes in 1991 to a current peak of 5,786 mt in 2010. This is in contrast to the catches of scalloped hammerhead sharks, which have decreased, for the most part, since reaching a maximum of 798 tonnes in 2002. According to shark fin traders, hammerheads are one of the sources for the best quality fin needles for consumption, and fetch a high commercial value in the Asian shark fin trade (Abercrombie et al., 2005). In Hong Kong, the world's largest fin trade market, scalloped hammerhead, and smooth hammerhead sharks are found under the "Chun chi" market category, the second most traded fin category in the market (Clarke et al., 2006a). Applying a Bayesian statistical method to the Hong Kong shark fin trade data, Clarke et al., (2006b) estimated that between 1 and 3 million hammerhead sharks, with an equivalent biomass of 60 – 70 thousand mt, are traded per year.

In the Pacific, there is a historical lack of shark reporting on logsheets for most fleets. In addition, if shark catch is reported, it is usually aggregated shark data. For example, in the Taiwanese large-scale and small-scale tuna longline fisheries, bycatch data were not reported until 1981 due to the low economic value of the bycatch in relation to the tunas (Liu et al., 2009). All shark data collected before 2003 was recorded in the logbooks under the category "sharks". After 2003, species-specific information was recorded for the blue shark, mako shark, and silky shark, but all other sharks remained lumped in the category "other sharks" (Liu et al., 2009). Due to these data gaps, WCPFC recently revised their scientific data reporting requirements. Beginning in 2011, WCPFC vessels are required to report species-specific catch information for the following shark species: blue, silky, oceanic white-tip, mako, thresher, porbeagle, and hammerheads (WCPFC 2011). Despite this requirement, recent catches of hammerheads have not been provided to the WCPFC for a number of longline fleets, including fleets from among the top twenty countries reporting Pacific shark catches to the FAO. The WCPFC also manages the active tuna purse seine fleet in this region, which has expanded significantly since the 1980s and experienced a sharp increase over the past 6 years. In the mid-1980s, the purse seine fishery accounted for only 40 percent of the total tuna catch, but in 2010, this percentage had increased to 75 percent (Williams and Terawasi 2011). The majority of the purse seine catch has historically been attributed to Japan, Korea, Chinese-Taipei and the USA fleets; however recently an increased number of Pacific Islands fleets as well as new fleets (from China, Ecuador, El Salvador, New Zealand, and Spain) have entered the WCPFC tropical fishery (Williams and Terawasi 2011). These new additions have brought the number of purse seine vessels up to 280, the highest it has been since 1972 (Williams and Terawasi 2011). However, WCPFC observer data, collected from 1994-2009, indicate that longline sets may pose more of a threat to non-target shark species than purse-seine sets in this convention area, but in terms of hammerhead sharks, observers reported only negligible catch but with high rates of finning in both types of sets (SPC 2010). In 2012, Bromhead et al., (2012) published a study that analyzed operational-level logsheet and observer data reported by fleets operating in the Republic of the Marshall Islands EEZ from 2005-2009. Although estimates of total annual longline catches of sharks ranged from 1,583 to 2,274 mt per year, only five scalloped hammerhead individuals were observed caught and subsequently discarded and finned during the study period (Bromhead et al., 2012).

Although range-wide abundance trends are missing in this DPS, CPUE data from South Africa and Australia suggest significant depletions of local populations. Declines of 58- 76 percent in the hammerhead population have been estimated for Australia's northwest marine region, and a recent decline of 63 percent in *S. lewini* abundance was estimated for 2005-2010 based on data from a Queensland shark control program. Similarly, in South Africa, catch rates of *S. lewini* in beach mesh programs revealed significant declines in CPUE from 1978-2003. However, these programs were also assessed to have at least a medium causative impact on these localized depletions. High levels of commercial fishing that target sharks and catch sharks as bycatch occurs in this DPS. For example, in the Republic of the Marshall Islands EEZ, the tuna fishery alone accounted for annual longline catches ranging from 1583 to 2274 tonnes of sharks (over the period of 2005-2009) (Bromhead et al., 2012). Furthermore, four of the top five exporters of shark fins to Hong Kong (Singapore, Taiwan, Indonesia, and the United Arab Emirates) are located in this DPS's range. The limited regulatory mechanisms to protect this DPS contribute to the risk of extinction due to overutilization by these various fisheries. For example, Indonesia, which at the beginning of the 21st century was the world's leading elasmobranch producer accounting for 13 percent of the world total, currently has very few fishery regulations and in effect has created an open access fishery (Tull 2009). The heavy and unregulated artisanal and industrial fishing by both Indonesian and foreign vessels has depleted many of the large fish stocks, including sharks, in Indonesian waters (Field et al., 2009, Tull 2009). As a result, many Indonesian fishermen have moved south to illegally fish in Australian waters (Field et al., 2009). The level of management controls in Indonesia is not expected to increase because of the impact it would have on the livelihood of the many artisanal fisherman that operate in this area (Tull 2009). Likewise, many of the island countries in the western Pacific do not currently have the resources to implement or enforce protective fishery management measures, as any available funds are needed for important national needs, like health and education programs (Bromhead et al., 2012). Inshore fishing pressure is also of concern, as the schooling behavior of this species makes it susceptible to being taken in mass quantities on nursery grounds. Heavy exploitation of immature sharks has been observed in this DPS off the coasts of Madagascar, Queensland, and Southeast Asia (McVean et al., 2006, Harry et al., 2011, CITES 2010). The extinction risk analysis (ERA) team concluded that the limited management measures, large takes of immature *S. lewini*, and heavy fishing (both legal and illegal) on shark populations contributes significantly to the risk of this DPS's extinction, and these threats are likely to continue into the foreseeable future.

The American Samoa longline fishery has had an observer program since 2006, with coverage ranging between 6 percent and 8 percent from 2006-2009, and between 20 percent and 33 percent since 2010. Only ten scalloped hammerhead sharks have been observed caught in the fishery since the observer program started (NMFS unpublished data). Based on the ten that were observed and several unidentified hammerheads we estimate that 77 scalloped hammerheads were caught between 2006 and June 30, 2015 (NMFS 2015a, NMFS unpublished data).
The Hawaii-based deep-set longline fishery catches scalloped Hammerhead sharks as bycatch at very low levels and the majority are from the central Pacific DPS, which is not listed as threatened or endangered. From 1995-2006, 56 scalloped hammerheads were caught on 26,507 observed sets in the HI longline fisheries (Walsh et al., 2009). Approximately 16 of those were caught by the deep-set fishery in the range of the Indo-West Pacific DPS, the rest were all in the range of the central pacific DPS. Since 2004, there have been three observed scalloped hammerhead sharks caught in the deep-set fishery in the Indo-West pacific DPS (PIRO Observer Program unpublished data).

The threat of climate change was considered a low threat to scalloped hammerheads and an integrated risk assessment done by Chin et al., 2010 provided evidence that they have low vulnerability to the threats from climate change (NMFS 2014b). The assessment took into account the in situ changes and effects that are predicted over the next 100 years in the Great Barrier Reef and assessed several species exposure, sensitivity, and adaptive capacity to a number of climate change factors including: water and air temperature, ocean acidification, freshwater input, ocean circulation, sea level rise, severe weather, light, and ultraviolet radiation (NMFS 2014b). The scalloped hammerhead had low vulnerability to each of the assessed climate change factors.

5.6.4 Conservation of the Species

The Hawaii longline fisheries are managed through the Pelagics FEP developed by the Western Pacific Fishery Management Council and approved by NMFS under the authority of the Magnuson-Stevens Act. Mandatory fishery observers have been monitoring both limited-entry fisheries (shallow and deep-set) since 1994, with observer coverage of at least 20 percent of trips since 2001 to provide a more comprehensive bycatch dataset. The Shark Finning Prohibition Act stopped shark finning in 2000 for the Hawaii-based longline fisheries, and a State of Hawaii ban on the possession of shark fins was imposed in 2010 (State of Hawaii SB2169).

At the international level, NMFS identified the increasing number of shark fin bans as one potential effort to conserve the DPS, especially in Asian countries where the demand for shark fin soup is the highest. In addition scalloped hammerheads were just voted on to be added to Appendix II of the CITES, which means increased protection, but still allows legal and sustainable trade (NMFS 2014d). A number of Pacific Island countries (including U.S. territories) have also created shark sanctuaries, prohibited shark fishing, or have strong management measures to control exploitation of sharks in their respective waters, including Tokelau, Palau, Marshall Islands, American Samoa, CNMI, Cook Islands, and French Polynesia (NMFS 2014d).

6 Environmental Baseline

The environmental baseline for an Opinion includes the past and present impacts of all State, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The Consultation Handbook further clarifies that the environmental baseline is “an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area.” (FWS & NMFS 1998). The purpose of describing the environmental baseline in this manner in an Opinion is to provide the context for the effects of the proposed action on the listed species.

The past and present impacts of human and natural factors leading to the status of the sea turtle and shark species addressed by this Opinion within the action area include fishing interactions (hooking and/or entanglement in gear), vessel strikes, climate change, pollution, and ingestion of or entanglement in marine debris. The environmental baselines for the green sea turtle, hawksbill sea turtle, leatherback sea turtle, South Pacific loggerhead sea turtle DPS, olive ridley sea turtle, the Indo-West Pacific scalloped hammerhead shark, and the five proposed green sea turtle DPSs within the action area are described below.

6.1 Green Sea Turtles

Green sea turtles are affected by longline fishing, nearshore fishing, and other human activities within the action area. The American Samoa longline fishery occurs partially on the high seas, and longline fishing by other countries also occurs in these high seas areas. Thus, longline fishing by all countries occurs within the action area and is part of the environmental baseline. Longline fishing is the greatest impact on green sea turtles on the high Seas within the action area. The information below applies to both green sea turtles as currently listed and to the five proposed DPSs since detailed information is not available to determine which DPS is affected in the action area, except for the information obtained from interactions with green sea turtles in the American Samoa longline fishery.

Between 2010 and 2014 countries operating in the Western Central Pacific Ocean reported 121 interactions with green sea turtles, which represented approximately 24 percent of the total turtles reported. The reports also noted interactions with another 186 unidentified turtles. If an additional 24 percent of the turtles are green sea turtles, then the minimum number of green sea turtle interactions is an estimated 165 individuals. Twenty one were reported as mortalities. These numbers come from 16 counties that listed turtles takes in their Annual Report Part I to the Western Central Pacific Fisheries Commission found on the 11th Regular Session of the Scientific Committee website out of 35 countries, not including U.S. interactions, which are addressed separately. These reports include interactions with longlines and purse seiners that occur in their EEZs and on the high seas; however, locations of the interactions are not included and some countries do not specify which fishery interacted with the turtles. These reported interactions represent minimum interactions and have not been expanded due to the lack of detail in many of the reports. The action area is only a small portion of the total area fished in the Pacific therefore the number of green sea turtles killed in the action area would be a proportion of the interactions reported above.

The American Samoa longline fishery is estimated to have interacted with an average of 24 green sea turtles (22 estimated mortalities) annually within the action area between 2006 and June 30, 2015 (NMFS 2015c). Based on the genetic analysis done by Dutton on the turtles sampled in the American Samoa fishery we expect that 50 percent were from the Central South Pacific DPS, 33 percent were from the Southwest Pacific DPS, 12 percent were from the East Pacific DPS, three percent were from the Central West Pacific DPS and two percent were from the East Indian-West Pacific DPS. The US purse seine fishery, which has an overlapping action area with that of the American Samoa longline fishery, is authorized to interact with 14 green sea turtles annually with no mortalities (NMFS 2006). Since 2010 the purse seine fleet has interacted with 12 green sea turtles (NMFS unpublished data).

Nearshore fisheries in American Samoa consist primarily of subsistence fishing, using hook-and-line (handlines or rod-and-reel), free diving, gillnetting, gleaning, and throw netting (Craig et al., 1993). Nearshore fisheries may sometimes result in entanglement and drowning of green sea turtles. Gillnets are the most problematic for turtles, because they are left untended, and entangled individuals usually drown. Hook-and-line fishing from shore or boats also hooks or entangles green sea turtles, although the chance of survival is higher than if caught in a gillnet. In a study of stranded green sea turtles in Hawaii (stranded turtles are injured, sick, or dead turtles found on shore), the most common known cause of stranding was the tumor-forming disease, fibropapillomatosis (28 percent) followed by hook-and-line fishing gear-induced trauma (7 percent) and gillnet fishing gear-induced trauma (5 percent) (Chaloupka et al., 2008b). However, most turtles drowned in fishing gear probably sink rather than stranding, making it very difficult to estimate the total number of green sea turtles killed annually by nearshore fishing interactions, even in Hawaii where the sea turtle stranding and salvage network is extensive and green sea turtles are much better monitored and studied than in American Samoa (NMFS 2008b).

In American Samoa, sea turtles are killed by collisions, both with boats when turtles surface, and with cars when adult females are searching for nesting sites. In Hawaii, the total number of green sea turtles killed annually during the period 1998-2007 by boat collisions was estimated at 25 – 50 turtles, based on stranding data (NMFS 2008b). Boats and green sea turtles are both less dense in American Samoa nearshore waters than in Hawaiian nearshore waters, thus the number of green sea turtles killed annually by boat collisions is likely fewer than 25 turtles. Because roads in American Samoa typically run adjacent to beaches, adult females searching for nesting sites sometimes crawl onto the roadway where they may be run over, such as a large hawksbill sea turtle female that was killed by a vehicle in late 2008 (Mata`afa 2008). However, most green turtle nesting in American Samoa is on the uninhabited Rose Atoll and sparsely inhabited (<6 people) Swains Island, thus vehicle collision is not a major source of mortality for green sea turtles in American Samoa. Pig predation on turtle eggs has been documented at Swains Island, but the level and intensity has yet to be quantified. DMWR (2015) also reports an additional 5 green turtle and 30 hawksbill sea turtle strandings on Tutila between October 1, 2014 and March 30, 2015 (although there is some discrepancy with reported data and it is possible that only 18 turtles (species unspecified) stranded). The majority of these strandings were recovered within Pago Pago harbor. This is interesting as there has been some anecdotal reports that turtles captured at sea might be tossed within the harbor by foreign vessels, hence making it appear that a disproportional amount of strandings are occurring within the harbor.

Other impacts contributing to the green turtle environmental baseline within the action area include climate change (see Section 6.5), marine debris, harvest, and contaminants. Marine debris may cause entanglement and possibly drowning, whereas ingested trash may cause intestinal blockage and death. The streams and coastlines of Tutuila are among the most littered within the U.S. Direct harvest of green sea turtles is likely still occurring in American Samoa (NMFS & FWS 2007a). Pago Pago Harbor is heavily contaminated because of industrial and sewage effluents, which may be impacting green sea turtles.

Green sea turtles are not known to nest in Western Samoa, although they do occur in the near shore reef habitats. Witzell (1982) surmised that green sea turtles found in waters of Upolu Island may be part of the group that nests on Rose Atoll during the summer. The harvest of turtles is both traditional and legal in Samoa with a minimum size restriction of 27 inches for both green and hawksbill sea turtles. Green and hawksbill sea turtle shells are sold in the Apia fish market. A 2006 survey in Samoa documented that turtles are often caught in 33 fishing villages of Upolu, and in 30 villages of Savaii (Momoemausu et al., 2006).

During the four year period from October 2004 to September 2008, the American Samoa Department of Marine and Wildlife Resources (DMWR) recorded 15 green sea turtles stranded on Tutuila measuring 46-85 cm CCL, six of which were dead. Of the four green sea turtles that were necropsied, two had plastic and aluminum in their guts (Tagarino et al., 2008). As a result of the September 29, 2009 tsunami, 51 turtles stranded. Of these, 41 were reportedly returned to sea by communities, several were dead, seven green sea turtles were released by DEC/SPREP, and one hawksbill sea turtle was likely consumed (Bell, Ward, and Ifopo 2009). Because DMWR's new turtle stranding program still has little data, and many turtles within the action area that are dead or dying from the above human impacts do not strand in American Samoa, it is not possible to estimate the number of green turtle mortalities resulting from climate change (see Section 6.7), marine debris, harvest, and contaminants in the past few years in the action area.

6.2 Leatherback Sea Turtles

Unlike green sea turtles and hawksbill sea turtles, leatherback sea turtles do not occur in the nearshore waters of the action area. Leatherback sea turtles are affected by longline fishing, climate change, and marine debris. Because the action area includes high seas, and other nations longline within these high seas area, the impact of all longlining combined within the action area is part of the environmental baseline.

Estimating the total number of leatherback sea turtle interactions by all nations combined in the Pacific, or within any part thereof, is difficult because of low observer coverage and inconsistent reporting. Between 2010 and 2014 countries operating in the Western Central Pacific Ocean reported 72 interactions with leatherback sea turtles with 10 mortalities, which represented approximately 14 percent of the total turtles reported. The reports also noted interactions with another 186 unidentified turtles. If an additional 14 percent of the unidentified turtles are leatherback sea turtles, then the minimum number of leatherback sea turtle interactions is an estimated 98 individuals. These numbers come from 16 counties that listed turtles takes in their Annual Report Part I to the Western Central Pacific Fisheries Commission found on the 11th Regular Session of the Scientific Committee website out of 35 countries, not including U.S. interactions, which are addressed separately. These reports include interactions with longlines and purse seiners that occur in their perspective EEZs and on the high seas; however, locations of the interactions are not included and some countries do not specify which fishery interacted with the turtles. These reported interactions represent minimum interactions and have not been expanded due to the lack of detail in many of the reports. The action area is only a small portion of the total area fished in the Pacific, therefore the number of leatherback sea turtles killed in the action area would be a proportion of the interactions reported above.

The American Samoa longline fishery is estimated to have interacted with an average of 9 leatherback sea turtles (6 estimated mortalities) annually within the action area between 2011 and June 30, 2015 (NMFS 2015c). The U.S. purse seine fishery, which has an overlapping action area with that of the American Samoa longline fishery, is authorized to interact with 11 leatherback sea turtles annually with no mortalities (NMFS 2006). Since 2010 the purse seine fleet has interacted with one leatherback sea turtle (NMFS unpublished data).

Other impacts contributing to the leatherback sea turtle environmental baseline within the action area include climate change and marine debris. Impacts from climate change may be affecting leatherback sea turtle habitat within the action area, as described in Sections 6.7. Leatherback sea turtles may be particularly susceptible to ingesting marine debris because plastic bags resemble jellyfish, their primary prey. Derelict fishing gear may cause entanglement and possibly drowning. None of the 45 stranded turtles reported from Tutuila during the four year period from October 2004 to September 2008 were leatherback sea turtles (29 hawksbill sea turtles, 15 green sea turtles, and two olive ridley sea turtles; Tagarino et al., 2008). Data are not available to estimate the number of leatherback sea turtle mortalities resulting from climate change (see Section 6.7) and marine debris in the past few years in the action area.

6.3 Olive Ridley Sea Turtles

Like the other sea turtle species addressed by this Opinion, past and present fisheries interactions have been, and continue to be, the greatest human impact on olive ridley sea turtles within the action area. Longline fishing is likely the most important past and present impact on olive ridley sea turtles. Between 2010 and 2014 countries operating in the Western Central Pacific Ocean reported 196 interactions with olive ridley sea turtles with 33 mortalities, which represented approximately 39 percent of the total turtles reported. The reports also noted interactions with another 186 unidentified turtles. If an additional 39 percent of the turtles are olive ridley sea turtles, then the minimum number of olive ridley sea turtle interactions is an estimated 268 individuals. These numbers come from 16 counties that listed turtles takes in their Annual Report Part I to the Western Central Pacific Fisheries Commission found on the 11th Regular Session of the Scientific Committee website out of 35 countries, not including U.S. interactions, which are addressed separately. These reports include interactions with longlines and purse seiners that occur in their EEZs and on the high seas, however locations of the interactions are not included and some countries do not specify which fishery interacted with the turtles. These reported interactions represent minimum interactions and have not been expanded due to the lack of detail in many of the reports. The action area is only a small portion of the total area fished in the Pacific therefore the number of olive ridley sea turtles killed in the action area would be a proportion of the interactions reported above.

The American Samoa longline fishery is estimated to have interacted with an average of 6 olive ridley sea turtles (2 estimated mortalities) annually within the action area between 2011 and June 30, 2015 (NMFS 2015c). The US purse seine fishery, which has an overlapping action area with that of the American Samoa longline fishery, is authorized to interact with 14 green sea turtles annually with no mortalities (NMFS 2006). Since 2010 the purse seine fleet has interacted with 16 olive ridley sea turtles (NMFS unpublished data).

Other impacts contributing to the olive ridley sea turtle environmental baseline within the action area include climate change and marine debris. Impacts resulting from climate change may be affecting olive ridley sea turtle habitat within the action area, as described in Section 6.7. Derelict fishing gear may cause entanglement and possibly drowning, and ingestion of plastic debris is likely to be causing some mortality. Of the 45 stranded turtles reported from Tutuila during the four year period from October 2004 to September 2008, two were olive ridley sea turtles, both dead. Necropsy results from one olive ridley sea turtle that stranded in Pago Pago harbor suggests that drowning was the possible cause of death. Data are not available to estimate the number of olive ridley sea turtle mortalities resulting from climate change (see Section 6.7) and marine debris in the past few years in the action area.

6.4 Hawksbill Sea Turtles

Like green sea turtles, juvenile hawksbill sea turtles recruit to nearshore areas, and are thus impacted by a host of human activities occurring in nearshore waters and on land. Hawksbill sea turtles within the action area are impacted by at least nearshore fishing, boat and car collisions, climate change, marine debris, harvest, predation, and contaminants. Unlike green sea turtles, leatherback sea turtles, and olive ridley sea turtles, Hawksbill sea turtlesare not commonly caught in longline fisheries, but longline fishing may have some impacts. Much less attention has been paid to effects of longline fishing on Hawksbill sea turtlesthan on loggerheads and leatherback sea turtle, thus no estimates are available for hawksbill sea turtle mortality due to longline fishing in the Pacific Ocean.

Between 2010 and 2014 countries operating in the Western Central Pacific Ocean reported 80 interactions with Hawksbill sea turtles with 12 mortalities, which represented approximately 8 percent of the total turtles reported. The reports also noted interactions with another 186 unidentified turtles. If an additional 8 percent of the turtles are hawksbill sea turtles, then the minimum number of hawksbill sea turtle interactions is an estimated 95 individuals. These numbers come from 16 counties that listed turtles takes in their Annual Report Part I to the Western Central Pacific Fisheries Commission found on the 11th Regular Session of the Scientific Committee website out of 35 countries, not including U.S. interactions, which are addressed separately. These reports include interactions with longlines and purse seiners that occur in their EEZs and on the high seas, however locations of the interactions are not included and some countries do not specify which fishery interacted with the turtles. These reported interactions represent minimum interactions and have not been expanded due to the lack of detail in many of the reports. The action area is only a small portion of the total area fished in the Pacific therefore the number of hawksbill sea turtles killed in the action area would be a proportion of the interactions reported above.

We have no record of hawksbill sea turtle bycatch in the Hawaii deep-set, Hawaii shallow-set, or American Samoa longline fisheries. A decomposed hawksbill sea turtle that was entangled in derelict fishing gear was retrieved by longline gear in Hawaii (i.e., the hawksbill sea turtle was killed by the derelict gear, not the longline gear). The U.S. purse seine fishery, which has an overlapping action area with that of the American Samoa longline fishery, is authorized to interact with 14 hawksbill sea turtles annually with no mortalities (NMFS 2006). Since 2010 the purse seine fleet has interacted with 10 hawksbill sea turtles (NMFS unpublished data).

As with green sea turtles, nearshore fisheries in American Samoa may sometimes result in entanglement and drowning of hawksbill sea turtles. Of the nine dead stranded hawksbill sea turtles that were necropsied in 2007-2008, four appear to have been killed by entanglement and/or hooking by fishing gear (Tagarino et al., 2008). Because hawksbill sea turtles forage in shallow areas, often remain just below the surface, and surface often to breathe, they are vulnerable vessel strikes.

Other impacts contributing to the hawksbill sea turtle environmental baseline within the action area include climate change, marine debris, harvest, and contaminants. Impacts associated with climate change may be affecting pelagic hawksbill sea turtle habitat within the action area, as described in Section 6.7. Marine debris may cause entanglement and possibly drowning, such as four of the nine dead stranded hawksbill sea turtles that appeared to have died due to fishing gear entanglement (Tagarino et al., 2008). Ingested trash may cause intestinal blockage and death. The streams and coastlines of Tutuila are among the most littered within U.S. jurisdiction. Direct harvest of hawksbill sea turtles is likely still occurring in American Samoa (NMFS & FWS 2007b). The harvest of turtles is both traditional and legal in Independent Samoa with minimum size restriction of 27 inches (0.7 m) for both green and hawksbill sea turtles. Green and hawksbill sea turtle shells are sold in the Apia fish market. Results from a 2006 survey in Samoa, indicate that turtles are often caught in 33 fishing villages on Upolu, and 30 villages on Savaii (Momoemausu et al., 2006). Pago Pago Harbor is heavily contaminated because of industrial and sewage effluents, which may be adversely affecting hawksbill sea turtles.

During the four-year period from October 2004 to September 2008, the American Samoa Department of Marine and Wildlife Resources (DMWR) recorded 29 hawksbill sea turtles stranded on Tutuila measuring 33-66 cm CCL, 19 of which were dead. As a result of the September 29, 2009 tsunami, 51 turtles stranded. Of these, 41 were reportedly returned to sea by communities, several were dead, seven green sea turtles were released by DEC/SPREP, and one hawksbill sea turtle was likely consumed (Bell, Ward, and Ifopo 2009). DMWR (2015) reported five green sea turtle and 30 hawksbill sea turtle strandings occurred on Tutila between October 1, 2014 and March 30, 2015 (although there is some discrepancy with reported data and it is possible that only 18 turtles (species unspecified) stranded). The majority of these strandings were recovered within Pago Pago harbor. There has been some anecdotal reports that some foreign vessels toss turtles captured at sea into the harbor making it appear that a disproportional amount of strandings are occurring within the harbor. Predation of nests and of nesting hawksbill sea turtles also occurs. Because DMWR’s new turtle stranding program has little data, and many turtles within the action area that are dead or dying from the above human impacts do not strand in American Samoa, it is not possible to estimate the number of hawksbill turtle mortalities resulting from climate change (see Section 6.7), marine debris, harvest, and contaminants in the action area.

6.5 South Pacific Loggerhead Sea Turtles

Fisheries interactions may be a threat to loggerhead sea turtles within the action area. Because the action area includes high seas, and other nations longline within these high seas area, the impact of all longlining combined within the action area is part of the environmental baseline. The American Samoa longline fishery has never had a documented interaction with a loggerhead sea turtle. Low observer coverage and inconsistent reporting makes it difficult to estimate the total number of loggerhead sea turtle interactions in the Pacific.

Between 2010 and 2014 countries operating in the Western Central Pacific Ocean reported 80 interactions with loggerhead sea turtles with 30 mortalities, which represented approximately 16 percent of the total turtles reported. The reports also noted interactions with another 186 unidentified turtles. If an additional 16 percent of the turtles are loggerhead sea turtles, then the minimum number of loggerhead sea turtle interactions is estimated to be 109 individuals. These numbers come from 16 counties that listed turtles takes in their Annual Report Part I to the Western Central Pacific Fisheries Commission found on the 11th Regular Session of the

Scientific Committee website out of 35 countries, not including U.S. interactions, which are addressed separately. These reports include interactions with longlines and purse seiners that occur in their EEZs and on the high seas, however locations of the interactions are not included and some countries do not specify which fishery interacted with the turtles. These reported interactions represent minimum interactions and have not been expanded due to the lack of detail in many of the reports. The action area is only a small portion of the total area fished in the Pacific therefore the number of loggerhead turtles killed in the action area would be a proportion of the interactions reported above.

The U.S. purse seine fishery, which has an overlapping action area with that of the American Samoa longline fishery, is authorized to interact with 11 loggerheads annually with no mortalities (NMFS 2006). Since 2010 the U.S. purse seine fleet has interacted with six loggerhead sea turtles (NMFS unpublished data).

Climate change and marine debris may be affecting pelagic loggerhead habitat within the action area. Lower breeding capacity of South Pacific loggerheads in years following higher sea surface temperatures may reflect reduced ocean productivity during warmer years within the action area (Chaloupka et al., 2008b). 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.

6.6 Indo-West Pacific Scalloped Hammerhead Shark DPS

Information in this section is summarized primarily from the 2014 Status Review Report (Miller et al., 2014), the 2014 Final Rule (NMFS 2014b) and other sources cited below. As described earlier the greatest threats to scalloped hammerhead sharks are overutilization from artisanal and commercial fisheries and illegal fishing. These threats are greater outside of the action area of the American Samoa longline fishery. Only a small portion of the Indo-West Pacific DPS range falls within the action area.

The American Samoa coral reef, bottomfish, precious coral, and crustacean fisheries did not have any recorded or observed catches of scalloped hammerhead sharks according to boat-based creel surveys conducted from 2002–2013. It is unlikely that the gear types used by these American Samoa fisheries would catch hammerhead sharks. Within the action area the American Samoa longline fishery catches very low numbers of scalloped Hammerhead sharks as bycatch. The American Samoa longline fishery has had an observer program since 2006, with coverage ranging between 6 percent and 8 percent from 2006-2009, and between 20 percent and 33 percent since 2010. Observers have documented 10 scalloped hammerhead sharks caught in the fishery since the observer program started (NMFS unpublished data). Based on the ten observed and several unidentified hammerhead sharks we estimate that the fishery captured 77 scalloped hammerhead sharks between 2006 and June 30, 2015, and 26 died (NMFS 2015a, NMFS unpublished data). As discussed earlier the historic level of reporting by most fisheries was minimal, and where it did exist it was not precise enough to determine species of hammerhead, or even shark in most cases. Therefore there is not much available information on the level of take of scalloped hammerheads by foreign fishers in the action area.

6.7 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 discussed in the *Threats to the Species* sections, climate change is likely beginning to affect all species of 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 percent 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). We do not have monitoring data over a long enough timescale to discern climate change related trends in sea turtle sex ratio 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 (see *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., 2007, 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 climate conditions influence juvenile recruitment and impact population trends in the North Pacific loggerhead DPS, Northwest Atlantic loggerhead DPS, western Pacific leatherback sea turtle, and Gulf of Mexico Hawksbill sea turtles(Van Houtan and Halley 2011, Van Houtan 2011, Del Monte-Luna et al., 2012). We do not know of any studies of changes in reproductive capacity and temporal shifts of nesting activity associated with changing environmental conditions 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). Leatherback sea turtles 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 leatherback sea turtles (McMahon and Hays 2006). Similar studies on changes in migration routes for loggerhead sea turtles, leatherback sea turtles, olive ridley sea turtles, and green sea turtles 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.

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 climate change-related phenomena influence these trends, rather than 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.

As discussed in the status of the species section climate change is not considered a major threat to scalloped hammerhead sharks.

In summary, several factors of climate change are affecting turtle populations or may affect 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, and some changes may be positive and others negative. Since changes due to increasing temperatures are expected to occur slowly over the next century, turtles could adapt to this particular stressor from climate change as they have done with a variable climate throughout their existence. Other stressors from climate change, like coastal flooding through increases in cataclysmic events, may be harder to adapt to.

6.8 Marine Debris and Contaminants

External activities that may have adverse effects on habitat include the dispersal of marine debris, large oil spills, and other types of marine pollution. Petroleum has the potential to be toxic when inhaled, ingested, or absorbed through the skin, mucous membranes, or eyes. Hydrocarbons can also bioaccumulate in zooplankton and fish eaten by other wildlife. Turtle prey species may also be effected by marine pollution which could affect turtles. Aside from large, catastrophic spills, the long-term effects of low levels of petroleum exposure are poorly understood.

In the marine environment, marine debris may serve as a source of mortality to all species of sea turtles. Debris related injury and mortality occurs though the ingestion of small debris and entanglement of animals in larger debris. Manmade materials such as plastics, micro plastics, and derelict fishing gear that may impact sea 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; Doyle et al., 2011; Keller et al., 2004; Parker et al., 2011; Wabnitz and Nichols 2010). While the impact of marine debris on sea turtles during their pelagic life stage is currently unquantified, it is 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.

Additional factors affecting sea turtles, albeit perhaps not as globally significant as those mentioned above, include increasing incidence of exposure to heavy metals and other contaminants in the marine environment. Contaminants such as organochlorine pesticides, polychlorinated biphenyls, flame retardants, emulsifiers to make plastics, mercury, copper, and other metals have been found in sea turtle tissue and eggs from numerous areas (Al Rawahy et al. 2006; Hermanussen et al., 2008; Keller et al., 2012; Lewis 2006; Malarvannan et al., 2011; Miao et al., 2001, Presti et al., 1999; van de Merwe et al., 2008). Although their explicit effects on sea turtles have yet to be determined, such exposure may lead to immunosuppression, enlarged livers, thyroid disruption, and neuro-behavioral changes (Keller et al., 2012). Heavy metals have been detected in corals (Huang et al., 2003), which diminish the health of coastal marine ecosystems and, in turn, adversely affect sea turtles and sharks.

Spills and discharges may consist of toxic hydrocarbon-based chemicals such as fuel oils, gasoline, lubricants, or other toxicants. The primary pathway for turtle and shark exposure to toxins is likely from land-based sources and on-shore or near-shore sources of chronic discharges. Major oceanic spills are rare but acute events. Federal laws and regulations strictly regulate the discharge of oil, garbage, waste, plastics, and hazardous substances into ocean waters under a variety of acts, including the Clean Water Act, as amended by the Oil Pollution Act of 1990, the Act to Prevent Pollution from Ships, MARPOL 1973/1978, and the Ocean Dumping Act. Violations of these laws may result in severe civil penalties, criminal fines, and imprisonment.

7 Effects of the Action

In this section of an Opinion, NMFS assesses the probable effects of the proposed action on threatened and endangered species, their critical habiat, as well as any species proposed for listing or proposed critical habitat. ‘Effects of the Action’ refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline. ‘Indirect effects’ are those that are likely to occur later in time (50 CFR 402.02). The Effects of the Action are considered within the context of the Status of Listed and Proposed Species and Environmental Baseline sections of this Opinion to determine if the proposed action can be expected to have direct or indirect effects on threatened and endangered species, and species proposed for listing as threatened or endangered, 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 potential stressors associated with the proposed action with regard to listed species.

NMFS may determine that some potential stressors result in insignificant, discountable, or beneficial effects to listed species, in which case these potential stressors are considered not likely to adversely affect listed species, and subsequently are considered no further in the Opinion. Those stressors that are expected to result in significant negative (i.e., adverse) effects to listed species are analyzed via the second, third, and fourth steps described below.

The second step identifies the magnitude of the 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 the stressors (*response analysis*). In this step, NMFS determines if the stressors are likely to result in any of the components of take as defined under the ESA (e.g., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct).

The final step in determining the effects of the action is establishing the risks those responses pose to listed resources (*risk analysis*). The risk analysis is different for listed species and designated critical habitat. However, the action area does not include proposed or designated critical habitat, thus it is not considered in this Opinion. Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (probability of extinction or probability of persistence) of listed species depends on the viability of their populations. This final step first determines the risk posed by the proposed action to affected DPSs or nesting aggregations, then relates that risk to the listed species.

Potential Stressors. The proposed action is the continued operation of the American Samoa longline fishery. The potential stressors associated with the proposed action for the six listed species (and proposed DPSs for the green sea turtle) addressed by this Opinion are fishing gear interactions (the greatest stressor, defined in footnote 1 in Section 1) and fishing vessel collisions. Vessels may travel through areas where green and hawksbill sea turtles occur, such as when vessels travel to and from port, passing through nearshore waters. The likelihood of vessel collision with sea turtles out at sea is considered very low because of the low density of these species in the action area and is considered discountable. The potential direct stressors of interactions and collisions are described in detail below in the species sections, because they vary considerably between species.

7.1 Green sea turtles

The stressors, exposure, response, and risk steps of the effects analysis for green sea 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's effect on green sea turtles: the 2005 Opinion (NMFS 2005a), the 2008 Hawaii bottomfish Opinion, (NMFS 2008c), the 2012 Opinion (NMFS 2012a), the 2014 Deep-set Opinion (NMFS 2014a), the green sea turtle status review (Seminoff et al., 2015), and other documents cited below.

7.1.1 Stressors

Longline fishing affects green sea turtles primarily by hooking, but also by entanglement and trailing of gear. Historically in the Hawaii deep-set longline fishery, green sea turtles have been more likely to be hooked externally or in the mouth (hook not ingested) than entangled or hooked internally (hook ingested). This appears to hold true in the American Samoa fishery also, according to the small number of observed interactions since the fishery started operating with observer coverage (Table 5). Hooking may be external, generally in the flippers, head, beak, 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, 2005a, 2008a).

Since April of 2006, 28 green sea turtles have been observed caught in this fishery, and all but two were dead (Table 5). The fishery uses mostly 13/0, 14/0, 15/0, and 16/0 circle hooks (most offset and some non-offset), but these hook types are not required. Sardines (pilchards) are used as bait in this fishery. In addition to fishing gear interactions, because green sea turtles recruit to nearshore habitat in American Samoa, and green sea turtles occur in shallow American Samoa waters, fishing vessels traveling to and from port may occasionally strike green sea turtles (NMFS 2008b).

Table 5. Observed green turtle interactions in the American Samoa longline fishery, June 2006 – June 30, 2015.

Date	Disposition	SCL (cm)
15-Jun-06	Dead, entangled	50
20-Jun-06	Dead, hook in flipper	26.5
7-Oct-06	Dead, hook in mouth	43
2-Jul-07	Dead, hook in mouth	47.5
11-May-08	Dead, hook in mouth	42
11-Jun-09	Dead, hook in flipper	46
2-Sep-09	Dead, hook in mouth	45
31-Oct-09	Dead, hook in mouth	45
18-Feb-10	Alive, hooked in flipper	45
2-Apr-10	Dead, hooked in mouth	24.5
20-May-10	Dead, hooked in mouth	36
7-Jul-10	Dead, hooked in mouth	39.5
9-Jul-10	Dead, hooked in flipper	36.5
30-Oct-10	Dead, hooked in mouth	46.5
15-Dec-10	Dead, hooked in neck	40
27-Dec-10	Dead, hooked in flipper	44
2-Feb-11	Dead, hooked in flipper	47
11-Apr-11	Dead, hooked in flipper	40.5
18-Apr-11	Dead, hooked in beak	30
10-May-11	Dead, hooked in mouth	40.1
9-Jun-11	Dead, hooked in mouth	36.2
16-Jun-11	Dead, hooked in flipper	39.5
11-Jul-11	Dead, hooked in flipper	54.3
2-Oct-11	Alive, hooked in flipper	2ft
5-Aug-13	Dead, hooked in flipper	43
27-Oct-13	Dead, hooked in flipper	41
8-Dec-13	Dead, hooked in flipper	44.8
21-Mar-14	Dead, hooked in neck	38.5

7.1.2 Exposure

Green sea turtle interactions in the American Samoa fishery are rare, unpredictable events. Since 2006, there have been 28 observed interactions with green sea turtles in the fishery. In September 2011, NMFS implemented Amendment 5 to the Pelagics FEP, which established specific requirements for fishing gear and deployment techniques to reduce incidental bycatch of this species. Prior to the implementation of the Amendment 5 gear modifications in September 2011, approximately 30 green sea turtles were taken on average annually. Post implementation of the gear modifications this number dropped to approximately 10 green sea turtles taken on average annually (Table 5). It is likely that the gear modifications were successful in decreasing the rate of green turtle interactions; however, no studies have been done that conclusively establish the gear modifications as the cause of the declining interaction rates. It is also important to note that effort has been declining in the fishery since 2007 and that observer coverage between 2006 and 2009 was less than 10 percent each year, meaning that the expansion factors used to calculate total turtle take during this period of time were much larger than the expansion factors used between 2010 and 2014 when observer coverage rates were on average about 20 percent each year.

Table 6. Observed and estimated total green sea turtles interactions with the American Samoa longline fishery for September 23, 2011– June 30, 2015**.** Only interactions observed after the new gear requirement are included in this analysis. Total estimates calculated in McCracken 2015a were used for 2012-2013. 2011, 2014, and 2015 were calculated using the percent observer coverage and the expansion factor.

Year	Observed	Estimated McCracken	percent Observer Coverage	Expansion Factor [a]	Estimated Interactions[b]	Total Hooks	Turtles per 1000 hooks
2011	2	NA	27.5	3.64	7.27	2,943,000	0.002470268
2012	0	0	19.8	5.05	0	12,115,000	0
2013	2	19	19.4	5.15	10.31	10,183,000	0.001865855
2014	2	NA	19.4	5.15	10.31	7,655,000	0.001346832
2015*	0	NA	17.9	5.59	0	675,781	0
Average							0.001136591
Future	17,554,000 * 0.001136591 / 1000=19.95, rounded to **20**						

[a] 100 ÷ observer coverage. E.g., for 2013, 100/19.4 = 5.15.

[b] (Observed interactions) x (Expansion factor). E.g., for 2013, 2(5.15) = 10.31.

*Percent coverage and total hooks is based on observer program report from 7/21/2015, which incorporates data through June 30, 2015.

From 2011 through June 2015, NMFS estimates 37 (7.27+ 19+10.31=36.58) green turtle interactions occurred in the American Samoa longline fishery, resulting in an estimated 33 (36.58*0.90=32.9) mortalities. Based on the number of observed interactions from September 2011-June 2015 and the proposed action, NMFS estimates that there could be up to twenty interactions with green sea turtles annually if the American Samoa longline fleet were to make approximately 5,920 sets and deploy 17,554,000 hooks annually. The mortality rate is estimated at 90 percent (NMFS 2015c).

The proposed action may also affect green sea turtles due to boat collisions with turtles in the action area. In Hawaii, vessel collisions are thought to be a source of green turtle mortality in fisheries with large numbers of vessels that take day trips, resulting in a large number of trips per year through nearshore waters where green sea turtles are concentrated. For example, the Hawaii bottomfish fishery was estimated in 2008 to take 71,800 trips per year in State and Federal waters, resulting in vessel collisions killing 2 – 5 green sea turtles per year (NMFS 2008b). The Hawaii longline fishery results in far fewer trips, thus the Hawaii shallow-set fishery was estimated in 2008 to kill essentially zero green sea turtles due to vessel collisions (NMFS 2008a). In American Samoa, the longline fishery has fewer vessels than in Hawaii, and green sea turtles are much scarcer than in Hawaii, thus the number of annual green turtle mortalities estimated to result from boat collisions from the proposed action is essentially zero. Therefore, we expect the proposed action would expose 20 green turtles, annually, to the effects of hookings and/or entanglements (Table 6).

7.1.3 Response

Interactions range from non-fatal hookings (injury) and entanglement, allowing the release of individuals to mortality. Typically, green sea turtles, however, die from their interactions. The calculated mortality rate for green turtles from observed interactions in the American Samoa longline fishery is 90 percent (NMFS 2015c). This rate of post-hooking mortality of green turtles is based on 28 green sea turtle interactions observed in the fishery from 2006 through June 30, 2015 and NMFS' post-hooking mortality criteria (Ryder et al., 2006). Using this mortality rate, we can convert predicted exposure (20 interactions annually) to an annual number of estimated mortalities. Accordingly, 20 interactions annually would lead to 18 (20 x 0.90 = 18) green sea turtle mortalities. To estimate the risk that the proposed action poses to population, we convert this number to the number of breeding female green turtles (termed the adult female nester equivalents (ANE)).

The proportion of females in the adult population.
The sex ratio of the green sea turtle populations are not known for all DPSs, but studies of some green populations suggest that sex ratio is 50:50, hence NMFS estimates the sex ratio for all DPSs in the Pacific to be 50:50 (Seminoff et al., 2015; Van Houtan 2015).

The adult equivalent.
For green sea turtles in the South Pacific, there are no published size-to-age relationships or age at first reproduction (AFR) estimates. However estimates were made using the global average AFR which ranges from 18-33 years (median 25.2), and the Hawaii population which is 17-28 years (Van Houtan 2015). Based on these average ages to maturity all greens that have interacted with the American Samoa fishery are juveniles and the ANE is 0.10 based on the anticipated level of take expected annually for this action (Van Houtan 2015).

7.1.4 Risk

As described above this action will directly impact green sea turtles in the South Pacific. As mentioned above in this assessment we are assessing the impact to the affected populations of species. At this time green sea turtles are listed globally but recently there was a proposal to list green sea turtles DPSs. Therefore we will assess the risk to green sea turtles in the South Pacific and then to the proposed DPSs in this region. As mentioned earlier the green sea turtle breeding population in the South Pacific contains an estimated 180,019 females (Seminoff et al., 2015, Van Houtan 2015). First, we examine the risk of the proposed action to the globally listed species and then to the five different DPSs in which those 180,019 females are found. The ANE for green sea turtles is 0.10 based on the anticipated level of take expected annually for this action (Van Houtan 2015). This represents less than 0.000001 percent of the population of female green nesters in the South Pacific (Van Houtan 2015). This level is negligible to the overall nesting population in the South Pacific and therefore to the globally listed species.

As shown by the genetic samples of green sea turtles from the American Samoa longline fishery, individuals may come from the following proposed DPSs: Central South Pacific DPS, Southwest Pacific DPS, East Pacific DPS, Central West Pacific DPS, and the East Indian-West Pacific DPS. Based on the percentages that can be attributed to each of these proposed DPS, we can estimate the level of anticipated mortalities to each of the proposed DPS and assess the risk to each proposed DPS.

Central South Pacific DPS

The highest percentage of turtles sampled come from the Central South Pacific DPS with a mean of 50 percent. Therefore we estimate that up to 9 (18 * 0.50=9) mortalities from 10 interactions could occur annually from this DPS. Based on the total ANE for all five DPS, which is 0.10, we estimate that the ANE impacted by the action in this DPS is 50 percent and therefore, 0.05 ANE annually. The estimated number of nesting females for the Central south Pacific nesting DPS is 2,902 (Seminoff et al., 2015). Therefore a 0.05 ANE mortality from 2,902 nesting females represents 0.0017 percent of this DPS. This level is negligible to the nesting population.

Southwest Pacific DPS

The next highest percentage of turtles sampled come from the Southwest Pacific DPS with a mean of 33 percent. Therefore we estimate that up to 6 (18 * 0.33=5.94) mortalities from 7 interactions could occur annually from this DPS. Based on the total ANE for all five DPS, which is 0.10, we estimate that the ANE impacted by the action in this DPS is 33 percent and therefore, 0.033 ANE annually. The estimated number of nesting females for the Southwest Pacific nesting DPS is 83,058 (Seminoff et al., 2015). Therefore a 0.033 ANE mortality from 83,058 nesting females represents 0.00004 percent of this DPS. This level is negligible to the nesting population.

East Pacific DPS

The next highest percentage of turtles sampled come from the East Pacific DPS with a mean of 12 percent. Therefore we estimate that up to 3 (18 * 0.12=2.16) mortalities from 3 interactions could occur annually from this DPS. The estimated number of nesting females for the East Pacific DPS is 20,112 (Seminoff et al., 2015). Based on the total ANE for all five DPS, which is 0.10, we estimate that the ANE impacted by the action in this DPS is 12 percent and therefore, 0.012 ANE annually. Therefore a 0.012 ANE mortality from 20,112 nesting females represents 0.00006 percent of this DPS. This level is negligible to the nesting population.

Central West Pacific DPS

A mean of 3 percent of the turtles sampled come from the Central West Pacific DPS. Therefore we estimate that up to one (18* .03= 0.54) mortality could occur annually from this DPS. The estimated number of nesting females for this DPS is 6,518 (Seminoff et al., 2015). Based on the total ANE for all five DPS, which is 0.10, we estimate that the ANE impacted by the action in this DPS is 3 percent and therefore, 0.003 ANE annually. Therefore a 0.003 ANE mortality from 6,158 nesting females represents 0.00005 percent of this DPS. This level is negligible to the nesting population.

East Indian-West Pacific

A mean of 2 percent of the turtles sampled come from the East Indian-West Pacific DPS. Therefore we estimate that up to one (18* .02= 0.36) mortality could occur annually from this DSP. The estimated number of nesting females for this DPS is 77,009 (Seminoff et al., 2015). Based on the total ANE for all five DPS, which is 0.10, we estimate that the ANE impacted by the action in this DPS is 2 percent and therefore, 0.002 ANE annually. Therefore a 0.002 ANE mortality from 77,009 nesting females represents 0.000003 percent of this DPS. This level is negligible to the nesting population.

7.2 Leatherback Sea Turtles

The stressors, exposure, response, and risk steps of the effects analysis for leatherback sea turtles with regard to implementation of the proposed action are described below. Leatherback sea turtles directly affected by fishing interactions are expected to be from the western Pacific population. Direct 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 leatherback sea turtle: the 2004 Opinion (NMFS 2004a), the 2005 Opinion (NMFS 2005a), the 2006 Opinion (NMFS 2006), 2008 Opinion (NMFS 2008a), the 2012 Opinion (NMFS 2012a), the 2014 Opinion (NMFS 2014a), and other documents cited below.

7.2.1 Stressors

Entanglement and foul hooking are the primary effects of longline fishing on leatherback sea turtles, whereas internal hooking is more prevalent in hardshell turtles, but has occurred in the Hawaii deep-set fishery in a few instances. Leatherback sea turtles 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 may collect on buoys and buoy lines at or near the surface, or some combination of these and/or other reasons. Entanglement may result in 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 leatherback sea turtle are internal hooking and trailing line. The effects of entanglement on leatherback sea turtles are substantial wounds and reduced mobility, causing impairment of feeding, breeding, or migration of the entangled individual. Because leatherback sea turtles 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 2005a, 2006a, 2006b, and 2008a).

Unlike green and hawksbill sea turtles, leatherback sea turtles do not recruit to nearshore habitat in American Samoa. Additionally, the likelihood of vessel collision with sea turtles out at sea is considered very low because of the low density of these species in the action area and risk of collision is considered discountable. Thus being struck by longline vessels traveling to and from port, or at sea, is not considered a relevant stressor.

7.2.2 Exposure

Leatherback sea turtles may be exposed to interactions directly caused by the proposed action, due to hooking and entanglement by fishing gear deployed by the American Samoa longline fishery. This exposure can be quantified as the expected annual number of interactions. The proposed action would result in approximately 17,554,000 hooks annually. Based on the number of hooks set and the number of leatherback sea turtle interactions between 2011- June 30, 2015 NMFS estimates that there will be approximately 23 leatherback sea turtle interactions annually (Table 7).

Table 7. Observed and estimated total Leatherback sea turtle interactions with the American Samoa longline fishery for 2011– June 2015[1]. Total caught estimated by McCracken used where available (McCracken 2015a), and total estimate using expansion factor when there was no estimate by McCracken.

Year	Observed	Estimated McCracken	percent Observer Coverage	Expansion Factor [a]	Estimated Interactions[b]	Total Hooks	Turtles per 1000 hooks
2011	2	4	33.3	3.00	4	11,074,000	0.000361206
2012	1	6	19.80	5.05	5	12,115,000	0.000495254
2013	2	13	19.40	5.15	10.3	10,183,000	0.001276638
2014	0	NA	19.40	5.15	0	7,655,000	0
2015*	3	NA	17.9	5.59	16.7	675,781	0.004439308
Average							0.001314481
Future	17,554,000*0.001314481 /1000 = 23.07						

*[a] 100 ÷ observer coverage. E.g., for 2013, 100/19.4 = 5.15.

[b] (Observed interactions) x (Expansion factor). E.g., for 2013, 2(5.15) = 10.3.

*Percent coverage and total hooks is based on observer program report from 7/21/2015, which incorporates data through June 30, 2015.

7.2.3 Response

Interactions range from non-fatal hookings (injury) and entanglement, allowing the release of individuals to mortality. Typically, adult leatherback sea turtles are released alive and juveniles die from their interactions. The severity of injuries to turtles that are released alive are determined using NMFS' post-hooking mortality criteria (Ryder et al., 2006). The calculated mortality rate for leatherback sea turtles from observed interactions in the American Samoa longline fishery is 70.6 percent (NMFS 2015c). This rate of post-hooking mortality of leatherback sea turtles is based on eight leatherback sea turtle interactions observed in the fishery since 2011 and NMFS' post-hooking mortality criteria (Ryder et al., 2006). Using this mortality rate, we can convert predicted exposure (23 interactions annually) to an annual number of estimated mortalities. Accordingly, 23 interactions annually would lead to 16.28 (23 x 0.76 = 16.28) leatherback sea turtle mortalities. However, in order to estimate the risk that the proposed action poses to the western Pacific leatherback sea turtle population, we must first estimate the number of adult females (ANE) harmed through injury or death.

The American Samoa longline fishery interacts with male and female leatherback sea turtles, and they are predominantly juveniles (Van Houtan 2015). In order to estimate the number of adult females that would potentially be killed by 23 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.

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[1] The BE analyzed data through 2014, however during the consultation period three leatherback sea turtle interactions were observed in the 2nd quarter of 2015, which is a higher number than previously seen in this fishery. Therefore the interaction rates were reanalyzed using the observed interactions and preliminary effort date through quarter 2 from the observer program.

The proportion of females in the adult population.
The sex ratio of the western Pacific leatherback sea turtle population is unknown, but studies of other leatherback sea turtle 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, Van Houtan 2013, 2015).

The adult equivalent.
Most leatherback sea turtles interacting with the American Samoa fishery have been juveniles (Van Houtan 2015). The minimum size when western Pacific leatherback sea turtle females first breed is estimated to be >120cm SCL[2] (Jones et al., 2011, Stewart et al., 2007, Van Houtan 2011).

In order to estimate the response of leatherback sea turtles to 23 interactions in terms of annual adult female mortalities, the interactions were first multiplied by the post-hooking mortality rate (0.760). In order to estimate the mortality of females/males from the proposed action, a 65/35 ratio was used.

The adult equivalent was determined using the discounting method (Van Houtan 2013, 2015), giving an estimate of 0.55[3] adult female mortalities annually or a single adult female mortality every 1.8 years from the Western Pacific nesting populations (Van Houtan 2015).

NMFS applied precautionary assumptions to all variables to ensure that the action's maximum impact was accounted for, to protect the listed species. 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 sea turtle populations. We used the maximum possible number of interactions per year (23). For example, the maximum number of leatherback sea turtle interactions that has occurred in a year in the American Samoa fishery since 2006 is 17 which was based on three observed interactions that occurred between January 2015 and May 2015, with observer coverage at approximately 18 percent. In addition a more conservative mortality rate was used because we did not separate out the larger turtles from the younger, smaller turtles which have a much higher mortality rate. The five smaller turtles all came up dead while the three larger turtles that were not boarded had a mortality rate of 21.7 percent. When using the individual rates in the ANE calculation, the ANE is 0.33 rather than 0.55.

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[2] 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.

[3] Two other scenarios were analyzed by Van Houtan based on size estimates of leatherback sea turtle not boarded due to their larger size. In the first scenario only those turtles that could be boarded and measured were included, which left out the larger older turtles, which had an ANE of 0.17. The second scenario used the observers approximate length as Straight carapace length even in situations where the observer described it as total lenth which overestimated the size; the ANE for this scenario was 1.7. These two scenarios are not as accurate as the preferred method which included the larger animals not boarded but with an adjustment applied to use straight carapace length instead of total length which matches the animals that were measured on deck.

7.2.4 Risk

The response of leatherback sea turtles to interactions with gear deployed by the American Samoa longline fishery is considered to be the mortality of 0.55 adult females annually or one adult female mortality every 1.8 years from a nesting population of 2739 females (Van Houtan 2015). This represents less than 0.0002 of the nesting population in the region, which is negligible. The risk posed by this level of mortality to the western Pacific leatherback sea turtle population was assessed by Van Houtan (2015) for application to this Opinion. Quantitative population viability analysis (PVA) modeling (i.e. classical PVA or a climate-based PVA), works with discrete numbers; whole numbers and not partial individuals. Rounding the calculated adult female mortality estimate up to a single individual would overestimate the fishery impacts (Van Houtan 2013, 2014, 2015). A recent article, "Estimating Limit Reference Points for Western Pacific Leatherback Turtles in the U.S. West Coast EEZ" (K. Alexandra Curtis, et al.) published on September 14, 2015, explores a possible model for estimating biological limit reference points (LRP) that may describe adverse population impacts to leatherback sea turtles by the California drift gillnet fishery. We considered whether such an approach might be helpful in our effort to evaluate impacts to leatherback sea turtles by the American Samoa longline fishery. In this regard, the authors of the LRP model caution that their approach is not a direct expression of "legal species conservation standards under the ESA, such as the jeopardy standard, and would need to be revisited in the event of management application of LRPs within that context." The LRP approach also relies on the application of scientific concepts from the Marine Mammal Protection Act (MMPA), including potential biological removal (PBR), logistic growth (and inherently carrying capacity), and maximum annual net population growth (Rmax), that were developed for assessing marine mammal populations with life histories characterized by low fecundity, high parental investment, and relatively low population variability. Because the relevance of these MMPA concepts to sea turtles, with life histories that are characterized by high fecundity, high mortality, no parental investment, and high population variability (Van Houtan and Halley 2011, Halley et al. in review) is uncertain, and because assumptions relating to leatherback sea turtle life history variables by Curtis et al. 2015 differ from existing data for Pacific populations, we believe that additional study is warranted. Thus, we do not apply a LRP approach to sea turtles in this biological opinion.

7.3 Olive Ridley Sea Turtles

The stressors, exposure, response, and risk steps of the effects analysis for olive ridley sea 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 ridley sea turtles: the 2004 Opinion (NMFS 2004a), the 2005 Opinion (NMFS 2005a), the 2006 Opinion (NMFS 2006), 2008 Opinion (NMFS 2008a), the 2012 Opinion (NMFS 2012a),the 2014 Opinion (NMFS 2014a), and other documents cited below.

7.3.1 Stressors

Longline fishing affects olive ridley sea turtles primarily by hooking, but also by entanglement and trailing of gear. Unlike green and hawksbill sea turtles, olive ridley sea turtles do not recruit to nearshore habitat in American Samoa, thus longline vessel strike (traveling to and from port) is not considered a risk. Additionally, the likelihood of vessel collision with sea turtles out at sea is considered very low because of the low density of these species in the action area and risk of collision is considered discountable. Thus being struck by longline vessels traveling to and from port, or at sea, is not considered a relevant stressor.

7.3.2 Exposure

Olive ridley sea 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 American Samoa longline fishery. This exposure can be quantified as the expected annual number of interactions. The proposed action would result in approximately 17,554,000 hooks annually (NMFS 2015a). Based on the number of olive ridley sea turtle interactions that occurred between 2011-June 30, 2015 NMFS expects up to 11 olive ridley sea turtle interactions annually (Table 8). Therefore, olive ridley sea turtle exposure to the effects of the proposed action is considered to be 11 interactions annually.

Table 8. Observed and estimated total olive ridley sea turtles interactions with the American Samoa longline fishery for 2011– June 30, 2015**.** Total caught estimated by McCracken used where available (McCracken 2015a), and total estimate using expansion factor when there was no estimate by McCracken.

Year	Observed	Estimated McCracken	percent Observer Coverage	Expansion Factor [a]	Estimated Interactions[b]	Total Hooks	Turtles per 1000 hooks
2011	1	4	33.3	3.00	3	11,074,000	0.000361206
2012	1	6	19.80	5.05	5.05	12,115,000	0.000495254
2013	1	4	19.40	5.15	5.15	10,183,000	0.000392812
2014	2	NA	19.40	5.15	10.3	7,655,000	0.00182887
2015*	0	NA	17.9	5.59	0	675,781	0
Average							0.000615628
Future	17,554,000 * 0.000615628 / 1000 = 10.80, rounded to **11**						

[a] 100 ÷ observer coverage. E.g., for 2013, 100/19.4 = 5.15.

[b] (Observed interactions) x (Expansion factor). E.g., for 2013, 1(5.15) = 5.15.

*Percent coverage and total hooks is based on observer program report from 7/21/2015, which incorporates data through June 30, 2015.

7.3.3 Response

Interactions range from non-fatal hookings (injury) and entanglement, allowing the release of individuals to mortality. The severity of injuries to turtles that are released alive are determined using NMFS' post-hooking mortality criteria (Ryder et al., 2006). The calculated mortality rate for olive ridley sea turtles from observed interactions in the American Samoa longline fishery is 30 percent (NMFS 2015c). This rate of post-hooking mortality of olive ridley sea turtles is based on five olive ridley sea turtle interactions observed in the fishery since 2011 and NMFS' post-hooking mortality criteria (Ryder et al., 2006). Using this mortality rate, we can convert predicted exposure (11 interactions annually) to an annual number of estimated mortalities. Accordingly, 11 interactions annually would lead to 3.3 (11 x 0.30 = 3.3) olive ridley sea turtle mortalities.

7.3.4 Risk

Based on the genetic results from the olive ridley sea turtles that were caught in the American Samoa longline fishery, all of the turtles are from the eastern Pacific nesting stocks (Dutton pers comm 2015). The eastern Pacific population has at least one million adult nesting females. We do not have the exact demographic data like we do for other species, therefore default numbers are used which are; 50:50 male to female population ratio, juvenile annual survival of 0.85, and time between interaction and first breeding (remaining juvenile stage duration) of 10 years (Van Houtan 2015). Based on these variables the ANE is 0.31 and the impact would be 0.000001 percent of the adult female population from one nesting area that would be affected (Van Houtan 2015). This level of impact is extremely small. The risk to the population from the proposed action is considered negligible, and therefore, neglible to the species as well.

7.4 Hawksbill Sea Turtles

The stressors, exposure, response and risk steps of the effects analysis for hawksbill sea 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 hawksbill sea turtles: the 2012 Hawaii shallow-set Opinion (NMFS 2012a), the 2014 deep-set Opinion (NMFS 2014a), and other documents cited below.

7.4.1 Stressors

Longline fishing may affect hawksbill sea turtles primarily by hooking, but also by entanglement and trailing of gear (Robins et al., 2002a). A dead hawksbill sea turtle that apparently was entangled and drowned in derelict fishing gear (netting) was retrieved by shallow-set gear in Hawaii (NMFS 2008a), and an unconfirmed hawksbill sea turtle interaction occurred in the American Samoa longline fishery (NMFS 2010a). Because hawksbill sea turtles, like green sea turtles, recruit to nearshore habitat in American Samoa, longline vessels traveling to and from port could strike hawksbill sea turtles (NMFS 2010).

Although no interactions with hawksbill sea turtles in the American Samoa longline fishery have been observed by fisheries observers, juvenile hawksbill sea turtles have been observed swimming on the surface alongside American Samoa-based longline fishing vessels and hawksbill sea turtles have been recovered by the DMWR stranding program in Tutuilla. Thus, it is reasonable to expect that these pelagic juveniles, which are also carnivorous, could become hooked or entangled in this fishery. In addition, NMFS had no records of leatherback sea turtle or olive ridley sea turtles interacting with the American Samoa longline fishery until recently when observer coverage was increased. We expect that interactions with hawksbill sea turtles likely occur, albeit at lower incidence rates than other species like green sea turtle, and have likely gone undocumented.

7.4.2 Exposure

Hawksbill sea turtle interactions are very unlikely in either the Hawaii or American Samoa longline fisheries, as shown by zero reported hawksbill sea turtle interactions in these fisheries since the Observer Program began in 1994 (in Hawaii) and 2006 (in American Samoa). However, satellite telemetry results from SPREP and DMWR suggest that pelagic juveniles and adults sometimes forage in pelagic habitat where these longline fisheries operate. In addition the opening of the LVPA to within twelve miles could increase the potential for interactions. Hawksbill sea turtle interactions have occurred in longline fisheries in the Atlantic (Yeung 1999) and Pacific (Robins et al., 2002a).

Based on an expansion of one observed interaction at approximately 20 percent (1*5=5) over a three year period, we anticipate there could be two annually (5/ 3=1.66). This estimate is based on the possibility of one observed hawksbill sea turtle interaction occurring over a three year period with observer coverage rate of approximately 20 percent.

Like green sea turtles, hawksbill sea turtles recruit as adults to nearshore habitat, where they remain except for breeding migrations. However, longline boat collisions with hawksbill sea turtles are considered discountable because of the small number of vessels in the American Samoa longline fishery, and the small number of hawksbill sea turtles in the action area.

7.4.3 Response

Due to the rarity of hawksbill sea turtle bycatch in this fishery, the death of a hawksbill sea turtle from the proposed action is considered very unlikely. Because the fishery operates far from shore, it is unlikely to affect adult hawksbill sea turtles. We cannot, however, discount the potential for interaction and thus estimate that one (1.66 *60 percent = .99) hawksbill sea turtle will be killed by the proposed action due to hooking or entanglement annually. This is based on the average mortality of the other hard shell turtles (green and olive ridley sea turtles) observed in this fishery, which is 60 percent (NMFS 2015c).

7.4.4 Risk

Hawksbill sea turtles within the action area likely originate from Oceania, which has an approximate population of 23,190 nesting females (Van Houtan 2015). We do not have the exact demographic data like we do for other species, therefore default numbers are used which are; 50:50 male to female population ratio, juvenile annual survival of 0.85, and time between interaction and first breeding (remaining juvenile stage duration) of 10 years (Van Houtan 2015). Based on these variables the ANE is 0.35 and the impact would be 0.0001 percent of the adult female population that would be affected (Van Houtan 2015). This level of impact is extremely small. NMFS estimates the American Samoa longline fishery will adversely affect hawksbill sea turtle sea turtles, although at a very low level unlikely to affect the viability of the global population. The risk to the population from the proposed action is considered negligible, and therefore, neglible to the species as well.

7.5 South Pacific Loggerhead DPS

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 sea turtles directly affected by interactions resulting from the proposed action are from the South Pacific Ocean DPS. The following information was used to conduct these analyses of the proposed action on loggerheads: the 2004 Opinion (NMFS 2004a), the 2005 Opinion (NMFS 2005a), the 2006 Opinion (NMFS 2006), 2008 Opinion (NMFS 2008a), the 2011 Loggerhead DPS listing, the 2012 Opinion (NMFS 2012a), the 2014 Opinion (NMFS 2014a) and other documents cited below.

7.5.1 Stressors

Longline fishing affects loggerhead turtles primarily by hooking, but also by entanglement and trailing of gear that remains attached to an animal. Deep-set longlining is done during the day and loggerheads generally feed at shallower depths than the gear is fished which makes them less susceptible to deep-set gear than shallow-set longline gear. Unlike green and hawksbill sea turtles, loggerheads do not recruit to nearshore habitat in American Samoa, thus longline vessel strike (traveling to and from port) is not considered a risk. Additionally, the likelihood of vessel collision with sea turtles out at sea is considered very low because of the low density of these species in the action area and risk of collision is considered discountable. Thus being struck by longline vessels traveling to and from port, or at sea, is not considered a relevant stressor.

7.5.2 Exposure

No loggerhead interactions have been reported in the American Samoa longline fishery. Loggerheads are the most commonly-caught sea turtle species in the Hawaii shallow-set longline fishery (NMFS 2012a) which fishes at depths less than 100 m and they are rarely caught in the Hawaii deep-set fishery which fishes between 150 and 400 m of depth. The American Samoa fishery operates at depths in between the Hawaii shallow-set and deep set fisheries ranges typically at depths greater than 100m. The American Samoa longline fishery action area is much smaller than that of the HI Longline fisheries and loggerheads are considered rare in the area. Although there are no confirmed sightings of loggerheads in American Samoa waters and the population of the South Pacific loggerhead DPS is small, there is a possibility for them to travel through the action area (Kobayashi et al., 2014). The proposed action may expose this species to potential hooking and entanglement and therefore we estimate that there may be one observed loggerhead interaction every three years. Based on approximately 20 percent, with coverage occasionally falling to just below 20 percent, NMFS estimates that could amount to a total of six interactions over a three year period, or two annually. Based on an expansion of one observed interaction at approximately 20 percent (1*5=5) over a three year period, we anticipate there could be two annually (5/ 3=1.66). This estimate is based on the possibility of one observed loggerhead interaction occurring over a three year period with observer coverage rate of approximately 20 percent.

7.5.3 Response

Due to the rarity of loggerhead bycatch in this fishery, the death of a loggerhead from the proposed action is considered very unlikely. We cannot, however, discount the potential for interaction and thus estimate that the potential for two interactions annually would lead to some level of mortality. Based on the mortality rate of observed loggerhead sea turtle interactions in the Hawaii Deep-set fishery and the shallow-set fishery, we estimate that the mortality rate could be approximately 50 percent (NMFS 2014a). Using this post-hooking mortality rate, two interactions annually could lead to one loggerhead mortality. In order to determine the impacts to the DPS we must translate the one mortality to adult female equivalents.

7.5.4 Risk

Loggerheads within the action area are from the South Pacific DPS which has a female nesting population of approximately 1400. We do not have the exact demographic data like we do for other species, therefore default numbers are used which are; 50:50 male to female population ratio, juvenile annual survival of 0.85, and time between interaction and first breeding (remaining juvenile stage duration) of 10 years (Van Houtan 2015). Based on these variables the ANE is 0.14 and the impact would be 0.0001 percent of the adult female population that would be affected (Van Houtan 2015). This level of impact is extremely small and therefore considered negligible.

7.6 Indo Pacific Scalloped Hammerhead Shark DPS

The stressors, exposure, response, and risk steps of the effects analysis for scalloped hammerhead sharks with regard to implementation of the proposed action are described below.

7.6.1 Stressors

Longline fishing affects scalloped hammerhead sharks primarily by hooking, but also by entanglement and trailing of gear. Historically, the longline fishery has very few interactions with scalloped hammerhead sharks and the majority are released alive.

7.6.2 Exposure

Scalloped hammerhead shark interactions in the American Samoa longline fishery are rare, unpredictable events. Since 2006, there have been ten observed interactions with scalloped hammerhead sharks in the American Samoa longline fishery (Table 9). Based on the number observed between 2006 and June 30, 2015, NMFS estimates that there could be up to twelve interactions with scalloped hammerhead sharks annually (Table 9, NMFS 2015a).

Table 9. Observed and estimated total scalloped hammerhead interactions with the American Samoa longline fishery for 2006– June 30, 2015**.** Total caught estimated by McCracken where available (McCracken 2015), and total estimate using expansion factor.

Year	Observed	Estimated McCracken	percent Observer Coverage	Expansion Factor [a]	Estimated Interactions[b]	Total sharks	sharks per 1000 hooks
2006	1	NA	8.1	12.35	13	14,264,000	0.000911385
2007	1	NA	7.1	14.08	15	17,554,000	0.000854506
2008	0	NA	6.4	15.63	0	14,444,000	0
2009	0	NA	7.7	12.99	0	15,085,000	0
2010	4	17				13,184,000	0.001289442
2011	2	7				11,074,000	0.000632111
2012	0	0				12,115,000	0
2013	0	0				10,183,000	0
2014	1	NA	19.40	5.15	5.15	7,655,000	0.000653168
2015*	1	NA	17.9	5.59	5.59	675,781	0.001479572
Average							0.000582018
Future	17,554,000 * 0.000582018 / 1000 = 10.21 + 1.55(additional based on unidentified)= 11.76						

[a] 100 ÷ observer coverage. E.g., for 2014, 100/19.4 = 5.15.

[b] (Observed interactions) x (Expansion factor). E.g., for 2014, 1(5.15) = 5.15.

*Percent coverage and total hooks is based on observer program report from 7/21/2015, which incorporates data through June 30, 2015.

2006–2009; 2014-2015 take expansion based on observer coverage.

2010–2013 take expansion from McCracken 2015b

Source: NMFS American Samoa Longline Observer Program Annual Reports 2006–2011 (NMFS 2006b, 2007, 2008b, 2009, 2010b, 2011, 2012, 2013, 2014d) and unpublished data; 2010–2013 McCracken 2015b

Between 2006 and 2015, there were seven smooth hammerheads observed caught in this fishery and three unidentified hammerheads caught in this fishery (NMFS observer program, unpublished, NMFS 2015a). The three observed unidentified hammerhead sharks result in an expanded estimate of an additional 24 unidentified hammerhead sharks caught in this fishery (NMFS 2015a). Based on the ratio of observed scalloped versus smooth hammerhead shark catches in this fishery from 2006-2014 (nine scalloped to seven smooth), the likelihood that the three observed unidentified catches of hammerhead shark were scalloped is approximately 56 percent and smooth hammerhead shark is approximately 44 percent. If 56 percent of these observed unidentified sharks are assumed to be scalloped hammerhead sharks, then an additional 14 scalloped hammerheads are estimated to have been caught in this fishery (24*56 percent) over this nine year period (NMFS 2015a). The average for this time period is 1.55 annually.

7.6.3 Response

Scalloped hammerhead shark response to the predicted exposure (12 interactions annually) from the proposed action can be converted to the annual number of estimated mortalities resulting from this exposure. Based on a 33 percent mortality rate, NMFS estimates the response rate to be up to 3.96 (12*33 percent) annually (NMFS 2015a).

7.6.4 Risk

The response of scalloped hammerheads to interactions with gear deployed by the American Samoa longline fishery is considered to be the mortality of up to four annually. The Indo-West Pacific scalloped hammerhead DPS occurs in a large area and abundance estimates for the entire DPS is unavailable. There are some areas where there are depletions of local populations such as off the coast of South Africa and Australia based on trends in abundance. Both of these areas are known to have high levels of illegal fishing that take sharks which is contributing to these decreasing trends. There is no information on the population trend in the area that the American Samoa longline fishery operates, however there is no evidence to suggest that there is a localized depletion in the area since there are no artisanal or international shark fisheries in the action area. The effective population size is estimated to be at least 11,280 adults, therefore four mortalities represent 0.04 percent (4/11,280*100=0.03546) of the population. Due to the small level of take we consider the risk to the scalloped hammerhead shark DPS from the proposed action to be negligible.

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 South Pacific Ocean (see Figure 2), 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 six species addressed by this Opinion may occur as a result of worsening climate change, and any increase in the fishing, ship traffic, and other actions described in the Environmental Baseline section. American Samoa fisheries and international fisheries that occur in the action area are expected to continue and therefore may impact sharks and turtles and their habitat in the future. The future effort level of these fisheries in the action area may vary considerably, although NMFS has no information to suggest that impacts to protected species will materially change from historic levels.

Global climate change is expected to continue and to therefore continue to impact sea turtles and their habitat. Rising temperatures at nesting beaches may continue to exacerbate a female bias 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). Only low-level nesting of greens and hawksbill sea turtles takes place inside the action area. However, turtles that occur in the action area come from other nesting beaches 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^{-1} shows that 86 percent of islands remained stable (43 percent) or increased in area (43 percent) while only 14 percent of study islands exhibited a net reduction in island area (Webb & Kench 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., 2012). The PDO and the Atlantic Multidecadal Oscillation 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 sea surface temperatures temperatures have been shown to influence breeding remigration, as mentioned earlier.

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 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 1988). In particular, there is no comprehensive assessment of the potential impacts of climate change within the action area or specific to sea turtles or scalloped hammerhead sharks 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 observed 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 sharks 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 sea turtles 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.

9 Integration and Synthesis of Effects

The purpose of this Opinion is to determine if the proposed action is likely to jeopardize the continued existence of listed species and species proposed for listing. "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 or a proposed species in the wild by reducing the reproduction, numbers, or distribution of that species. This Opinion considers the *Effects of the Action* within the context of the Status of *Listed Species and Proposed Species* and *Environmental Baseline*, as described in the *Approach* section (beginning of *Effects of the Action*). We determine if mortality of individuals of listed species, and species proposed for listing, 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 Proposed 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 six listed species, and five proposed green sea turtle DPSs, addressed by this Opinion.

9.1 Green sea turtles

As described in the green turtle section of the Effects of the Action (Section 7.1), the proposed action is likely to result in 20 green turtle interactions annually, 18 resulting in mortality. Thus the proposed action is expected to result in 18 mortalities of green sea turtles from the Pacific region, equivalent to 0.1 adult female green sea turtles annually from this region. Green sea turtles that interact with the American Samoa longline fishery come from five different nesting aggregations, which correlate to DPSs proposed for listing. Those five DPSs are: Central South Pacific DPS, Southwest Pacific DPS, East Pacific DPS, Central West Pacific DPS, and the East Indian-West Pacific DPS based on genetics studies from sampled turtles.

As discussed in the green turtle section of the Status of Listed Species, the estimated number of nesting females for the Area of the Pacific where these turtles originate is approximately 189,374 females with some areas increasing, some decreasing, and others less understood.

As discussed in the green turtle section of the Environmental Baseline, there is not detailed information on turtle takes in much of the Western Central Pacific ocean, in which the action area is a small part. Based on reports from 13 countries that operate in the WCPFC convention area at least 165 green sea turtles were observed caught with 21 reported mortalities from 2010-2014. A portion of those takes are expected to be within the action area. From the American Samoa longline fishery we estimate that 22 mortalities occurred annually over the last 10 years. Based on these numbers we estimate that at least 100 mortalities occur on an annual basis in the action area from commercial longlining and purse seining. In addition, green sea turtles from this region are killed annually by nearshore activities such as direct harvest, fishing, and boat collisions within the action area. Green sea turtles in the action area may be impacted by worsening climate change, but those impacts are not discernible in the action area and in the context of this analysis and cannot be quantified because of associated uncertainties, as described above in Section 8.

As described in the Effects of the Action we anticipate that the proposed action will result in approximately 18 mortalities annually which is the equivalent of 0.10 adult female mortalities annually from a breeding population of at least 180,019 females in the Pacific. This is less than 0.000001 percent of breeding females in the Pacific. Based on genetic analysis of incidentally caught green sea turtles this mortality will be across five different proposed DPSs found in the region. Viewed within the context of the Status of the Species and the Environmental Baseline, and considered together with the Cumulative Effects, the mortality of 0.1 adult female green turtle equivalents caused by the proposed action is insufficient to adversely affect the dynamics of green sea turtles as a species. That is, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of green sea turtles in this region or the potential for recovery (discussed further in this section) of the species. In addition we analyzed the impacts to the proposed DPSs.

Central South Pacific DPS

The number of nesting females in the Central South Pacific DPS is 2,677 (Seminoff et al., 2015). Green turtle temporal population trends in the Central South Pacific are poorly understood. Partial and inconsistent monitoring from the largest nesting site in this aggregation, Scilly Atoll, suggests significant nesting declines from persistent and illegal commercial harvesting (Petit). Nesting abundance is reported to be stable to increasing at Rose Atoll, Swains Atoll, Tetiaroa, Tikehau, and Maiao. However, these sites are of moderate to low abundance and in sum represent less than 16 percent of the population abundance at Scilly Atoll alone. Nesting abundance is reported to be stable to increasing at Tongareva Atoll (White and Galbraith 2013).

The highest percentage of turtles sampled from the American Samoa longline fishery come from the Central South Pacific DPS with a mean of 50 percent (Dutton, pers comm). The estimated number of nesting females for the Central south Pacific nesting DPS is 2,902 (Seminoff et al., 2015). Therefore a 0.05 (50 percent of 0.10) ANE mortality from 2,902 nesting females represents 0.0017 percent of this DPS. Viewed within the context of the Status of the Species and the Environmental Baseline, and considered together with the Cumulative Effects, the mortality of 0.05 adult female green turtle equivalents caused by the proposed action is insufficient to adversely affect the dynamics of the proposed Central South Pacific DPS. That is, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of green sea turtles in this DPS or the potential for recovery.

Southwest Pacific DPS

The abundance estimate for the Southwest Pacific DPS is 83,058 (Seminoff et al., 2015). Nesting occurs in many islands throughout the region but there are only two nesting areas (Raine Island and Heron Island) with long-term (>15 years) annual indices of nesting abundance. The Raine Island, Australia index count (1994–2004, intermittent) has high inter-annual variability and a slightly increasing linear trend. Heron Island, Australia, index count (1967–2004, intermittent) also has high interannual variability and a slightly increasing linear trend. Although long robust time series are not available for New Caledonia, recent and historic accounts do not suggest a significant decline in abundance of green sea turtles nesting in New Caledonia (Maison et al., 2010).

The next highest percentage of turtles sampled from the American Samoa longline fishery come from the Southwest Pacific DPS with a mean of 33 percent. The estimated number of nesting females for the Southwest Pacific Pacific nesting DPS is 83,058 (Seminoff et al., 2015). Therefore a 0.033 (33 percent of 0.10) ANE mortality from 83,058 nesting females represents 0.00004 percent of this DPS. Viewed within the context of the Status of the Species and the Environmental Baseline, and considered together with the Cumulative Effects, the mortality of 0.033 adult female green turtle equivalents caused by the proposed action is insufficient to adversely affect the dynamics of the proposed Southwest Pacific DPS. That is, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of green sea turtles in this DPS or the potential for recovery.

East Pacific DPS

The total for the entire East Pacific DPS is estimated at 20,112 nesting females (Seminoff et al., 2015). 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). 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., 2010a, NMFS and FWS 2007a).

The next highest percentage of turtles sampled from the American Samoa longline fishery come from the East Pacific DPS with a mean of 12 percent. The estimated number of nesting females for the East Pacific DPS is 20,112 (Seminoff et al., 2015). Therefore, a 0.012 (12 percent of 0.10) ANE mortality from 20,112 nesting females represents 0.00006 percent of this DPS.

Viewed within the context of the Status of the Species and the Environmental Baseline, and considered together with the Cumulative Effects, the mortality of 0.012 adult female green turtle equivalents caused by the proposed action is insufficient to adversely affect the dynamics of the proposed East Pacific DPS. That is, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of green sea turtles in this DPS or the potential for recovery.

Central West Pacific DPS

Currently, there are approximately 51 nesting sites and 6,518 nesting females in the Central West Pacific DPS. There is insufficient long-term and standardized monitoring information to adequately describe abundance and population trends for many areas of the Central West Pacific DPS. The limited available information suggests a nesting population decrease in some portions of the DPS like the Marshall Islands, or unknown trends in other areas such as Palau, Papua New Guinea, the Marianas, Solomon Islands, or the FSM (Maison et al., 2010).

A mean of three percent of the turtles sampled come from the Central West Pacific DPS. The estimated number of nesting females for this DPS is 6,518 (Seminoff et al., 2015). Therefore a 0.003 (3 percent of 0.10) ANE mortality from 6,158 nesting females represents 0.00005 percent of this DPS. Viewed within the context of the Status of the Species and the Environmental Baseline, and considered together with the Cumulative Effects, the mortality of 0.003 adult female green turtle equivalents caused by the proposed action is insufficient to adversely affect the dynamics of the proposed Central West Pacific DPS. That is, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of green sea turtles in this DPS or the potential for recovery.

East Indian-West Pacific DPS

The largest nesting site for the East Indian-West Pacific DPS lies within Northern Australia, which supports approximately 25,000 nesting females, calculated from the 5,000 nesting female’s order of magnitude (Limpus, 2009). Currently, the East Indian-West Pacific DPS hosts 58 reported nesting sites (in some cases nesting sites are made up of multiple beaches based on nesting survey information) with six of these sites supporting more than 5,000 nesting females each (including the 25,000 nesters in Northern Australia). The total nester abundance for this DPS is estimated to be approximately 77,009 (Seminoff et al., 2015). Green turtle populations within this DPS have experienced increases at some nesting sites and decreases at others. Nonetheless, populations are substantially depleted from historical levels.

A mean of two percent of the turtles sampled come from the East Indian-West Pacific DPS. The estimated number of nesting females for this DPS is 77,009 (Seminoff et al., 2015). Therefore a 0.002 (2 percent of 0.10) ANE mortality from 77,009 nesting females represents 0.000003 percent of this DPS. This level of mortality is negligible to the DPS. Viewed within the context of the Status of the Species and the Environmental Baseline, and considered together with the Cumulative Effects, the mortality of 0.002 adult female green turtle equivalents caused by the proposed action is insufficient to adversely affect the dynamics of the proposed East Indian-West Pacific DPS. That is, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of green sea turtles in this DPS or the potential for recovery.

We considered to what extent the effects of the action affect survival and recovery of the green sea turtle and for each proposed DPS. The NMFS and FWS' ESA Section 7 Handbook (FWS and NMFS 1998) provides further definition for *survival* and *recovery*, as they apply to the ESA's jeopardy standard.

> *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.
>
> *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 and FWS (1998e) Green Turtle and NMFS and FWS (1998a) East Pacific Green Turtle recovery plans contain a number of goals and criteria that should be met to achieve recovery. There are no recovery plans for the proposed DPSs at this time. 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; and international agreements are in place to protect shared stocks.

As discussed above, the anticipated mortalities resulting from the continued authorization of the American Samoa fishery results in the removal of approximately 18 juveniles annually across five different DPSs: nine from the Central South Pacific DPS, seven from the Southwest Pacific DPS, three from the East Pacific DPS, one from the Central West Pacific DPS, and one from the East Indian-West Pacific DPS. 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 eighteen juvenile green sea turtles caused by the proposed action is insufficient to adversely affect the population dynamics of the species as currently listed or the proposed Central South Pacific DPS, the Southwest Pacific DPS, the East Pacific DPS, the Central West Pacific DPS, and the East Indian-West Pacific DPS. We do not expect the proposed action to reduce the reproduction, numbers, or distribution of these proposed DPSs or the globally listed species.

We conclude that the incidental take and resulting mortality of green 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 proposed DPSs or the globally listed 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, or proposed DPSs, and therefore the species, and we do not expect it to affect the green sea 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 one 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, take would be subject to mitigation measures to reduce its impact. 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.

Although the proposed action would result in the mortality of up to eighteen juvenile green sea turtles annually, as discussed above, this level of mortality would present negligible additional risk to the proposed DPSs and to the globally listed species. Since it represents a negligible risk, 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 populations, 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.

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. 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.

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 Central South Pacific DPS, the Southwest Pacific DPS, the East Pacific DPS, the Central West Pacific DPS, and the East Indian-West Pacific DPS and therefore the species as a whole in the wild.

9.2 Leatherback Sea Turtles

As discussed in the leatherback sea turtle section of the *Status of Listed Species and Proposed Species*, the western Pacific leatherback sea turtle population harbors the last remaining nesting aggregation of significant size in the Pacific and is facing a declining trend. The total number of adult females in western Pacific population was estimated at 2,739 Van Houtan (2015).

As discussed in the leatherback sea turtle section of the *Environmental Baseline*, there is not detailed information on turtle takes in much of the Western Central Pacific ocean, in which the action area is a small part. Based on reports from 13 countries that operate in the WCPFC convention area at least 98 leatherback sea turtles were observed caught with 10 reported mortalities from 2010-2014. A portion of those takes are expected to be within the action area. From the American Samoa longline fishery we estimate that six mortalities occurred annually over the last 10 years. Based on these numbers we estimate that at least 50 mortalities occur on an annual basis in the action area from commercial longlining and purse seining. Leatherback sea turtles in the action area may be impacted by worsening climate change, but those impacts are not discernible in the action area and in the context of this analysis and cannot be quantified because of associated uncertainties, as described above in Section 8.

As described in the leatherback sea turtle section of the *Effects of the Action*, if we assume that the proposed action will result in up to approximately 17,554,000 hooks annually, then that level of effort will result in 23 leatherback sea turtle interactions annually, and a maximum 16.28, mostly juvenile mortalities annually (representing 0.55 adult females) from the Pacific population. The loss of 16.28 mostly juvenile leatherback sea turtle is equivalent to the loss of 0.55 adult females annually (the adult female mortality equivalent), or one female mortality every 1.8 years (or 0.0002 percent of breeding females in the Western Pacific population). The risk posed by this level of mortality to the western Pacific leatherback sea turtle population was assessed by Van Houtan (2015) for application to this Opinion. A quantitative population viability analysis (PVA) could not be reliably applied to this scenario because of the low numbers of adult female equivalents. Modeling works with discrete numbers; whole numbers and not partial individuals. Moreover, NMFS considered rounding the calculated adult female mortality (ANE) estimate up to a single individual but determined this was not reliable because it would overestimate the fishery's impacts. Therefore, given the fishery's extremely low impacts on ANE, it was determined that no further PVA modeling was possible (Van Houtan 2015).

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, marine debris, 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 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 and developing embryos. While leatherback sea turtle 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, Saba et al., 2012) 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 Opinion.

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

The NMFS and FWS [(1998b) 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.

Adult female nesting population size for the western Pacific population is estimated at approximately 2739 (Van Houtan 2015). As discussed above, the anticipated deaths resulting from the continued authorization of the American Samoa fishery results in the removal of approximately 16.28 annually, or 0.55 adult female nester mortalities, or 0.0002 percent of the population of western Pacific nesters. Additionally, the western Pacific population is one of several populations that make up the leatherback sea turtle species. Because this contribution to mortality is a small fraction of what total mortality for the species might be, we do not expect that the small number of individuals killed 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 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 maintain genetic heterogeneity, broad demographic representation, and successfully reproduce. The proposed action will have a small effect on the overall size of the populations and therefore the species, and we do not expect it to affect the leatherback sea turtles' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, it is unlikely 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 one 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, take would be subject to mitigation measures to reduce its impact. The adult 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 expected to effect 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.

The proposed action is anticipated to result in the mortality of up to one nesting female every 1.8 years, 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, 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 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 nesting females from the proposed action.

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 and recovery of the species. Although any level of take and mortality can have an adverse effect on the 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. We expect the populations and therefore the species will remain large enough to not only persist (survive) but to retain the potential to recover. Moreover, the proposed action does not appreciably impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy, discussed above.

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 sea turtle 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.

9.3 Olive Ridley Sea Turtles

As discussed in the olive ridley sea turtle section of the *Status of Listed Species*, nesting of eastern Pacific olive ridley sea turtles steadily increased from 1991 to present up to over 1 million nests annually. The western Pacific olive ridley sea turtle population is a smaller, widely-scattered population with the largest nesting occurring in the Indian ocean; an estimate of 100,000 turtles nested in 2012 in Orissa (IOSEA 2013).

As discussed in the olive ridley sea turtle section of the *Environmental Baseline,* there is not detailed information on turtle takes in much of the Western Central Pacific ocean, in which the action area is a small part of. Based on reports from 13 countries that operate in the WCPFC convention area at least 268 olive ridley sea turtles were observed caught with 33 reported mortalities from 2010-2014. A portion of those interactions and mortalities would occur within the action area. From the American Samoa longline fishery we estimate that two mortalities occurred annually over the last 10 years. Based on these numbers we estimate that at least 100 mortalities occur on an annual basis in the action area from commercial longlining and purse seining. Olive ridley sea turtles in the action area may be impacted by worsening climate change, but those impacts are not discernible in the action area and in the context of this analysis and cannot be quantified because of associated uncertainties, as described above in Section 8.

As described in the olive ridley sea turtle section of the *Effects of the Action*, if we assume that the proposed action will result in approximately 17,554,000 hooks annually, then that level of effort will result in 11 olive ridley sea turtle interactions annually (Table 8), which will result in approximately four mortalities annually, which is equivalent to 0.31 adult female nesters annually. All four are expected to be from the larger eastern Pacific population. The eastern Pacific population has at least one million adult nesting females. Therefore the effect would be 0.000001 percent of the adult female population that would be affected annually. This level of impact is extremely small. The risk to the population from the proposed action is considered negligible, and therefore, neglible to the species as well.

As discussed in the *Cumulative Effects* section (Section 8), 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 and developing embryos. While olive ridley sea turtle 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. Olive ridley sea turtles in the east Pacific Ocean are seemingly adaptable to fluctuating environmental conditions. They possess the ability to shift from an unproductive habitat to one where the waters are biologically productive, which may minimize the impacts of climate change (Plotkin 1994 and 2010 in NMFS and FWS 2014).

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 Opinion.

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

The NMFS and FWS (1998d) 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 American Samoa fishery results in the removal of approximately four turtles or 0.31 adult nester equivalents annually. Viewed within the context of the Status of the Species, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects, we expect the annual mortality of four olive ridley sea turtles caused by the proposed action will not adversely affect the population dynamics of eastern Pacific olive ridley sea turtles. Moreover, we do not expect the proposed action will appreciably reduce the reproduction, numbers, or distribution of the population, and thus the species.

We conclude that the incidental take and resulting mortality of olive ridley sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival and recovery of the species. 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 negligible effect on the overall size of the population, and we do not expect it to affect the olive ridley sea turtles' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not expect 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.

Although the proposed action would result in the mortality of up to four olive ridley sea turtles annually, as discussed above, this level of mortality would present negligible 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 sea turtle nesting population, which is the source of animals found at foraging grounds, means it would not substantially impair or prohibit increases to olive ridley 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, we do not expect the proposed action to result in negative indirect effects to the species.

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 population, we find that the expected level of take from the overall action, including a small number of mortalities, is sufficiently small that it would not effect the long-term viability 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. Notwithstanding the expected annual mortalities resulting from the proposed action, we expect that the population will remain large enough to retain the potential for recovery. Moreover, we do not expect 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.

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, 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 Pacific olive ridley sea turtles in the wild.

9.4 Hawksbill Sea Turtles

As described in the hawksbill sea turtle section of the *Effects of the Action*, the proposed action could result in one hawksbill sea turtle mortality, which is equivalent to 0.35 ANE from Oceania due to hooking or entanglement annually. Hawksbill sea turtles within the action area likely originate from Oceania, where an estimated 5,400-6,160 females nest annually with a declining trend. Van Houtan used the average of 5,797 annual nesters, which with a 4-year run sum equals 23,190 nesting females in the impacted population. This level of take is 0.0001 percent of the adult female population that would be affected. This level of impact is extremely small. The risk to the population from the proposed action is considered negligible, and therefore, neglible to the species as well.

As discussed in the hawksbill sea turtle section of the *Environmental Baseline*, hawksbill sea turtles are likely killed annually by longlining, nearshore fishing, direct harvest, car collisions, and other human activities in the action area. There is no detailed information on turtle takes in much of the Western Central Pacific ocean, in which the action area is a small part of. Based on reports from 13 countries that operate in the WCPFC convention area at least 95 hawksbill sea turtles were observed caught with 12 reported mortalities from 2010-2014. A portion of the individuals killed likely occur within the action area. Based on these numbers we estimate that at least 50 mortalities could occur on an annual basis in the action area from commercial longlining and purse seining. There have been no observed interactions or mortalities in the American Samoa fishery to date. Hawksbill sea turtles in the action area may be impacted by worsening climate change, but those impacts are not discernible in the action area and in the context of this analysis and cannot be quantified because of associated uncertainties, as described above in Section 8.

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

The NMFS and FWS (1998) hawksbill 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 25 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 American Samoa fishery could result in the removal of approximately one turtle, or 0.35 adult female nesters annually. 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 hawksbill sea turtle caused by the proposed action will not adversely affect the population viability of hawksbill sea turtles. Moreover, we do not expect the proposed action to appreciably reduce the reproduction, numbers, or distribution of the population, and thus the species.

We conclude that the incidental take and resulting mortality of hawksbill sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival and recovery of the species. 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 negligible effect on the overall size of the population, and we do not expect it to affect the hawksbill sea turtles' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not expect 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 25 years.

Although the proposed action could result in the mortality of up to one hawksbill sea turtle annually, as discussed above, this level of mortality would present negligible 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 hawksbill sea turtle nesting population, which is the source of animals found at foraging grounds, means it would not substantially impair or prohibit increases to hawksbill 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, the proposed action is unlikely to indirectly adversely effect the species.

The incidental lethal and non-lethal takes of hawksbill 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 population, we find that the expected level of take from the overall action, including a small number of mortalities, is small and unlikely to adversely effect population viability 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. Notwithstanding the expected annual mortalities resulting from the proposed action, we expect that the population will remain large enough to retain the potential for both survival and recovery of the species. Moreover, we do not expect that the proposed action is reasonably likely to result in an appreciable reduction in the likelihood of recovery of the hawksbill 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.

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 expect that the lethal and non-lethal takes of hawksbill 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 hawksbill sea turtles in the wild.

9.5 South Pacific Loggerhead Sea Turtle DPS

As discussed in the loggerhead sea turtle section of the *Status of Listed Species*, nesting of South Pacific loggerhead sea turtles decreased in the 80s-90s. Since 2001, loggerhead sea turtle nesting trends at each of the six index beaches shows a reversal of the downward trend indicating that the use of TEDs have been effective in reducing bycatch mortality and that the eastern Australian nesting population is in a recovery mode with approximately 500 nesting females per year (Limpus et al., 2013; Hamann et al., 2013). The most current 2015 IUCN Red List Assessment provides mean values for the past five years at: Woongarra Coast (392 females/yr), Wreck Island (381 females/yr), and Tyron Island (222 females/yr) (IUCN 2015).

As discussed in the loggerhead sea turtle section of the *Environmental Baseline,* there is no detailed information on turtle takes in much of the Western Central Pacific ocean, in which the action area is a small part of. Based on reports from 16 countries that operate in the WCPFC convention area at least 109 loggerheads were observed caught with 30 reported mortalities from 2010-2014. A portion of those interactions and mortalities would occur within the action area. Based on these numbers we estimate that at least 50 mortalities occur on an annual basis in the action area from commercial longlining and purse seining. There have been no observed interactions or mortalities in the American Samoa fishery to date. Loggerhead sea turtles in the action area may be impacted by worsening climate change, but those impacts are not discernible in the action area and in the context of this analysis and cannot be quantified because of associated uncertainties, as described above in Section 8.

As described in the loggerhead sea turtle section of the *Effects of the Action*, our analysis assumes that the proposed action will result in up to approximately 17,554,000 hooks set annually. That level of effort is could result in two loggerhead interactions annually, and could lead to one mortality annually (representing 0.14 adult female) from the South Pacific DPS. This represents 0.0001 percent of breeding females in the South Pacific DPS. The risk posed by this level of mortality to the North Pacific loggerhead sea turtle DPS was assessed by Van Houtan (2015) for application to this Opinion. Quantitative population viability analysis (PVA) modeling works with discrete numbers; whole numbers and not partial individuals. Rounding the calculated adult female mortality (ANE) estimate up to a single individual would overestimate the fishery impacts, and therefore it was determined that the no further modeling was possible due to the extremely small impacts (Van Houtan 2015). NMFS has determined that the loss of 0.14 adult females annually as a result of the proposed action will have a negligible effect on the South Pacific DPS.

As discussed in the *Cumulative Effects* section, effects to this DPS are likely to occur as a result of worsening climate change, and any increase in fishing, marine debris, 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 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 0.14 of an adult female due to the proposed action is not expected to adversely affect population dynamics of the South Pacific loggerhead sea turtle 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 FWS' ESA Section 7 Handbook (FWS and NMFS 1998) provides further definitions for *survival* and *recovery*, as they apply to the ESA's jeopardy standard (please refer to the green turtle discussion in this section for definitions).

The NMFS and FWS (1998c) 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. 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.

Adult female nesting population size for the Sorth Pacific DPS is conservatively estimated at approximately 1400 (Van Houtan 2015). As discussed above, the anticipated deaths resulting from the continued authorization of the deep-set fishery results in the removal of approximately 0.14 female annually, or 0.0001 percent of breeding females in the South Pacific loggerhead population (Van Houtan 2015). Because this contribution to mortality is an insignificant fraction of what total mortality for the species might be, we do not expect 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.

We conclude that the incidental take and resulting mortality of South 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. 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 loggerhead sea turtles' ability to meet their lifecycle requirements and to retain the potential for recovery.

Moreover, we do not expect 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 one 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 could result in some incidental take of this DPS by the U.S. fishery, take would be subject to existing mitigation measures to reduce its impact. 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.

The proposed action will result in the mortality of less than one nesting female annually, as discussed above, this level of mortality would present negligible additional risk to the South 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.

The incidental lethal and non-lethal takes of loggerhead sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the South Pacific DPS. Although any level of take and mortality can have an adverse effect on the population, we find that the expected level of take from the action, including a small number of mortalities, is extremely small and unlikely to effect population viability 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 0.14 of an adult female equivalent. 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 South 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.

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 expect 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 South Pacific loggerhead sea turtle DPS in the wild.

9.6 Indo-West Pacific Scalloped Hammerhead Shark DPS

As discussed in the hammerhead section of the *Status of Listed Species* the population size of the Indo-West Pacific DPS is unknown but likely has experienced localized depletion in some parts of the range including off South Africa and Australia. These declines are attributed to overutilization by industrial/commercial fisheries, artisanal fisheries, and illegal fishing of the scalloped hammerhead shark as the most serious threats to the persistence of this DPS. Current effective population sizes are estimated at least 11,280 from studies in several areas around the region.

As discussed in the scalloped hammerhead section of the Environmental Baseline, a very small number of scalloped hammerheads are likely to be killed annually by the American Samoa longline fishery in the action area. However, we do not have estimates of takes from non-U.S. fisheries that operate in the action area. Within the action area the American Samoa longline fishery catches scalloped Hammerhead sharks as bycatch at very low levels. As discussed earlier the historic level of reporting by most fisheries was minimal, and where it did exist it was not precise enough to determine species of hammerhead, or even shark in most cases. Therefore we do not have an estimate of take in the action area by non U.S. vessels.

As described in the scalloped hammerhead shark section of the *Effects of the action*, response to the predicted exposure (twelve interactions annually) from the proposed action can be converted to the annual number of estimated mortalities resulting from this exposure. We estimate the response to be the mortality of four (rounded from 3.96) annually. This level of mortality represents approximately 0.04 percent of the population, which is an insignificant level. In addition, this is based on a likely underestimate of the effective population size in the region.

As discussed in the *Cumulative Effects* section, an increase in fishing could cause the greater impacts on the DPS since overutilization by fisheries is considered the greatest threat to the species. However there has been a trend recently for greater protection of sharks throughout the region through shark sanctuaries, prohibited shark fishing, and the prohibition of shark fins at all official reception dinners in China. In addition the Shark Conservation Act of 2010 requires all fisherman harvesting sharks to land the carcass intact.

We conclude that the incidental take and resulting mortality of scalloped hammerhead sharks 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 DPS 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 DPS, and we do not expect it to affect the scalloped hammerhead sharks' ability to meet their lifecycle requirements and to retain the potential for recovery.

Although the proposed action could result in up to four scalloped hammerhead sharks 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.

The incidental lethal and non-lethal takes of scalloped hammerhead sharks 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 and not likely to effect population viability 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. We expect that the population will remain large enough to retain the potential for recovery. There is no recovery plan at this time for the Indo-West Pacific scalloped hammerhead shark.

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, the lethal and non-lethal takes of scalloped hammerhead sharks associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of both the survival and recovery of the Indo-western Pacific scalloped hammerhead shark DPS.

All Species: Climate Change. Parmesan and Yohe (2003) consider climate change a driver of small-magnitude but consistent impact that is important in that it systematically affects century-scale biological trajectories and ultimately the persistence of species. Based on this consideration and the available data in predicting future impacts described earlier, the significance of climate change in the context of this analysis is low considering the limited temporal and spatial scale over which the action is likely to occur. There is currently no demonstrated link between climate change-induced environmental impacts such as sea level rise and marine turtle population indices in the modern record. This may be because most sea turtle data sets only overlap with the most recent 20-50 years of climate data, a period which is not long enough to discern changes in climate directly linked to anthropogenic causes. As indicated *supra*, the action which potentially affects ESA-listed species under NMFS jurisdiction consists of fishing operations conducted by the American Samoa longline fishery within the action area which is described in Section 4. While there is not a pre-determined length of operation for this fishery, re-consultation is required as stated in Section 12, (e.g. if ITS is exceeded, new information becomes available, the proposed action is modified, or a new species or critical habitat is designated in the action area) and will require analyses using new and updated information, including with respect to climate change impacts. Re-consultation and the resulting updated analysis of climate change-related impacts to sea turtles is likely to occur well before impacts associated with climate change and resulting adaptations are expected to be evident at a population level for listed sea turtle species. We anticipate that over the expected timeframe of the action and within the action area, recent and future mortalities that can be linked directly to climate change impacts will not be discernible because non-climate related causes dominate local, short-term biological changes. Also, it is difficult to predict how the uncertain effects of climate change will impact sea turtles when combined with other threats. Although it is likely that some sea turtle nesting sites will lose a percentage of their area to rising sea levels and typhoon activity, the synergistic impacts of these threats in the action area, and the sea turtles' ability to adapt, remain uncertain. In summary, as discussed previously in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections, very little scientific data have been collected regarding the current or future impacts of anthropogenic climate change on sea turtles, either globally or in the action area. Therefore, we cannot predict with precision how climate change will continue to impact sea turtle populations or how they will adapt to environmental changes in various habitats. Based on the best available data, we conclude that climate change-related impacts to sea turtles and sea turtle adaptations to climate change are both long-term processes that will manifest over a timescale that exceeds the term of this Opinion. Both processes are also subject to many uncertainties and are not yet well enough understood to permit more meaningful quantitative or qualitative analysis. As such, climate change-related impacts do not appear to have had a measurable impact on these species or to be likely to reduce the potential for recovery of these species in the context of the proposed action.

10 Conclusion

This Conclusion presents NMFS' Opinion regarding whether the aggregate effects of the factors analyzed under the *Environmental Baseline* (Section 6), the *Effects of the Action* (Section 7), and the *Cumulative Effects* (Section 8) in the action area, when viewed against the *Status of Listed and Proposed Species* (Section 5), are likely to jeopardize the continued existence of the listed or proposed species (i.e., jeopardy determination). The proposed Federal action addressed by this Opinion is the continued operation of the American Samoa longline fishery. After reviewing the current status of ESA-listed green sea turtles, hawksbill sea turtles, leatherback sea turtles, the South Pacific loggerhead sea turtle DPS, olive ridley sea turtles, the Indo-West Pacific scalloped hammerhead shark DPS, and the proposed green sea turtle DPSs: the Central South Pacific DPS, the Southwest Pacific DPS, the Central West Pacific DPS, the East Pacific DPS, and the East Indian-West Pacific DPS, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' Opinion that the proposed action is not likely to jeopardize the continued existence of these six species or proposed DPSs. Critical habitat has not been designated in the action area, so no critical habitat would be affected by the proposed action.

11 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)).

Typically, for proposed species the prohibitions against taking the species found in Section 9 of the Act would not apply until the species is listed. However, in this case, the green sea turtle currently is listed as threatened throughout its range, and the proposed change in its listing status would partition the globally listed species into smaller DPSs. Should the listing be finalized as proposed, then this Conference Opinion may be adopted as a Biological Opinion, and these measures with their terms and conditions would continue as non-discretionary.

11.1 Amount or Extent of Take

The annual numbers of interactions and mortalities expected to result from implementation of the proposed action of the continued operation of the American Samoa longline fishery are shown for a 3-year period in Table 10 below (i.e., a 3-year ITS). The ITS is established for 3-year periods (i.e., years 1 – 3) after implementation of the proposed action. If the total number of authorized sea turtle interactions during any consecutive 3-year period is exceeded, reinitiation of consultation will be required (50 CFR 402.16). After implementation of the proposed action and the period of years 1 through 3 has ended, a new 3-year ITS period will begin with years 2 through 4, and so on. The Reasonable and Prudent Measures below and their implementing Terms and Conditions are designed to ensure that the proposed action reduces interactions to anticipated annual levels and minimizes those impacts.

Table 10. The total number of turtles, and scalloped hammerhead shark interactions (i.e. take) expected from the proposed action over a three –year period. Also shown are the total mortalities (i.e. take) (males and females, adults and juveniles) expected to result from this number of interactions, and the annual equivalent adult female mortalities (AFMs) for turtles. Observed takes are extrapolated to total interactions (takes) in order to monitor the ITS by multiplying the number of confirmed observed takes by an expansion factor based on current observer coverage.

Species	3-Year Interactions	3-Year Total mortalities	3-Year Equivalent AFMs
Green sea turtle	60	54	0.3
Leatherback sea turtle	69	49	1.65
Olive ridley sea turtle	33	10	0.93
Hawksbill sea turtle	6	3	1.05
South Pacific loggerhead turtle DPS	6	3	0.42
*Indo-West Pacific Scalloped Hammerhead Shark DPS	36	12	NA

*An ITS is not required to provide protective coverage for the Indo-West Pacific scalloped hammerhead shark DPS because there are no take prohibitions under ESA section 4(d) for this DPS. Consistent with the decision in *Center for Biological Diversity v. Salazar*, 695 F.3d 893 (9th Cir. 2012), however, this ITS is included to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger so the action does not jeopardize the species if the level of take analyzed in the biological opinion is exceeded.

In addition an ITS was created based on the proposed Distinct Population Segments for green sea turtles that are anticipated to be affected. This ITS will only be valid if and when the proposed listings become final (Table 11).

Table 11. The total number of green sea turtle interactions (i.e. take) from each proposed DPS expected from the proposed action over a three –year period. Also shown are the total mortalities (i.e. take) (males and females, adults and juveniles) expected to result from this number of interactions, and the annual equivalent adult female mortalities (AFMs) for each DPS. Observed takes are extrapolated to total interactions (takes) in order to monitor the ITS by multiplying the number of confirmed observed takes by an expansion factor based on current observer coverage. We note the estimated proportion of each DPS in parentheses, which will be used to prorate green turtle interactions to the applicable DPSs. Assignment of green turtle takes to DPSs may be informed by genetic analysis of a particular turtle, where applicable, rather than the mixed stock analysis percentages. This ITS will be used for green sea turtles when the proposed DPS listings are finalized.

Green Turtle DPS (Percent represented)	3-Year		
	Interactions	Total mortalities	Equivalent AFMs
Central South Pacific DPS (50)	30	27	0.15
Southwest Pacific DPS (33)	20	17.82	0.099
East Pacific DPS (12)	7	6.48	0.036
Central West Pacific DPS (3)	2	1.62	0.009
East Indian-West Pacific DPS (2)	1	1.08	0.006

11.2 Impact of the Take

In the accompanying Opinion, NMFS determined that the level of incidental take anticipated from the proposed action is not likely to jeopardize the green sea turtle, leatherback sea turtle, hawksbill sea turtle, South Pacific loggerhead sea turtle DPS, olive ridley sea turtle, or the Indo-West Pacific scalloped hammerhead shark DPS. Additionally, the level of incidental take anticipated from the proposed action is not likely to jeopardize the continued existence of the five proposed green sea turtle DPSs: the Central South Pacific DPS, the Southwest Pacific DPS, the Central West Pacific DPS, the East Pacific DPS, and the East Indian-West Pacific DPS.

11.3 Reasonable and Prudent Measures

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

The incidental take expected to result from the proposed action is shown in Table 10 above for each sea turtle species and the scalloped hammerhead shark, and in Table 11 for the proposed green sea turtle DPSs. NMFS has determined that the following reasonable and prudent measures, as implemented by the terms and conditions (identified in Section 11.4), are necessary and appropriate to minimize the impacts of the American Samoa longline fishery, as described in the proposed action, on sea turtles and sharks, and to monitor the level and nature of any incidental takes. These measures apply to both the globally listed green sea turtle and to the proposed DPSs. 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 investigate and promote activities to reduce the likelihood of sea turtle and scalloped hammerhead shark interactions.

2. NMFS shall collect data on the capture, injury, and mortality of sea turtles and scalloped hammerhead sharks caused by the American Samoa longline fishery, and shall also collect basic life-history information, as available.

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

4. NMFS shall require that comatose or lethargic sea turtles 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.

5. NMFS shall require the carcasses of sea turtles that are dead or that appear dead and cannot be resuscitated when brought on board a vessel be discarded and only retained for sea turtle research if requested by NMFS, as practicable and in consideration of best practices for safe vessel and fishing operations.

6. NMFS shall investigate post-hooking mortality of scalloped hammerhead sharks to identify safe handling and release methods.

11.4 Terms and Conditions

NMFS shall undertake and comply with the following terms and conditions to implement the reasonable and prudent measures identified in Section 11.3 above.

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

   1A. NMFS shall conduct research, as practicable, on potential gear modifications and fishery trends to understand and reduce the number and/or severity of interactions with protected species in the American Samoa longline fishery.

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

   2A. 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 and scalloped hammerhead sharks. Observers shall also collect life-history information on sea turtles captured by the American Samoa longline 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 upon release. In addition NMFS shall investigate methods to obtain more accurate lengths of large turtles that cannot be boarded. 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.

2B. NMFS shall disseminate semi-annual summaries of the data collected by observers to the NMFS PIRO Assistant Regional Administrators of Protected Resources and Sustainable Fisheries, as well as the NMFS Sea Turtle Coordinators in the PIR, Southwest Region, and Headquarters.

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

3A. NMFS shall continue to require and provide protected species workshops for all owners and operators of vessels registered for use with American Samoa longline limited access permits, to educate vessel owners and operators in handling and resuscitation techniques to minimize injury and promote survival of hooked or entangled sea turtles. 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.

3B. NMFS shall continue to train observers about sea turtle biology and techniques for proper handling and resuscitation.

3C. NMFS shall require that American Samoa longline fishermen remove hooks from live turtles as quickly and carefully as possible to avoid further injury to the turtle, as practicable and in consideration of best practices for safe vessel and fishing operations. NMFS shall require that each American Samoa 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 ingested or the animal is too large to bring aboard).

3D. NMFS shall require that each American Samoa longline vessel with freeboard more than 3 ft carry and use a dip net to lift a sea turtle onto the deck to facilitate gear removal. If the vessel has a freeboard less than 3 ft, sea turtles must be eased onto the deck by grasping its carapace or flippers, to facilitate the removal of fishing gear. 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.

3E. NMFS shall require each American Samoa longline vessel to carry and use, as appropriate, a wire or bolt cutter that is capable of cutting through any hook used by the vessel that may be imbedded externally, including the head/beak area of a turtle.

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

4A. NMFS shall require that American Samoa longline vessel operators bring comatose sea turtles aboard and perform resuscitation techniques according to the procedures described at 50 CFR 665, as practicable and in consideration of best practices for safe vessel and fishing operations, except that observers shall perform resuscitation techniques on comatose sea turtles if observers are available on board.

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

    5A. NMFS shall require that dead sea turtles not be consumed, sold, landed, offloaded, transshipped, or kept below deck. Fishermen must return turtles to the ocean after identification, unless NMFS, including observers, requests the turtle be kept and returned to port for further study.

12 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 reduce 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 and conservation efforts which would help in reducing adverse impacts to listed species in the Pacific Ocean, specifically those occurring in Oceania.

1. NMFS should maintain annual observer coverage in the American Samoa longline fishery at greater than or equal to 20 percent, as practicable, to obtain data necessary to provide a statistically robust estimate of sea turtle and scalloped hammerhead shark bycatch in this fishery.

2. 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 WCPFC and IATTC sea turtle conservation and management measures for commercial longline fisheries operating in the 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 and eastern Pacific;
    e. Observer programs on commercial vessels operating in the western Pacific region and expansion of existing programs, and;
    f. Continuation of ecological, habitat use, and genetics studies of all sea turtles occurring in foraging and migratory habitats in the Pacific, continue monitoring impacts through stranding programs, and promote mitigation studies and handling measures for fisheries operating in these waters.

3. NMFS should continue to encourage, support and work with regional partners to better understand and quantify threats from human actions (e.g., fishery, pollution, habitat degradation, and harvest-related impacts, etc.), and implement long-term sea turtle monitoring, conservation, and recovery programs at critical nesting and foraging habitats.

4. NMFS should conduct research on alternative fishing methods and/or gear configurations to reduce the number and/or severity of sea turtle interactions in the American Samoa longline fishery.

13 Reinitiation Notice

This concludes formal consultation on the continued authorization of the American Samoa longline fishery. 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 the incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. If the amount or extent of incidental take identified in the incidental take statement that is enclosed in this Opinion is exceeded, NMFS SFD should immediately request initiation of formal consultation.

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Endangered Species Act Intergovernmental Coordination and Conservation Branch
Protected Resources Division
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
Honolulu, Hawaii

SECTION 515 PRE-DISSEMINATION REVIEW & DOCUMENTATION FORM

AUTHOR/RESPONSIBLE OFFICE: Dawn Golden, Intergovernmental Coordination and Conservation Branch, Protected Resources Division, Pacific Islands Regional Office, National Marine Fisheries Service, Honolulu, Hawaii

TITLE/DESCRIPTION: Biological Opinion regarding the Continued Operation of the American Samoa longline fishery

PRESENTATION/RELEASE DATE: October 15, 2015

MEDIUM: Final biological opinion will be provided to Mr. Bob Harman of the Sustainable Fisheries Division, Pacific Islands Regional Office, National Marine Fisheries Service.

PRE-DISSEMINATION REVIEW:
Name and Title of Reviewing Official:

Mr. Pat Opay
Section 7 Coordinator, Protected Resources Division,
Pacific Islands Regional Office

Pursuant to Section 515 of Public Law 106-554 (the Data Quality Act), this product has undergone a pre-dissemination review.

Signature Date

SECTION 515 INFORMATION QUALITY DOCUMENTATION

1. Utility of Information Product

Explain how the information product meets the standards for **utility**:

A. Is the information helpful, beneficial or serviceable to the intended user?

This document is intended to assist the Sustainable Fisheries Division, Pacific Islands Regional Office of the National Marine Fisheries Service in meeting their obligations under Section 7 of the ESA. It analyzes and documents the impacts of the proposed continued operation of the American Samoa longline fishery on listed species and critical habitat utilizing documents provided by the National Marine Fisheries Service and other published and unpublished information related to listed species, activities specific to fishing, and other relevant information.

B. Is the data or information product an improvement over previously available information? Is it more current or detailed? Is it more useful or accessible to the public? Has it been improved based on comments from or interactions with customers?

The document is a new document assessing the specific impacts to listed species during fishing activities. This document has been shared with the Sustainable Fisheries Division, Pacific Islands Regional Office and has been improved based upon their expertise and input.

C. What media are used in the dissemination of the information? Printed publications? CD-ROM? Internet?
Is the product made available in a standard data format?
Does it use consistent attribute naming and unit conventions to ensure that the information is accessible to a broad range of users with a variety of operating systems and data needs?

The document will be provided in print form as well as electronically.

2. Integrity of Information Product

Explain (**Bold text**) how the information product meets the standards for **integrity:**

(A.) All electronic information disseminated by NOAA adheres to the standards set out in Appendix III, Security of Automated Information Resources, OMB Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

B. If information is confidential, it is safeguarded pursuant to the Privacy Act and Titles 13, 15, and 22 of the U.S. Code (confidentiality of census, business and financial information).

C. Other/Discussion
(e.g., Confidentiality of Statistics of the Magnuson-Stevens Fishery Conservation and Management Act; NOAA Administrative Order 216-100 - Protection of Confidential Fisheries Statistics; 50 CFR 229.11, Confidentiality of information collected under the Marine Mammal Protection Act.)

3. Objectivity of Information Product

(1) Indicate which of the following categories of information products apply for this product:

G Original Data
G Synthesized Products
G Interpreted Products
G Hydrometeorological, Hazardous Chemical Spill, and Space Weather Warnings, Forecasts, and Advisories
G Experimental Products
G Natural Resource Plans
G Corporate and General Information

(2) Describe how this information product meets the applicable objectivity standards. (See the DQA Documentation and Pre-Dissemination Review Guidelines for assistance and attach the appropriate completed documentation to this form.)

Natural Resource Plans are information products that are prescribed by law and have content, structure, and public review processes (where applicable) that will be based upon published standards, e.g., statutory or regulatory guidelines. Examples of such published standards include the National Standard Guidelines (50 CFR Part 600, Subpart D), Essential Fish Habitat Guidelines, and Operational Guidelines Fishery Management Plan Process, all under the Magnuson-Stevens Fishery Conservation and Management Act; and the National Marine Sanctuary Management Plan Handbook (16 U.S.C. section 1434) under the National Marine Sanctuary Act. These Natural Resource Plans are a composite of several types of information (e.g., scientific, management, stakeholder input, and agency policy) from a variety of internal and external sources. Examples of Natural Resource Plans include fishery, protected resource, and sanctuary management plans and regulations, and natural resource restoration plans.

Objectivity of Natural Resource Plans will be achieved by adhering to published standards, using information of known quality or from sources acceptable to the relevant scientific and technical communities, presenting the information in the proper context, and reviewing the products before dissemination. Biological Opinions are included under the category of Natural Resource Plans.

What published standard(s) governs the creation of the Natural Resource Plan?
Section 7 of the Endangered Species Act and its implementing regulations require that agency Plans (or biological opinions) use the best scientific and commercially available data. Use of such data is the published standard that governs the creation of the Plan.

Does the Plan adhere to the published standards? Yes. The Plan is consistent with the best scientific and commercially available data standard used by NMFS Protected Resources Division, Pacific Islands Regional Office for section 7 consultation under the Endangered Species Act. The Plan evaluated and used the best scientific and commercially available data for its analysis.

Was the Plan developed using the best information available? The Plan used the best scientific and commercially available information. The data used was available and accessible in a manner consistent with section 7(a)(2) of the Endangered Species Act of 1973 *et seq.*, the regulations implementing section 7 of the Endangered Species Act, and policy and guidance for section 7 consultations. We evaluated and used data submitted from the Sustainable Fisheries Division, Pacific Islands Regional Office of the National Marine Fisheries Service, published journal articles and published and unpublished reports.

The Plan clearly articulated the methods by which this product was created. The approach used in drafting this product was discussed under the heading "Approach to the Assessment" within the document.

Have clear distinctions been drawn between policy choices and the supporting science upon which they are based? The document concluded that the continued operation of the fisheries will not jeopardize the continued existence of any ESA-listed marine mammals, sea turtles, or sharks or destroy or adversely modify designated critical habitat under NMFS' jurisdiction. The final biological opinion presents NMFS' consideration of the best available scientific and commercial information.

Have all supporting materials, information, data and analysis used within the Plan been properly referenced to ensure transparency? The Plan cites Source documents and data throughout the document. The Plan also contains a *Literature Cited* section that clearly documents these Sources per agency standards.

Describe the review process of the Plan by technically qualified individuals to ensure that the Plan is valid, complete, unbiased, objective and relevant. The review process consisted of internal review by NMFS' Protected Resources Division, Pacific Islands Regional Office staff with subject matter expertise. Additionally, the Plan was reviewed by the NOAA Fisheries Pacific Islands Regional Office General Counsel and NMFS regional staff with experience implementing the Endangered Species Act. They included the Protected Resources Division Section 7 Coordinator, the Chief of the Pacific Islands Section of the NOAA Office of General Council, and the Protected Resources Division Assistant Regional Administrator. The Sustainable Fisheries Division also reviewed the Plan using their expertise in fishing activities.