UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

April 8, 2011

In response, refer to:
2011/01408:EP

Mark Helvey
Assistant Regional Administrator
Sustainable Fisheries Division
Southwest Regional Office
National Marine Fisheries Service
501 West Ocean Blvd Suite 4200
Long Beach, CA 90802

Dear Mr. Helvey:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) final biological opinion (Opinion enclosed) based on NMFS Protected Resources Division (PRD) review of the proposed action of continued authorization of the deep-set tuna longline fishery managed under the Fishery Management Plan (FMP) for U.S. West Coast Highly Migratory Species (HMS) and the continued operation of HMS fishery vessels in the deep-set tuna longline fishery under permits pursuant to he High Seas Fishing Compliance Act (HSFCA) and its effects on species listed on the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), in accordance with Section 7 of the ESA. Specifically, this Opinion is primarily focused on analyzing the effects on four species of sea turtles: green (globally listed as threatened except for breeding populations in Florida and Gulf of Mexico which are listed as endangered); loggerhead (globally listed as threatened); leatherback (globally listed as endangered); and olive ridley (globally listed as threatened except for the nesting population on the Pacific coast of Mexico which are listed as endangered). On March 16, 2010, NMFS and the United States Department of the Interior issued a proposed rule that would establish nine distinct population segments (DPSs) of loggerhead sea turtles (75 FR 12598). A final rule is expected to be published in late 2011. The proposed loggerhead DPS found in the action area for this opinion is the North Pacific Ocean (NPO) DPS. The NPO DPS is being proposed for listing as endangered. This opinion, therefore, is also a conference opinion pursuant to §7(a)(4) of the ESA that considers the effects of the action on the NPO DPS of loggerhead sea turtles.

Based on the best available scientific and commercial information, NMFS' Opinion concludes that the continued authorization of the deep-set tuna longline fishery managed under the FMP for U.S. West Coast HMS and the continued operation of HMS fishery vessels in the deep-set tuna longline fishery under permits pursuant to the HSFCA are not likely to jeopardize the continued existence of the ESA-listed sea turtles covered in this Opinion.

NMFS PRD and SFD have had discussion on the preparation and scope of this Opinion, the development of the Incidental Take Statement, as well as Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&Cs)of the Opinion, which are non-discretionary pursuant to Section 7(b)(4) of the ESA. Discretionary Conservation Recommendations are also contained in this Opinion. The ITS within this opinion covers a three year period beginning this year, 2011, and ended at the end of the fishing season 2013. The next three year period will begin at the beginning of the fishing season in 2014. Due to the low anticipated number of interactions between DSLL gear and sea turtles, issuing the ITS for a period of three consecutive years was considered by SFD and PRD the most reasonable approach. This Opinion includes the same RPMs and T&Cs that are in NMFS' 2004 Opinion on the HMS FMP and applies them to the DSLL. The DSLL was not part of the proposed action in the 2004 HMS FMP.

Please contact Mr. Chris Yates at (562) 980-4007, if you have any questions.

Sincerely,

Kevin Chu

for Rodney R. McInnis
Regional Administrator

Enclosure

cc: Copy to file: 151422SWR2011PR00184

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

ACTION AGENCY:	**National Marine Fisheries Service, Southwest Region, Sustainable Fisheries Division**
ACTION:	Authorization of (1) the deep-set tuna longline fishery managed under the Fishery Management Plan for U.S. West Coast Highly Migratory Species, and (2) continued operation of Highly Migratory Species fishery vessels in the deep-set tuna longline fishery under permits pursuant to the High Seas Fishing Compliance Act.
CONSULTATION CONDUCTED BY:	National Marine Fisheries Service, Southwest Region, Protected Resources Division
FILE NUMBER:	SWR2011PRD00184
DATE ISSUED:	**April 8, 2011**

1. INTRODUCTION

On February 4, 2004, the National Marine Fisheries Service (NMFS), Southwest Region (SWR) Protected Resources Division (PRD) completed a biological opinion on the adoption of: (1) a proposed Highly Migratory Species (HMS) Fishery Management Plan (FMP) under the Magnuson-Stevens Fishery Conservation and Management Act; (2) continued operation of Highly Migratory Species fishery vessels under the High Seas Fishing Compliance Act; and (3) an Endangered Species Act (ESA) regulation on the prohibition of shallow longline sets east of the 150° West longitude. The proposed action as described by the SWR's Sustainable Fisheries Division and consulted upon by PRD did not include a deep-set longline (DSLL) for tuna fishery. The HMS FMP regulates and allows fishing with deep-set longline for HMS on the high seas, however at the time of the 2004 consultation it was believed that such a fishery would not develop. The terms and conditions of the 2004 opinion require NMFS to place observers aboard any longline vessel subject to the HMS FMP making deep sets in order to monitor the effects to listed species.

In 2005, one fisherman began operating a DSLL fishery, targeting primarily bigeye tuna. As required, observers were placed on his vessel. In policy adopted by NMFS in 2004, fisheries for which a High Seas Fishing Compliance Act permits are issued must be compliant with the National Environmental Policy Act (NEPA) and the ESA. The Southwest Region determined that due to the lack of analysis of the deep-set longline fishery in the HMS FMP EIS and the 2004 opinion, that it was appropriate to conduct a NEPA analysis (a draft Environment Assessment has been prepared by SFD) and initiate ESA consultation on the DSLL component of the HMS fishery. Further, as described by the participant in this fishery at public meetings, an olive ridley sea turtle was observed entangled in gear and killed during the DSLL fishing operations in January 2006 (PFMC meeting April 2009). The SFD anticipates that other fishermen may choose to enter this fishery, thus they have requested an initiation of consultation for the deepset longline component of the HMS fishery as required in the 2004 opinion. The deepset longline fishery has developed in such a manner that causes an effect to the listed species or critical habitat not considered in the original 2004 opinion. The development of the DSLL fishery and the take of the olive ridley triggered the initiation of this consultation.

This opinion analyzes the effects of the DSLL component of the HMS fishery only. The 2004 biological opinion on the rest of the HMS FMP is still applicable. There have been no changes in the HMS FMP, as analyzed in the 2004 opinion, that trigger re-initiation of consultation.

On March 16, 2010, NMFS and the United States Department of the Interior issued a proposed rule that would establish nine distinct population segments (DPSs) of loggerhead sea turtles (75 FR 12598). The proposed loggerhead DPS found in the action area for this opinion is the North Pacific Ocean (NPO) DPS. The NPO DPS is being proposed for listing as endangered. This opinion, therefore is also a conference opinion pursuant to §7(a)(4) of the ESA that considers the effects of the action on the NPO DPS of loggerhead sea turtles.

1.2 Consultation history

Beginning in January 2006, PRD and SFD engaged in informal consultation on the deep-set longline fishery, with PRD providing technical assistance to SFD of its obligations under the ESA. On December 29, 2006, SFD provided PRD with an initiation package detailing the DSLL fishery, the proposed action, and requested formal consultation to analyze the effects of the proposed action on olive ridley, loggerhead, leatherback, and green turtles.

As requested, PRD engaged in consultation on the proposed action defined in the December 29, 2006 memo. The proposed action area was narrowly defined in the original memo as the area between 20° north latitude to 30° north latitude and between 118° west longitude and 135° west longitude, consistent with the DSLL observed in 2005 and 2006. The original proposed action described the fishery as occurring December through May. Also, the original action did not include continued authorization of the DSLL under the High Seas Fishing Compliance Act (HSFCA) which is required of fisheries operating on the high seas. SFD and PRD engaged in discussions with participants and potential participants in the DSLL to better define the possible fishery effort. The two divisions also reviewed the HMS FMP to determine the scope of the longline fishery, as well as reviewed NOAA's policy regarding HSFCA. After a series of meetings, SFD prepared a memo revising the proposed action on June 1, 2007.

There were three key changes in the proposed action described and analyzed in SFD's revised memo. The first is the proposed action area, which is defined as the entire north Pacific; however, the primary area of activity has been and is expected to continue to be between the equator and 35° north latitude and between the United States and Mexico EEZ boundaries (i.e., more than 200 nm from shore) and 140° west longitude. Second, the timing of the proposed action was changed. Most of the fishing effort is expected to occur from December to May, based upon observer records although it is possible that a low level of effort may occur in the fall. No effort is expected in the summer. Finally, the proposed action is modified to include the continued operation of HMS fishery vessels under permits pursuant to the High Seas Fishing Compliance Act (HSFCA). Because the DSLL component of the HMS fishery was not considered part of the proposed action in 2004, it was not analyzed as part of the biological opinion on the adoption of the HMS FMP (NMFS 2004). Therefore, a section 7 consultation on the deep-set longline fishery that has developed since 2004 is necessary in order to be compliant with NMFS' policy regarding the HSFCA and the ESA.

In September 2008, SFD completed a draft Environmental Assessment (EA) analyzing the continuation of the DSLL fishery. The draft EA was released for public comment and included questions about the impacts on protected species. SFD, with assistance from PRD, responded to comments, but made no changes to the proposed action. The revised DEA was provided to PRD in February 2010. Thus, the proposed action as described in their June 1, 2007 letter of initiation is the proposed action that is subject to this biological opinion. As described in the DEA, the analysis of impacts was done for a three year period in order to account for possible changes in the fishery. SFD plans to continue to evaluate the DSLL fishery over the next three years and may proposed regulatory changes (e.g., limited entry) in the future, however at this point, no changes are planned in the near term. Thus the proposed action is the authorization of the DSLL fishery for the next three years, ending in May 2014.

SFD determined that all four species of sea turtles in the proposed action area are likely to be adversely affected; these are green, loggerhead, leatherback, and olive ridley sea turtles. A number of listed whales are likely to be within the proposed action area, but none are expected to be adversely affected by the proposed action, per SFD's analysis. Also, there is no designated critical habitat within the proposed action area, so there will be no adverse modification or destruction of critical habitat as a result of fishing under the proposed action.

2. APPROACH TO THE ASSESSMENT

2.1. Method

After receiving a complete description of the proposed action from the SFD, we began our assessment of how best to analyze the effects of the proposed action.

2.1.1. Description of the proposed action

As a first step in our analysis we deconstruct the action by describing the gear and methods used in the proposed fishery. We then describe the proposed action area, based upon the information provided by the action agency. An important aspect of the proposed action is the anticipated effort level, which is based upon the best estimates available from the action agency. Finally, we describe any conservation measures included in the proposed action and proposed observer coverage.

2.1.2 Conduct exposure analyses to determine ESA-listed species and critical habitats that are likely to be exposed to the effects of the deep-set fishery

Our next step was to determine which ESA-listed species may be in the proposed action area and which species are likely to be exposed to the proposed action. Once we have determined which species are likely to be exposed to the deep-set longline fishery, we provide information on the species status.

As part of this step, we considered where exposure may occur, which populations and which life stage of affected species may be exposed, the number of individuals that may be exposed, and how exposure may vary based upon variables such as oceanographic conditions. Because so little direct information on species interactions with DSLL is available from within the primary area of activity within the proposed action area, another deep-set longline fishery was used as a surrogate and exposure probabilities supported by available information on the distribution of species within the action area.

2.1.3 Conduct response analysis to determine ESA-listed species' likely response to the deep-set longline fishery

Once we determined which species are most likely to be exposed and affected by the proposed action, we determined the likely responses of those individuals to the exposure. Again, basis for this analysis was data taken from a similar DSLL fishery, as there is very limited direct information from the fishery within the area of most anticipated effort.

2.1.4 Conduct a risk analysis to determine the risk to the population and the species as listed from the DSLL fishery

Our final step in the analysis includes the results of the previous two steps. We consider the effects of the proposed action within the context of the species' current status, environmental baseline and factors affecting the species within the action area. All of the species considered in this opinion are migratory, we therefore considered a variety of effects both within and outside the immediate action area that can have profound and sometimes unquantifiable effects of the species.

As described in step two, we considered the life stages of the individuals likely to be captured (if the information is available) and what is likely to happen to the individuals as a result of interactions with the proposed DSLL fishery. We then considered the effect of the loss of individuals on the specific populations and on the global populations, for species listed globally. We considered both qualitative and quantitative methods for assessing impacts. There are limited quantitative available to assess impacts. One is a model developed in 2008 by the Pacific Islands Fisheries Science Center to assess the impacts of loggerhead and leatherback mortality on their respective nesting populations (Snover 2008). This model was one of the tools that we used in our assessment.

Our charge in this is not to identify all sources of mortalities and threats to all relevant species and rank these in order of significance. Neither is it to rank the proposed action within the existing threats. Our task is to determine if the anticipated exposure and response of species, when added to the existing and ongoing threats, conservation efforts, and species viability, would be reasonably expected to reduce the species reproduction, survival, and recovery in the wild.

2.2. Information available for the analysis

2.2.1 Observer information

The DSLL fishery has been observed at 100% since it began in 2005. While NMFS respects that these data are confidential under the the Magnuson-Stevens Fishery Conservation and Management Act, information on the level of bycatch has been provided to the public by the participant in the fishery during public testimony. NMFS therefore uses the data in the same manner in which it was provided, very broadly defined so as to not violate confidentiality.

2.2.2 Hawaii deep-set longline fishery

This fishery has been observed at approximately 20% for the past decade and represents a much larger data set for developing analyses of possible impacts. The fishery operates primarily to the south of Hawaii between the Equator and 20° N. In some years there may be considerable fishing north of Hawaii, up to 30° N. The fishery operates between 180° and 140° west longitude (NMFS 2008). While it is acknowledged that the primary action area of the Hawaii DSLL is not the same as the primary area of the proposed HMS DSLL fishery, both fisheries may operate anywhere on the high seas of the Pacific, north of the equator, so the Hawaii DSLL is not an unreasonable proxy for the types of exposures, species and responses that may occur in the HMS DSLL fishery.

2.2.3 U.S. shallow-set longline fisheries based in Hawaii and California

Observer data are available from the shallow-set longline fisheries that occur on the high seas. Up until 2004, there was a California based shallow-set longline fishery that occurred off the U.S. West Coast EEZ which was observed at approximately 20% (approximately 460 observed sets). Since 2004, the Hawaii based shallow-set longline fishery has operated with 100% observer coverage. While neither of these fisheries operate in the area where most effort is anticipated in the proposed action (i.e., east of 140° West longitude and north of the equator), they do serve as another data source of which species may be exposed to the proposed action and possible responses of the individuals.

3. DESCRIPTION OF THE PROPOSED ACTION

3.1. Gear and methods

NMFS proposes to authorize under the HMS FMP and the HSFCA a small scale deep-set tuna longline fishery. The gear is typically set at first light in the morning and hauled back close to dusk depending on the time of year. Average soak time is about 12 hours. The gear is set so that the deepest sag of the mainline is 100 to 320 meters below the surface of the water. The mainline is typically made of single strand monofilament approximately 3.1 mm to 3.5 mm in diameter. The mainline diameters and colors (clear, mixed, white) may differ among fishermen and preferences. The mainline length ranges from 7 km to 75 km. The float lines are typically made of single strand monofilament measuring 17.8 m to 18.4 m in length, with a line diameter of 2.0 mm. The number of float lines deployed varied by length of main line set and ranged from 20 to 128 for the observed sets. Branch lines in this fishery are reportedly 7.8 m to 10.9 meters in length. The branch lines are typically made of monofilament, clear or mixed in color, measuring 2.0 mm in diameter. Single strand monofilament leaders range in length from 1.5 m to 4.0 m and are attached to weights weighing 75 g to 80 g at the end of each branch line. Leaders are generally double weighted to ensure deeper sink rates. Each branch line leader pairing terminates in a single hook varying in size and shape. A variety of hooks are typically used in this fishery including size 38 tuna hooks, size 9 J-hooks, and size 16/0 circle hooks. There is no required hook type or size in this fishery. A minimum of 15 hooks are clipped on the main line at regular intervals between each float. Sardine bait is typically used in this fishery.

Participants in this fishery are required to adhere to all applicable Federal regulations found at 50 CFR 223.206(d)(9), which stipulates that the mainline be set greater than 100 meters below the surface of the water, a minimum of 15 hooks must be deployed between two floats when using monofilament longline, and no fewer than 10 hooks must be deployed between two floats when using basket-style longline gear. In addition, no lightsticks may be used.

The target species of this fishery are tuna, primarily bigeye, although a variety of other tunas are also caught and retained including albacore and yellowfin. Other marketable species that are landed in the deep-set tuna longline catch include, but are not limited to opah (*Lampris regius*), mahi mahi (*Coryphaena hippurus*), escolar (*Lepidocybium flavobrunneum*), and pomfret (*Taractichthys steindachneri)*. Relatively few sharks, in proportion to those caught, have been marketed from the high seas fishery. The major shark bycatch in this fishery is blue shark, which is discarded for economic reasons because the flesh quickly deteriorates after death.

3.2 Action Area and Effort

Since 2005, all of the fishing activity has occurred between the equator and 35° north latitude and between the United States and Mexico EEZ boundaries (200 nm from shore) and 140° west longitude. This area is representative of where most, if not all, DSLL activity is likely to occur. The HMS FMP does not prohibit DSLL activity anywhere north of the equator and outside the U.S. West Coast EEZ, however there is a seasonal prohibition on longline gear use from April 1 to May 31 in waters bounded on the south by 0° latitude, on the north by 15° N. latitude, on the east by 145° W. longitude, and on the west by 180° W. longitude. The action area is the north Pacific, with the time and area closure noted above, with the primary area of activity being outside the U.S. West Coast EEZ west to 140° W. longitude and from the equator to 35 north.

NMFS Southwest Region observer records show all of the deep-set tuna longline sets observed since 2005 were between the months of January and May, thus all were within the proposed action area as described above. Most of the effort in the fishery is expected to occur during the months of December through May. No fishing effort is expected in the summer. It is possible that some fishing effort will occur in the fall months, however, this is expected to be minimal.

There is currently no requirement in the HMS FMP that vessels engaged in deep-set tuna longline fishing carry vessel monitoring systems (VMS).

SFD, in consultation with the current participant, believes that future fishing effort in this fishery will be approximately 1,900 hooks per set. This level is consistent with numbers of hooks typically employed in the Hawaii-based deep-set tuna longline fishery. The anticipated effort level for the proposed action will be approximately 800,000 hooks, based on six vessels making 14 sets per trip, 5 trips per season, and setting 1,900 hooks per set. SFD does not anticipate that six vessels will participate in this fishery immediately. However, this level of effort may be realized in the future, particularly if regulations and/or poor catches in other West-Coast based fisheries force eligible vessels to seek alternate open-access fishing options available to them.

SFD, in their initiation of consultation, requested that we consider the effects of the proposed action over the next three years. It is believed that there will be no changes to the fishery during this time. However, SFD anticipates that changes to the DSLL fishery may be proposed in a few years, thus triggering re-initiation of consultation. Therefore, the biological opinion is for the 2011, 2012 and 2013 fishing seasons.

4. STATUS OF SPECIES There are a number of species listed under the ESA that may occur in the action area. These are listed in Table 1.

Table 1: ESA listed species under NMFS jurisdiction that may occur in the action area

Blue whale *(Balaenoptera musculus)*		Endangered
Fin whale *(Balaenoptera physalus)*		Endangered
Humpback whale (*Megaptera novaeangliae*)		Endangered
Sei whale (*Balaenoptera borealis*)		Endangered
Sperm whale (*Physeter macrocephalus*)		Endangered
Steller sea lion - eastern distinct population segment (DPS) (*Eumetopias jubatus*)		Threatened
Killer whales - southern resident DPS (*Orcinus orca*)		Endangered
Northern right whale (*Eubalaena glacialis*)		Endangered
Guadalupe fur seals, (*Arctocephalus townsendi)*		Threatened
Leatherback turtle (*Dermochelys coriacea*)		Endangered
Loggerhead turtle (*Caretta caretta*)*		Threatened
Olive ridley (*Lepidochelys olivacea*)		Endangered/threatened
Green turtle (*Chelonia mydas*)		Endangered/Threatened
Steelhead (*Oncorhynchus mykiss*)	Southern California DPS	Endangered
	South-Central California DPS	Threatened
	Central California Coast DPS	Threatened
	California Central Valley DPS	Threatened
	Northern California DPS	Threatened
	Upper Columbia River DPS	Endangered
	Snake River Basin DPS	Threatened
	Lower Columbia River DPS	Threatened
	Upper Willamette River DPS	Threatened
	Middle Columbia River DPS	Threatened
Chinook (*Oncorhynchus tshawytscha*)	Puget Sound	Threatened
	Sacramento River winter	Endangered
	Snake River Fall	Threatened
	Snake River Spring/Summer	Threatened
	Lower Columbia River	Threatened
	Upper Willamette River	Threatened
	Upper Columbia River Spring	Endangered
	Central Valley Spring	Threatened
	California Coastal	Threatened
Chum (*Oncorhynchus keta*)	Hood Canal Summer Run	Threatened
	Columbia River	Threatened
Coho (*Oncorhynchus kistuch*)	Central California Coastal	Threatened
	S. Oregon/N. CA Coastal	Threatened
	Lower Columbia River	Threatened
	Oregon Coast natural	Threatened
Sockeye (*Oncorhynchus nerka*)	Snake River	Endangered

* On March 16, 2010, NMFS and DOI proposed a rule that would establish nine DPS's of loggerhead turtles; the DPS that interacts with this fishery was proposed to be listed as endangered. A final rule is expected in 2011.

Interactions between DSLL gear and protected species are quite rare (NMFS 2005), we therefore considered both the existing fishery and other fisheries to evaluate which ESA listed species are most likely to be affected by the action. As noted above, since 2005, one fisherman has been DSLL fishing and has been observed at 100%. The fisherman has publicly testified that his DSLL fishing operations caught and killed one olive ridley turtle while fishing, but no other protected species. Given the rarity of protected species interactions with DSLL gear, the limited effort from the existing fishery may not be representative of an expanded DSLL fishery (if effort increases or the area fished expands). To determine possible effects of increasing the proposed action area, we reviewed observer records from the Hawaii-based DSLL, which operates in some of the same areas as the proposed area of the West Coast-based DSLL fishery (i.e., the entire north Pacific). We also reviewed the available information from the shallow-set longline fisheries that operated or operate in the proposed action area.

NMFS finds that four species of sea turtles are likely to be adversely affected by the DSLL, green, loggerhead, leatherback, and olive ridley sea turtles. This is based upon observations of sea turtles captured in the Hawaii-based DSLL (NMFS 2005). We reviewed the areas where these captures were observed and the available information on sea turtle distribution and abundance in the areas. Based upon this review and the area most likely to be fished under the proposed action (i.e., east of 140 West longitude) it is likely the same four species of sea turtle are likely to be adversely affected by the California based DSLL as are affected by the Hawaii based DSLL fishery.

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The proposed action is not considered likely to adversely affect ESA listed marine mammal species. The area where most of the fishing activity is likely to occur, east of 140 and outside the U.S. West Coast EEZ, is one where humpback whales are rarely encountered. Most humpbacks from the eastern north Pacific stock, which is the stock most likely to be found in an area close to where most fishing activity is expected, remain within the U.S. West Coast EEZ when migrating in the fall and spend the winter mating and birthing season off the coasts of Mexico and central America, generally close to shore (Calambokidis *et al.* 2008) and outside of the proposed action area. If the fishery does expand to the entire north Pacific, effort may occur where humpbacks from the western north Pacific stock and central north Pacific stocks may be exposed to the fishery, particularly as these animals migrate from feeding areas in the waters off Alaska and western Canada to wintering grounds in Hawaii. Reviewing the observer records from the Hawaii-based DSLL indicates that only two humpbacks have been observed entangled in gear in the Hawaii-based DSLL form 2002 through the third quarter of 2010 (the most recently available information). Both were released but injured http://www.fpir.noaa.gov/OBS/obs_hi_ll_ds_rprts.html, accessed 2-10-11). Based upon the area of most fishing activity and the rarity of humpback whale entanglements in the Hawaii-based DSLL, which operates in the wintering grounds of the western north Pacific and central north Pacific stocks of humpbacks, it is considered very unlikely that the West Coast-based DSLL fishery will interact with humpback whales.

Sperm whales are another ESA listed marine mammal that may be within the proposed action area. However, the proposed action is considered very unlikely to result in the entanglement of sperm whales. Sperm whale depredation on longlines has been recorded in some areas, including Alaska, however entanglements are rare. No sperm whales have been observed entangled in the Hawaii- based DSLL fishery since 2003 with approximately 19,000 observed sets. The area where most of the Hawaii-based DSLL fishery occurs overlaps an area of sperm whale abundance, thus sperm whale entanglements are more likely in this area than in the area of primary activity of the proposed action. While it is not impossible that a sperm whale may be adversely affected by the proposed action, given the rarity of sperm whale entanglements in the Hawaii-based DSLL, which operates in an area and time when sperm whales are likely to be in the area, it is considered extremely unlikely that sperm whales will be affected by the proposed action.

In the Hawaii-based DSLL and SSLL (which primarily occur south and north of the Hawaiian Islands, respectively) and the California based SSLL (which operated primarily just outside the U.S. West Coast EEZ), no ESA listed marine mammals, other than humpback and sperm whales (described above) were observed entangled or captured in fishing gear. The Hawaii-based DSLL has been observed taking false killer whales. The location of the interactions and genetic analysis from the whales indicate that the animals that interact with longline fisheries are from the Hawaii pelagic stock of false killer whales. On November 17, 2010, NMFS proposed that the Hawaiian insular false killer whale is a distinct population segment (DPS) and that this DPS should be listed as endangered on the ESA (75 FR 70169). The range of the insular DPS is very limited and extends out to 75 nautical miles from shore around the Hawaiian Islands, thus within the EEZ around Hawaii. This is not within the action area of the West Coast based DSLL, therefore, this action is considered not likely to affect the Hawaiian insular false killer whale DPS currently proposed to be listed as endangered.

No species of ESA listed marine fish have been observed captured in longline fisheries operating in the proposed action area. The ocean distribution of ESA listed marine fish is not well known, however, salmon and steelhead may be found in the proposed action area based on tracking of these animals. There is no evidence of interactions between salmonids and longline gear. NMFS finds that the action is not likely to adversely affect marine fish species listed on the ESA.

Based upon this and information on the distribution of species within the action area, it is likely that only ESA listed sea turtles will be adversely affected by this proposed action.

All fishing under the proposed action occurs outside of the EEZ of the U.S., including the Hawaiian Islands and Atolls. There is no designated or proposed critical habitat for any ESA listed species within the proposed action area. Critical habitat will not be considered further in this consultation.

The following sections provide brief status descriptions of the sea turtle species considered most likely to be affected by the continued operation of the West Coast based DSLL fishery. Complete status descriptions can be found in previous documents including NMFS's 2004 biological opinion on the HMS FMP. Updates of that data are provided as available for sea turtles.

4.1. Green Turtles

4.1.1. Global status

Green turtles are listed as threatened under the ESA, except for the populations that nest in Florida and the Pacific coast of Mexico, which are listed as endangered. The 2007 5-year review indicated that based upon the available nesting information available for 46 areas, nesting populations are increasing, decreasing, and remaining stable, although for many areas there is insufficient information to draw conclusions on population trends. There are nine identified Pacific nesting populations, four are increasing, three are stable and two are unknown (NMFS & USFWS 2007). In 2004, the Marine Turtle Specialist Group published their review of the global status of green turtles. Based upon nesting numbers at 32 index sites around the world, there has been a 48% to 67% decline in the number of nesting females over the last 3 generations (approximately 150 years) (Seminoff 2004). The approach used was considered conservative and actual declines may exceed 70%. Causes for this decline include harvest of eggs, subadults and adults, incidental capture by fisheries, loss of habitat, and disease.

4.1.2 General Distribution

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

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

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

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

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

4.1.3 Population Status and Trends

NMFS and USFWS (2007a) provided population estimates and trend status for 46 green turtle nesting beaches around the world. Of these, twelve sites had increasing populations (based upon an increase in the number of nests over 20 or more years ago), four sites had decreasing populations, ten sites were considered stable. For twenty sites there are insufficient data to make a trend determination or the most recently available information is too old (15 years or older) (NMFS 2007a). The overall nesting female population, based upon the mean annual reproductive effort, is estimated to be between 108,761 and 150,521. A more complete review of the most current information on green sea turtles is available in the 5-Year Status Review document published in 2007 by the US Fish and Wildlife Service and NMFS at: www.nmfs.noaa.gov/pr/pdfs/species/greenturtle_5yearreview.pdf

There have been no green turtles observed interacting with this fishery. Observer coverage on this fishery is 100%, but there is a low level of effort (only one fisherman). Rather than extrapolate this limited data to a larger fishery (i.e., increased fishing effort) we considered a fishery with more data, the Hawaii-based DSLL fishery observer data, to approximate likely impacts of the proposed action. We determined that the Hawaii-based DSLL is the closest proxy fishery to the proposed action since it uses the same gear type and operates within the proposed action area. In the Hawaii-based DSLL fishery, green turtles incidentally captured in the fishery were from the eastern Pacific and central Pacific nesting populations (53% and 47%, respectively) (NMFS 2008). Based upon this and the location of most effort (east of 140° W longitude), we assume that green turtles from the Eastern Pacific and Central Pacific populations are most likely to be affected by the proposed action. We assume there is approximately a 50:50 chance of an interaction with adults or sub-adults from either of these two nesting populations.

4.1.3 Populations within the action area

Two populations of green turtles may be found within the action area, greens that nest in the Eastern Pacific and greens that nest in Hawaii, the Central Pacific.

4.1.3.1 Eastern Pacific

Green turtles in the Eastern Pacific are considered one of the most depleted populations of green turtles in the world. The primary green turtle nesting grounds in the eastern Pacific are located in Michoacán, Mexico, and the Galapagos Islands, Ecuador (NMFS and USFWS 1998a). Here, green turtles were widespread and abundant prior to commercial exploitation and uncontrolled subsistence harvest of nesters and eggs. Sporadic nesting occurs on the Pacific coast of Costa Rica. Analysis using mitochondrial DNA (mtDNA) sequences from three key nesting green turtle populations in the eastern Pacific indicates that they may be considered distinct management units: Michoacán, Mexico; Galapagos Islands, Ecuador, and Islas Revillagigedos, Mexico (Dutton 2003).

The most current information on the status of eastern Pacific green turtle nesting is given in Table 2. This indicates that three of the four known significant populations appear to be stable or increasing. Nesting along the Central American coast has not been well described or documented as of yet.

Table 2. Estimates of current green turtle nesting rookeries in the eastern Pacific (Source: NMFS and USFWS 2007a; Michoacan, Colola beach - C. Delgado-Trejo, Univ. of Michoacan, pers. comm., 2009).

Eastern Pacific Ocean	Units[1]	Years	Abundance	Trend
Revillagigedos Islands, Mexico	AN	1999-2002	90	stable
Michoacan, Mexico	AF	2000-2008	1550	increasing
Central American Coast	AN	late 1990s	184-344	uncertain
Galapagos Islands	AF	2001-2006	1650	stable

[1]AN = Annual number of nests. AF = Number of females nesting annually.

Green turtles are also known to migrate long distances from nesting areas to feeding grounds. In the Atlantic, green turtles migrated 2200 km from Ascension Island (middle of the Atlantic) to the South American coast (Hays, *et al*. 2001). Green turtles that were satellite tagged at the French Frigate Shoals nesting site showed an eastward migration to the main Hawaiian islands off Oahu in 26 days traveling far from shore and over waters thousands of meters deep (Balazs, *et al*. 1994). However, the Eastern Pacific population of green turtles has been reported to stay close to shore and have relatively small home ranges. In the Gulf of California, a group of green turtles that were tagged with radio and sonic telemetry transmitters showed a range of diving depths including dives to greater than 40 m. This population of turtles did not leave the Gulf of California throughout the summer study months (Seminoff, *et al*. 2002).

4.1.4.2 Central Pacific – Hawaii

Green turtles in Hawaii are considered genetically distinct and geographically isolated although the nesting population at Islas Revillagigedos in Mexico appears to share the mtDNA haplotype that commonly occurs in Hawaii. Since enactment of the ESA in 1973 the nesting population of Hawaiian green turtles has shown a gradual but definite increase (Balazs 1996; Balazs and Chaloupka 2004). During the first five years of monitoring (1973-1977) the mean annual nesting abundance at East Island in the French Frigate Shoals in the Northwest Hawaii Islands was 83 nesting females. Long term monitoring of the East Island population indicates that this population is rapidly increasing at a rate of 5.7% per year (Chaloupka et al. 2008, Balazs and Chaloupka 2006). There has been an increase in in-water abundance trends, corresponding with the increase in nesting females (Balazs *et al.* 2005). Unfortunately, the green turtle population in the Hawaiian Islands area is afflicted with a tumor disease, fibropapilloma, which is of an unknown etiology and often fatal, as well as spirochidiasis, both of which are the major causes of stranding of this species (G. Balazs, NMFS, personal communication, 2000).

4.1.5. Threats

A thorough discussion of threats to green turtles worldwide can be found in the most recent 5-Year Review (NMFS and USFWS 2007a). Major threats include: coastal development and loss of nesting and foraging habitat; incidental capture by fisheries; the harvest of eggs, sub-adults and adults. Climate change is also emerging as a critical issue.

Destruction, alteration, and/or degradation of nesting and near shore foraging habitat is occurring throughout the range of green turtles. These problems are particularly acute in areas with substantial or growing coastal development, beach armoring, beachfront lighting, and recreational use of beaches. In addition to damage to the nesting beaches, pollution and impacts to foraging habitat becomes a concern. Pollution run-off can degrade sea grass beds that are the primary forage of green turtles. Due to green turtles' more coastal lifestyle, collisions with boat traffic are known to cause significant numbers of mortality every year (NMFS and USFWS 2007a).

The bycatch of green sea turtles, especially in coastal fisheries, is a serious problem because in the Pacific, many of the small-scale artisanal gillnet, setnet, and longline coastal fisheries are not well regulated. These are the fisheries that are active in areas with the highest densities of green turtles (NMFS and USFWS 2007a). This makes it difficult to assess what impacts they are having on this population.

The meat and eggs of green turtles has long been favored throughout much of the world that has interacted with this species. As late as the mid 1970s, upwards of 80,000 eggs were harvested every night during nesting season in Michoacán (Clifton *et al*. 1982). Even though Mexico has implemented bans on the harvest of all turtle species in its waters and on the beaches, poaching of eggs, females on the beach, and animals in coastal water continues to happen. In some places throughout Mexico and the whole of the eastern Pacific, consumption of green sea turtles remain a part of the cultural fabric and tradition (NMFS and USFWS 2007a).

Based upon available information, it is likely that green sea turtles are being affected by climate change. Like other sea turtle species, increasing temperatures have the potential to skew sex ratios of hatchling and many rookeries are already showing a strong female bias as warmer temperatures in the nest chamber leads to more female hatchlings (Doely *et al*. 2001; Kaska *et al.* 2006; Chan and Liew 1995). Increased temperatures also lead to higher levels of embryonic mortality (Matsuzawa *et al.* 2002). An increase in typhoon frequency and severity, a predicted consequence of climate change (Webster *el al*. 2005) can cause erosion which leads to high nest failure (VanHouten and Bass 2007). Green sea turtles feeding may also be affected by climate change. Seagrasses are a major food source for green sea turtles and may be affected by changing water temperature and salinity (Short and Neckles 1999; Duarte 2002). Climate change could cause shifts in ocean productivity (Hayes *et al*. 2005), which may affect foraging behavior and reproductive capacity for green sea turtles (Solow *et al.* 2002).

At this time, it is not possible to reliably predict the magnitude of future climate change and the impacts on green turtles. The existing data and current scientific methods and analysis are not able to predict the future effects of climate change on this species or allow us to predict or quantify this threat to the species (Hawkes *et al.* 2009). Given this lack of available information and within the context of the temporal scale of the proposed action, climate change related impacts are not considered significant.

4.1.6 Conservation

Extensive conservation efforts that have developed over the last 30 years appear to be having an impact on this species, as nesting populations have stabilized or are increasing in a number of regions, including some in the Pacific (NMFS and USFWS 2007a). In the eastern Pacific, prohibitions on the harvest and exploitation of green turtles have been placed into effect in many places. Measures to reduce bycatch are being implemented through many local, national, and international agreements and instruments. Notable measures include: the publication of a FAO Technical Consultation on Sea Turtle – Fishery Interactions; the formation of the Inter-American Convention for the Protection and Conservation of Sea Turtles, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which bans the importation of any sea turtle species or their parts. Due to these and other measures, the harvest of greens has been reduced and nesting beach conservation and community based initiatives have been put in place to protect green turtles in nesting and nearshore foraging areas (Gilman et al. 2007).

4.2 Loggerhead Turtles

4.2.1 Global status

The loggerhead turtle is listed as threatened under the ESA throughout its range, primarily due to direct capture, incidental capture in various fisheries, and the alteration and destruction of its habitat. The species is currently listed globally, although it is difficult to determine the overall status of the global population. Some populations are increasing, but many are decreasing and for many, there is insufficient information with which to assess the status (USFWS and NMFS 2007b).

4.2.2 General distribution

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics (*in* NMFS and USFWS 1998b).

For loggerheads, the transition from hatchling to young juvenile occurs in the open sea, and evidence from genetic analyses and tracking studies show that this part of the loggerhead life cycle involves trans-Pacific developmental migration (Polovina *et al*. 2003). Large aggregations (numbering in the thousands) of mainly juveniles and subadult loggerheads are found off the southwestern coast of Baja California, over 10,000 km from the nearest significant nesting beaches (Nichols, *et al.* 2000; Pitman 1990). Genetic studies have shown these animals originate from a Japanese nesting subpopulation (Bowen, *et al.* 1995), and their presence reflects a migration pattern probably related to their feeding habits (Cruz, *et al*. 1991 cited in Eckert 1993). While these loggerheads are primarily juveniles, carapace length measurements indicate that some of them are 10 years old or older.

Recently, satellite tracking of loggerheads has provided insight into their behavior and distribution in the Pacific. Loggerheads exhibit shallow dive patterns with >90 percent of their dives within the top 40 m of water, which is shallower than the hook depth range of DSLL fishing gear (hook depths of 100 m or more below the water's surface) (Polovina, *et al*. 2004). Satellite tracking of loggerheads indicates that they occupy a wide range of sea surface temperatures (SSTs) from 15–25° C while in the Central North Pacific, although tracks of turtles within narrowly defined temperature bounds were also observed (Polovina, *et al.* 2004). Satellite tracking indicates that loggerheads tagged and released from North Pacific fisheries and Japan travel in the North Pacific Transition Zone (NPTZ) and the Kuroshio Extension Current, perhaps spending years as juveniles feeding in these large Pacific currents (Polovina, *et al*. 2004; Polovina, *et al.* 2006). Satellite tracks of juvenile loggerheads in the NPTZ end at approximately 130° W. longitude, which is the eastern boundary of the Sub-Arctic and Sub-Tropical gyre in which the NPTZ is found (Polovina, *et al*. 2004). This area is within the proposed action area and on the western edge of the California Current. Researchers speculate that when the gyre meets the southbound California Current, objects in the gyre, including juvenile loggerheads, are moved into the waters off Baja (Nichols *et al*. 2000). Many juvenile loggerheads spend years in the near shore, primarily foraging off Baja California, Mexico feeding. As adults, these loggerheads head back across the Pacific to nesting beaches in Japan. Limited satellite tracking of loggerheads tagged in Baja indicate a due east movement which suggests they may be utilizing the Sub-tropical front at 25–30° N. latitude (Nichols, *et al*. 2000).

4.2.3 Population status and trends

Loggerheads are currently listed as threatened as a global species. On March 16, 2010, the USFWS and NMFS published proposed rules, a 12 month petition finding and request for public comments that would recognize that the species (currently treated as a single "species") is composed of nine distinct population segments (75 FR 12598). This was the result of a petition received on by NMFS and USFWS on July 16, 2007 from the Center for Biological Diversity and Turtle Island Restoration Network requesting that loggerhead turtles in the North Pacific be reclassified as a distinct population segment (DPS) with endangered status and that critical habitat be designated. On November 16, 2007, NMFS and FWS received a petition from the Center for Biological Diversity and Oceana requesting that loggerhead turtles in the Northwest Atlantic Ocean be reclassified as a DPS with endangered status and that critical habitat be designated. NMFS and FWS published a 90-day finding that the petitions presented substantial information and that the petitioned actions may be warranted. A biological review team (BRT) was convened in February 2008 and tasked with determining whether DPSs exist and assess the extinction risk of each DPS. In August 2009, the BRT published the results of their analysis. They concluded that the nine identified population segments meet the standard for being considered a DPS; they are both discrete from other conspecific population segments and significant to the species to which they belong, *Caretta caretta* (Conant *et al.* 2009).

The BRT has identified the following nine loggerhead DPSs distributed globally and their status:
(1) North Pacific Ocean DPS – currently at risk of extinction (proposed endangered)
(2) South Pacific Ocean DPS - currently at risk of extinction (proposed endangered)
(3) North Indian Ocean DPS - currently at risk of extinction (proposed endangered)
(4) Southeast Indo-Pacific Ocean DPS - currently at risk of extinction (proposed endangered)
(5) Southwest Indian Ocean DPS - not currently at immediate risk of extinction (proposed threatened)
(6) Northwest Atlantic Ocean DPS - currently at risk of extinction (proposed endangered)
(7) Northeast Atlantic Ocean DPS - immediate risk of extinction (proposed endangered)
(8) Mediterranean Sea DPS - immediate risk of extinction (proposed endangered)
(9) South Atlantic Ocean DPS - not currently at immediate risk of extinction (proposed threatened)

4.2.4 Population in the action area

In the Pacific Ocean, loggerhead turtles are composed of the North Pacific nesting aggregation (located in Japan), comprising separate nesting groups (Hatase *et al.* 2002), and a smaller South Pacific nesting aggregation that occurs primarily in Australia (Great Barrier Reef and Queensland), and to a lesser extent in New Caledonia, New Zealand, Indonesia, and Papua New Guinea. Clutch size averages 110 to 130 eggs, and one to six clutches of eggs are deposited during the nesting season (Dodd 1988). The average re-migration interval is between 2.6 and 3.5 years (*in* NMFS and USFWS 1998c), and adults can breed up to 28 years (Dobbs 2002). More information can be found by reviewing the 5-Year Status Review document published in 2007 by the US Fish and Wildlife Service and NMFS at www.nmfs.noaa.gov/pr/pdfs/species/loggerhead_5yearreview.pdf.

4.2.4.1 North Pacific

In the western Pacific, the only major nesting beaches are in the southern part of Japan (Dodd 1988). In Japan, loggerheads nest on beaches across 13 degrees of latitude (24°N to 37°N), from the mainland island of Honshu south to the Yaeyama Islands, which appear to be the southernmost extent of loggerhead nesting in the western North Pacific. Researchers have separated 42 beaches into five geographic areas: (1) the Nansei Shoto Archipelago (Satsunan

Islands and Ryukyu Islands); (2) Kyushu; (3) Shikoku; (4) the Kii Peninsula (Honshu); and (5) east-central Honshu and nearby islands. There are nine "major nesting beaches" (defined as beaches having at least 100 nests in one season within the last decade) and six "submajor nesting beaches" (defined as beaches having 10-100 nests in at least one season within the last decade), which contain approximately 75% of the total clutches deposited by loggerheads in Japan (Kamezaki *et al*. 2003).

Balazs and Wetherall (1991) speculated that 2,000 to 3,000 female loggerheads nested annually in all of Japan. From nesting data collected by the Sea Turtle Association of Japan since 1990, the latest estimates of nesting females on almost all of the rookeries are as follows: 1998 - 2,479 nests; 1999 - 2,255 nests; 2000 - 2,589 nests. Considering multiple nesting estimates, Kamezaki *et al*. (2003) estimated that approximately less than 1,000 female loggerheads return to Japanese beaches per nesting season. Matsuzawa (2006) has updated nesting numbers from 2001-2004 to 3,122, 4,035, 4,519, and 4,854, respectively. Snover (2008) cited Matsuzawa (2008) in her estimates of the total adult nesting population. The Sea Turtle Association of Japan reported over 10,000 nests laid in 2008 (I. Kinan, NMFS, personal communication, 2009). Over the short term, the last ten years, nesting appears to be increasing. However, these data are not sufficiently long-term to conclude a trend in the population. Snover (2008) estimated that the total number of adult females in the Japanese nesting population was 2,915 for the period 2005-2007 (this assumed a clutch frequency of 3.49 females per year).

4.2.5 Threats

A detailed account of threats of loggerhead sea turtles around the world is provided in recent 5-Year Review (NMFS and USFWS 2007b) and the 2009 Status Review (Conant *et al.* 2009). The most significant threats facing loggerheads in the North Pacific include coastal development and bycatch in commercial fisheries. Recent genetic analyses on female loggerheads nesting in Japan suggest that this "subpopulation" is comprised of genetically distinct nesting colonies (Hatase, *et al.* 2002) with precise natal homing of individual females. As a result, Hatase *et al.* (2002) indicate that loss of one of these colonies would decrease the genetic diversity of Japanese loggerheads; recolonization of the site would not be expected on an ecological time scale. In addition to the normal threats of coastal development on sea turtle nests and hatchling success in Japan, the armoring of beaches with large concrete structures to prevent erosion have restricted much of the available nesting beach habitat to areas below the tide line, which make nests and eggs susceptible to being washed away if not translocated (Matsuzawa 2006, NMFS and USFWS 2007b). For both juvenile and adult individuals in the ocean, bycatch in commercial fisheries remains a very significant factor. Specifically in the Pacific, bycatch continues to be reported in gillnet and longline fisheries operating in 'hotspot" areas where loggerheads are known to congregate, such as off Baja California (Peckham *et al*. 2007), and has yet to be well described in an important pelagic foraging area known as Kuroshio Extension Bifurcation Region (Polovina *et al*. 2006). Additionally, bycatch in coastal pound net fisheries in Japan is another source of mortality (Ishihara 2007).

Based upon available information, it is likely that loggerhead sea turtles are being affected by climate change. Climate change and associated sea level rise have the potential to affect loggerhead sea turtles (described in more detail in the Environmental Baseline section below).

The following is a review of literature related to loggerheads. Matsuzawa *et al.* (2002) found that the Minabe Senri Beach pre-emergence hatchlings suffered from heat related mortality and concluded that even small temperatures could effect loggerhead nest success. Among sea turtle species, warmer nest temperatures produce females, while cooler temperatures in the nest chamber result in males. Hansen *et al.* (1998) reported that loggerheads nests in the U.S. have a skewed sex ratio, with high numbers of females produced. As global temperatures rise and sand temperatures rise, it is reasonable to assume that more females will be produced, thus skewing the natural sex ratio of hatchling cohorts to a larger proportion of females. Another effect of climate change on nesting beaches is sea level rise which will likely cause inundation of nesting beaches. On beaches that have not been altered, it is reasonable that turtles could nest higher on the beaches if necessary. However, many loggerhead nesting sites, particularly North Pacific loggerheads that next in Japan, have been extensively modified and hardened (e.g., seawalls) and thus have limited areas for loggerheads to move to in order to nest.

Chaloupka *et al.* (2008) examined 51 years of nesting numbers in the Pacific along with sea surface temperatures in four key foraging areas used by turtles at these nesting sites. They found that SSTs in the core foraging areas were increasing and that there was a relationship between SSTs and nesting success. In years with higher than normal SST, the number of females that nested was lower than normal. Conversely, in years with lower than normal SST, nesting numbers were higher than normal the following year. Cooler ocean temperatures are usually associated with higher productivity which supports development of sufficient fat within females to support reproduction and migration to nesting beaches. Thus warmer waters in the short and long term could reduce nesting and recruitment by Pacific loggerheads (Chaloupka *et al.* 2008).

At this time, it is not possible to reliably predict the magnitude of future climate change and the impacts on loggerhead sea turtles. The existing data and current scientific methods and analysis are not able to predict the future effects of climate change on this species or allow us to predict or quantify this threat to the species (Hawkes *et al.* 2009). Given this lack of available information and within the context of the temporal scale of the proposed action, climate change related impacts are not considered significant.

4.2.6 Conservation

Considerable effort has been made to document and address loggerhead bycatch in fisheries around the world. The development of solutions to reduce or mitigate capture, such as the use of circle hooks in longline fisheries and turtle excluder devices (TEDs) in trawl fisheries, and the use of time-area closures when turtles are known to aggregate, have proven to be effective (NMFS and USFWS 2007b). Conservation and recovery efforts are either ongoing or in development across many different international, regional, and other agreements or conventions across the globe. Recent conservation efforts in the Pacific are detailed in the 2009 Status review (Conant *et al.* 2009) and summarized below.

While conservation efforts for the North Pacific Ocean loggerhead DPS are substantive and improving and may be reflected in the recent increases in the number of nesting females, they still remain inadequate to ensure the long-term viability of the population. For example, while most of the major nesting beaches are monitored, some of the management measures in place are inadequate and may be inappropriate. On some beaches, hatchling releases are coordinated with the tourist industry or nests are being trampled on or unprotected. The largest threat on the nesting beach, reduced availability of habitat due to heavy armament and subsequent erosion, is just beginning to be addressed but without immediate attention, may ultimately result in the demise of the highest density beaches. Efforts to reduce loggerhead bycatch in known coastal fisheries off Baja California, Mexico and Japan is encouraging, but concerns remain regarding the mortalities of adults and subadults in mid-water pound nets and the high costs that may be involved in replacing and/or mitigating this gear. With these coastal fishery threats still emerging, there has not yet been sufficient time – or a nation-wide understanding of the threat – to develop appropriate conservation strategies or work to fully engage with the Government of Japan. Greater international cooperation and implementation of the use of circle hooks in longline fisheries operating in the North Pacific Ocean is necessary, as well as understanding fishery related impacts in the South China Seas. Further, it is suspected that there are substantial impacts from illegal, unreported, and unregulated fishing, which the U.S. is attempting to address under the revised Magnuson-Stevens Fishery Conservation and Management Act. While conservation projects for this population have been in place since 2004 for some important areas, efforts in other areas are still being developed to address major threats, including fisheries bycatch and long-term nesting habitat protection.

4.3 Leatherback Turtles

4.3.1 Global status

The leatherback turtle is listed as endangered under the ESA throughout its global range. Increases in the number of nesting females have been noted at some sites in the Atlantic, but there have been substantial declines or extinctions of some populations throughout the Pacific, such as in Malaysia and Mexico. The most recent estimate places the North Atlantic adult population between 34,000 and 94,000 (Turtle Expert Working Group 2007).

4.3.2 General distribution

Leatherback turtles are widely distributed throughout the oceans of the world. The species is found in four main regions of the world: the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The four main regional areas may further be divided into nesting population. Leatherback turtles are found on the western and eastern coasts of the Pacific Ocean, with nesting aggregations in Mexico and Costa Rica (eastern Pacific) and Indonesia, the Solomon Islands, Papua New Guinea, with scattered nesting in Thailand, Malaysia, Australia and Fiji (western Pacific). In the Atlantic Ocean, leatherback nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida. In the Caribbean, leatherbacks nest in the U.S. Virgin Islands and Puerto Rico. In the Indian Ocean, leatherback nesting aggregations are reported in India and Sri Lanka.

Leatherback turtles have the most extensive range of any living reptile and have been reported circumglobally from 71°N to 47°S latitude in the pelagic Pacific and in all other major pelagic ocean habitats (NMFS and USFWS, 1998c). For this reason, however, studies of their abundance, life history and ecology, and pelagic distribution are exceedingly difficult. Leatherback turtles lead a completely pelagic existence, foraging widely in temperate waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been proposed that mating most likely takes place outside of the tropical waters, before females move to their nesting beaches (Eckert and Eckert, 1988). Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Morreale, *et al*., 1994; Eckert, 1998; Eckert, 1999a). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert, 1998).

4.3.3 Population status and trends

Leatherback turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, and the Gulf of Mexico (Ernst and Barbour, 1972). Globally, leatherback turtle populations have declined. In 1980, the leatherback population was estimated at approximately 115,000 (adult females) globally (Pritchard, 1982b). By 1995, one estimate claimed this global population of adult females had declined to 34,500 (Spotila *et al.* 1996). Populations have declined in Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. The most recent five year review of the status of leatherbacks globally looked at populations by regions. For the Indian Ocean and Southeast Asia, Hamann *et al.* (2006) provided numbers for nesting females. These are generally quite low with a total for all known nesting beaches in the low hundreds of females. Conversely, in the Atlantic nesting populations are stable or increasing at all beaches except the Western Caribbean and West Africa (where there are insufficient years of data to assess trends) (Turtle Expert Working Group 2007). The most recent population estimate for the North Atlantic ranges from 34,000 to 94,000 adult leatherbacks.

The population estimates in the Pacific are lower than the Atlantic. In the Eastern Pacific, nesting counts indicate that the population has continued to decline since the mid 1990s leading some researchers to conclude that the leatherback is on the verge of extinction in the Pacific Ocean (e.g. Spotila *et al*. 1996; Spotila *et al*., 2000). However, the status of Western Pacific leatherbacks appears to be less dire. Recently published estimates of breeding females suggest that the Western Pacific population is 2,700 to 4,500 adult females (Dutton *et al*. 2007). This number is substantially higher than the population estimate of 1,775 to 1,900 Western Pacific breeding females published in 2000 and used to predict possible extinction in the Pacific (Spotila 2000). The larger population estimate is due to adding in a number of nesting females from beaches that were not previously included in population estimates and thus is not indicative of a positive growth trend in the population. For a more complete review of leatherbacks, see the 5-Year Status Review document published in 2007 by the US Fish and Wildlife Service and NMFS at www.nmfs.noaa.gov/pr/pdfs/species/leatherback_5yearreview.pdf.

Based on published estimates of nesting female abundance, leatherback populations are declining at all major Pacific basin nesting beaches, particularly in the last two decades (Spotila *et al*. 1996; NMFS and USFWS 1998c; Spotila *et al*. 2000). Declines in nesting populations have been documented through systematic beach counts or surveys in Malaysia (Rantau Abang, Terengganu), Mexico and Costa Rica. In other leatherback nesting areas, such as Papua New

Guinea, Indonesia, and the Solomon Islands, there have been no systematic consistent nesting surveys, so it is difficult to assess the status and trends of leatherback turtles at these beaches. In all areas where leatherback nesting has been documented, however, current nesting populations are reported by scientists, government officials, and local observers to be well below abundance levels of several decades ago.

4.3.4 Populations in the action area

Genetic markers in 16 of 17 leatherback turtles sampled to date from the central North Pacific (captured in the Hawaii-based longline fishery) have identified those turtles as originating from nesting populations in the southwestern Pacific; the other specimen, captured in the southern range of the Hawaii fishery, was from nesting beaches in the eastern Pacific (Dutton and Eckert 2005). All three leatherbacks captured in the California-based longline fishery were found to originate from western Pacific nesting beaches, based on genetic analyses. All leatherbacks captured off central California (n=40) have been found to originate from western Pacific nesting beaches (P. Dutton, NMFS, personal communication, 2006).

4.3.4.1 Western Pacific Nesting Populations of Leatherback Turtles

Leatherbacks in the Western Pacific nest at Indonesia, Papua New Guinea, and the Solomon Islands, with limited leatherback nesting activity in Viet Nam, Thailand, Fiji, Vanuatu, and Australia. Malaysia was once the site of an enormous leatherback nesting population which is now considered functionally extinct with only 2-3 females returning annually to nest each year. The largest extent nesting populations are in northern Indonesia at Jamursba-Medi and Wermon.

All leatherbacks in the Pacific face similar threats to their populations including poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by wild and domestic animals. Little is known about the status of the western Pacific leatherback nesting populations, but once major leatherback nesting assemblages have declined, some to the point of extirpation. Dutton *et al*. (2007) report that there may be 1,100 to 1,800 females nesting annually at 28 nesting sites in the western Pacific. Calculations using the same methods used by Spotila *et al*. (1996) yields a minimum total estimate of nesting females in this area of approximately 2,700 to 4,500 animals (taking into account an estimated re-nesting interval of 2.5 years, Spotila *et al*. (1996)). The actual re-nesting interval for western Pacific leatherbacks may vary from this estimate.

Migratory routes of leatherback turtles originating from eastern and western Pacific nesting beaches are not entirely known. However, satellite tracking of post-nesting females and foraging males and females, as well as genetic analyses of leatherback turtles caught in U.S. Pacific fisheries or stranded on the West Coast of the U.S. suggest that the leatherbacks found off the U.S. West Coast are from the Western Pacific nesting populations. Leatherbacks forage off central California, generally at the end of the summer, when upwelling relaxes and sea surface temperatures increase. These areas are upwelling "shadows," regions where larval fish, crabs, and jellyfish are retained in the upper water column during relaxation of upwelling. Researchers estimated an average of 178 leatherbacks (CV=0.15) were present between the coast and roughly the 50 fathom isobath off California. Abundance over the study period was variable between years, ranging from an estimated 20 leatherbacks (1995) to 366 leatherbacks (1990) (Benson *et al*. 2007a). Other observed areas of summer leatherback concentration include northern California and the waters off Washington through northern Oregon, offshore from the Columbia River plume. Foraging areas of leatherbacks in the high seas is not known, although based upon limited satellite tracking of turtles tagged off California and incidental capture of leatherbacks in Hawaii-based fisheries, it is likely that the animals move southwest off the coast, generally moving towards waters south of Hawaii.

Western Pacific and eastern Pacific leatherbacks can be identified through genetic markers. All leatherbacks captured off central California (n=40) have been found to originate from western Pacific nesting beaches, based on genetic analyses (P. Dutton, NMFS, personal communication, 2006). The Malaysian nesting population, a portion of the western Pacific population, has unique genetic markers and none were identified in the leatherbacks sampled. This may be related to the extremely small extent nesting population; only two to ten females have been recorded nesting at Terengganu since 1994, or differences in foraging strategies (i.e., leatherbacks that nest in Malaysia may forage near their nesting sites, rather than in the open north Pacific).

4.3.4.1.1 Malaysia

The decline of leatherback turtles is severe at one of the most significant nesting sites in the western Pacific region - Terengganu, Malaysia, with current nesting representing less than 2 percent of the levels recorded in the 1950s, and there are no signs of a population increase. In the 1960s, the leatherback turtles nesting on the beaches in Terengganu represented one of the largest remaining nesting aggregations for this species in the Pacific Ocean. Since then, the population has declined to a handful of individual, nesting females. The nesting population at this location has declined from 3,103 females estimated nesting in 1968 to 2 nesting females in 1994. The causes for the decline in this population include: many years of excessive egg harvest, egg poaching, the direct harvest of adults in this area and entanglement in coastal fisheries. A report published in 2006 by the United Nations Environmental Programme (UNEP) suggests that the Malaysia population is effectively extinct (www.bernama.com, accessed 8/14/06). Despite fishing regulations to limit coastal fisheries and protection of some nesting beaches, only ten nests were counted in 2006, although a number of smaller nest sites are believed to exist in Malaysia.

4.3.4.1.2 Indonesia

In Indonesia, leatherbacks have been protected since 1978 and low density nesting occurs along western Sumatra (200 females nesting annually) and in southeastern Java (50 females nesting annually), although these estimates are from the early 1980s (*in* Suarez and Starbird, 1996a; Dermawan 2002). Nesting beaches in East Java are monitored generally by National Park officers; there is sporadic low nesting on Suka Made (Meru Betiri National Park) and higher levels of nesting at Alas Purwo National Park (~4,500 eggs laid in 2000) (Adnyana 2006).

The largest leatherback rookery is at the north coast of Papua. Leatherback nesting generally takes place on two major beaches, located 30 km apart, on the north Vogelkop coast of the State of Papua: Jamursba-Medi (18 km) and Wermon beach (6 km) (Starbird and Suarez 1994; Hitipeuw *et al*. 2007). Declines in annual nests largely due to commercial exploitation of eggs led to beach protections being implemented in 1992. No clear trend in the population since 1993 can be detected from the available information; however, it is clear from discussions with locals that the number of leatherbacks observed nestings at these beaches has declined substantially since the 1970s and 1980s.

Leatherbacks nest on Jamursba-Medi during April through September, with a peak in June, July and August (Suarez *et al*. 2000; Hitipeuw *et al*. 2007). A summary of data collected from leatherback nesting surveys from 1981 to 2005 for Jamursba-Medi has been compiled, re-analyzed, and standardized and is shown in Table 5 (Hitipeuw and Maturbongs 2002; Hitipeuw 2003b; Hitipeuw *et al*. 2007). The annual counts of nests in 2006, 2007, and 2008 are provided by the SWFSC.

Table 3. Estimated numbers of nests and female leatherback turtles nesting on Jamursba-Medi Beach, along the north coast of the State of Papua (Summarized by Hitipeuw and Maturbongs, 2002 and Hitipeuw, 2003b; Hitipeuw *et al*. 2007; SWFSC, unpublished data)

Survey Period	# of Nests	Adjusted # Nests	Estimated # of Females[3]
Jamursba-Medi Beach:			
September, 1981	4,000+	7,143[1]	1,232 - 1,623
April - Oct. 1984	13,360	13,360	2,303 - 3,036
April - Oct. 1985	3,000	3,000	658 - 731
June - Sept. 1993	3,247	4,091[2]	705 - 930
June - Sept. 1994	3,298	4,155[2]	716 - 944
June - Sept. 1995	3,382	4,228[2]	729 - 961
June - Sept., 1996	5,058	6,373[2]	1,099 - 1,448
May - Aug., 1997	4,001	4,481[4]	773 - 1,018
May - Sept. 1999	2,983	3,251	560 – 739
April - Dec., 2000	2,264	No	390 – 514
March - Oct., 2001	3,056	No	527 – 695
March - Aug., 2002	1,865	1,921	331 – 437
March – Nov., 2003	3,601	2,904	621 – 818
March – Aug., 2004	3,183	3,871	667 – 879
April – Sept., 2005	2,666	2,562	441 - 582
April – Oct 2006	2,133	n/a	n/a
April – Oct 2007	2,490	n/a	n/a
April – Oct 2008	1,601	n/a	n/a

[1]The total number of nests reported during aerial surveys was adjusted to account for loss of nests prior to the survey. Based on data from other surveys on Jamursba-Medi, on average 44% of all nests are lost by the end of August.
[2]The total number of nests have been adjusted based on data from Bhaskar's surveys from 1984-85 from which it was determined that 26% of the total number of nests laid during the season (4/1-10/1) are laid between April and May.
[3]Based on Bhaskar's tagging data, an average number of nests laid by leatherback turtles on Jamursba-Medi in 1985 was 4.4 nests per female. This is consistent with estimates for the average number of nests by leatherback turtles during a season on beaches in Pacific Mexico, which range from 4.4 to 5.8 nests per female . The range of the number of females is estimated using these data.
[4]Number adjusted from Bhaskar (1984), where percentage of nests laid in April and September is 9% and 3%, respectively, of the total nests laid during the season.

Nesting of leatherbacks on Wermon beach primarily takes place during the austral summer, but occurs throughout the year, from October through September, with a peak in December through March (Thebu and Hitipeuw 2005). In recent years, the beach has been monitored during much of the nesting season, including the peak period, and researchers have documented approximately 400 – 3,000 nests per year (Thebu and Hitipeuw 2005; Hitipeuw *et al*. 2007), which may equate to several hundred females nesting per year (given 4.4 to 5.8 nests per female). Given shorter monitoring periods in past studies, it is difficult to analyze any trends for this nesting beach (see Table 4).

Table 4. Number of leatherback turtle nests observed along Wermon Beach

Monitoring Period	# nests	Source
Nov. 23-Dec. 20, 1984 and Jan. 1-24, 1985	1,012	Starbird and Suárez, 1994; Suárez *et al*., 2000
Dec. 6-22, 1993	406	Starbird and Suárez, 1994; Suárez *et al*., 2000
Nov. 2002 - June, 2003	1,442	Hitipeuw, 2003b
Nov. 2003 – Sept., 2004	2,881	Thebu and Hitipeuw, 2005
Oct. 2004 – Sept. 2005	1,980	Hitipeuw, WWF, pers. comm., 2006
Oct. 2006 – April 2007	1,319	SWFSC
Oct. 2007 – April 2008	912	SWFSC
Oct. 2008 – April 2009	859	SWFSC

The leatherback turtles nesting on the beaches in the State of Papua represent one of the largest remaining nesting aggregations for this species in the Pacific Ocean. The nesting aggregation appears to be relatively large and has fluctuated between 400 and 1,000 individuals annually throughout most of the 1990s and early 2000s although there is insufficient data available to determine if the population growth is positive, negative, or stable.

4.3.4.1.3 Papua New Guinea

In Papua New Guinea, leatherbacks nest primarily along the coast of the Morobe Province, mostly between November and March, with a peak of nesting in December. Researchers are analyzing all known data to determine status and trends. Aerial surveys in Papua New Guinea have been flown for the last three years (2004-2006) during the peak of the leatherback nesting season (January). Results from the January 2005 survey estimated 1,195 leatherback nests in an area covering 2,692 kilometers of coastline, including the Madang, Morobe and Oro provinces (north coast of mainland PNG), New Britain, Bougainville, Buka, and the southwestern coast of New Ireland (Benson *et al.* 2007c).

4.3.4.1.4 Solomon Islands

In the Solomon Islands, the rookery size has been estimated to be fewer than 100 females nesting per year (D. Broderick, personal communication, *in* Dutton, *et al*. 1999); however recent reports indicate considerable scattered nesting around the islands and that there may be on the order of hundreds of females, rather than tens of females (Dutton *et al*. 2007).

4.3.4.1.5 Vanuatu

Leatherbacks have been reported nesting on some of the over 80 islands in Vanuatu. Because this country consists of many remote islands, there is still much to be learned regarding the importance of the beaches of Vanuatu to western Pacific leatherbacks. Currently, Epi Island has the largest number of nests, with approximately 20-30 nesting females on the southwestern beaches and a smaller number on the east coast. There is scattered nesting on the other islands, based on survey data and anecdotal reports.

There is also very limited leatherback nesting activity in Viet Nam, Thailand, Fiji, and Australia.

4.3.4.2 Eastern Pacific Nesting Populations of Leatherbacks

Leatherback nesting populations are declining at a rapid rate along the Pacific coast of Mexico and Costa Rica. Leatherbacks have been documented nesting as far north as Baja California Sur and as far south as Panama, with few areas of high nesting (Sarti 2002). Individuals from Eastern Pacific origin tend to migrate into the South Pacific off the coast of South America, (Dutton 2005-2006; Shillinger *et al*. 2008). Based upon the proposed action area, it is not anticipated that Eastern Pacific leatherbacks will be exposed to or affected by the proposed action. The following is a brief description of the status of this Pacific basin population.

4.3.4.2.1 Costa Rica

Since 1988, leatherback turtles have been studied at Playa Grande (in Las Baulas), the fourth largest leatherback nesting colony in the world. During the 1988-89 season (July-June), 1,367 leatherback turtles nested on this beach, and by the 1998-99 season, only 117 leatherback turtles nested (Spotila *et al*. 2000). The subsequent four nesting seasons have shown continued declines, with only 69 nesting females during the 2001-02 season, and 55 nesting females during the 2002-03 season. Scientists speculate that the low turnout during 2002-03 may be due to the "better than expected season in 2000-01 which temporarily depleted the reproductive pool of adult females in reproductive condition following the El Nino/La Nina transition" (R. Reina, Drexel University, personal communication, September, 2003). The number of females nesting in 2003-04 was 159 turtles, while during 2004-05, only 49 females nested. As of October, 2009, the number of nesting turtles at Las Baulas in 2005-06, 2006-07 and 2007-08 was 124, 76 and 90 respectively. The estimation for 2008-09 is 32 turtles but it still needs to be confirmed by researchers on-site (M. Santiadriantomillo, Drexel University, pers. comm., 2009). There have also been anecdotal reports of leatherbacks nesting at Playa Caletas and Playa Coyote.

4.3.4.2.2 Mexico

The decline of leatherback subpopulations is even more dramatic off the Pacific coast of Mexico. Surveys indicate that the eastern Pacific Mexican population of adult female leatherback turtles has declined from 70,000[1] in 1980 (Pritchard 1982, *in* Spotila *et al*. 1996) to approximately 60 nesting females during the 2002-03 nesting season, the lowest seen in 20 years (L. Sarti, UNAM, personal communication, June, 2003). A summary of total leatherback nests counted and total

[1] This estimate of 70,000 adult female leatherback turtles comes from a brief aerial survey of beaches by Pritchard, who has commented: "I probably chanced to hit an unusually good nesting year during my 1980 flight along the Mexican Pacific coast, the population estimates derived from which have possibly been used as baseline data for subsequent estimates to a greater degree than the quality of the data would justify" (Pritchard 1996).

females estimated to have nested along the Mexican coast from 2000 through 2008 is shown in Table 5.

Table 5. Annual number of estimated leatherback nestings (# nests) from 2000-2008 on index beaches and total nesting beaches.

Index beach	2000-01	2001-02	2002-03	2003-04[1]	2004-05	2005-06	2006-07	2007-08
Primary Nesting Beaches (40-50% of total nesting activity)								
Mexiquillo	624	20	36	528	42	191	105	169
Tierra Colorada	535	49	8	532	61	300	112	106
Cahuitan	539	52	73	349	33	230	79	121
Barra de la Cruz	146	67	3	275	29	136	130	104
Total - primary index beaches	1,844	188	120	1,684	165	857	426	500
Total - Mexican Pacific	4,550	624	738	4,043	n/a	2,732	n/a	n/a

[1]Source: García *et al*. 2004.
Source: Sarti, pers. comm., October, 2009

4.3.5 Threats

Threats to leatherbacks are detailed in the recent 5-year review (NFMS & USFWS 2007c) and threats to the Western Pacific population (the population affected by the proposed action) are detailed in the proceedings of the 2004 leatherback workshop (WPFMC 2004). The primary threats identified are fishery bycatch and impacts at nesting beaches.

Leatherbacks have been observed captured in a variety of ocean and coastal fishery gears including longlines, drift gillnet, set gillnet, trawl, and trap fisheries. Details on fishery bycatch are provided, as available, in the section below.

At nesting sites, population declines are primarily the result of a wide variety of human activities, including legal harvests and illegal poaching of adults, immatures, and eggs; incidental capture in fisheries (coastal and high-seas); and loss and degradation of nesting and foraging habitat as a result of coastal development, including predation by domestic dogs and pigs foraging on nesting beaches associated with human settlement and commercial development of coastal areas (Heppell *et al.* 2003a, Lutcavage *et al.* 1997). Increased environmental contaminants (e.g. sewage, industrial discharge) and marine debris, which adversely impact nearshore ecosystems that turtles depend on for food and shelter, including sea grass and coral reef communities, also contribute to the overall decline. In addition to anthropogenic factors, natural threats to nesting beaches and marine habitats such as coastal erosion, seasonal storms, predators, temperature variations, and phenomena such as El Niño also affect the survival and recovery of leatherback populations.

Based upon available information, it is likely that leatherback sea turtles are being affected by climate change. Similar to other sea turtle species, leatherbacks are likely to be affected by rising temperatures that may affect nesting success and skew sex ratios and rising sea surface temperatures that may affect available nesting beach areas as well as ocean productivity. Leatherbacks are known to travel within specific isotherms and these could be affected by climate change and cause changes in their migration and prey availability (Robinson *et al.* 2008). Unlike other sea turtle species which may be prey limited due to climate changes to their forage base, leatherbacks feed primarily on jellyfish which may increase in abundance due to ocean warming (Brodeur *et al.* 1999; Attrill *et al.* 2007; Richardson *et al*. 2009).

At this time, it is not possible to reliably predict the magnitude of future climate change and the impacts on leatherback sea turtles. The existing data and current scientific methods and analysis are not able to predict the future effects of climate change on this species or allow us to predict or quantify this threat to the species (Hawkes *et al.* 2009). Given this lack of available information and within the context of the temporal scale of the proposed action, climate change related impacts are not considered significant.

4.3.6 Conservation

For the past several years, the Western Pacific Fishery Management Council (WPFMC) has worked with NMFS' Pacific Island Fishery Science Center (PIFSC), Pacific Islands Region (PIR), and the SWFSC to identify priorities for regional sea turtles conservation efforts. The priorities for this program are: data management to fill information gaps; conservation measures to reduce direct harvest of sea turtles and protect nesting beach habitat; education and outreach about sea turtle conservation; international management and networking; and fishery mitigation through research and transfer of gear technologies designed to reduce bycatch of sea turtles to foreign fisheries. These include more extensive surveys, beach monitoring and protection programs, observer training programs for fisheries, and education and outreach programs for local communities.

Conservation efforts at nesting beaches are being carried out in the eastern and western Pacific. During the last few years conservation efforts at nesting beaches in Mexico and Costa Rica have led to increased survival of eggs, and therefore greater hatchling production per nesting female. This has the potential for increasing future recruitment if post-hatchling survival is not further reduced; however, since numbers of nests are so low, and post-hatchling and juvenile natural mortality are assumed to be high, this increase in hatchling production may only result in the addition of a few adults annually. However, the increases in numbers of adult leatherbacks and greens following years of aggressive beach and nest protection suggest that this is an important area for conservation efforts.

In addition to direct conservation measures, a number of international agreements have been signed over the past several years that are designed to benefit sea turtles, including leatherbacks, in the Pacific. These include the adoption in 2003 of the Bellagio Blueprint, a multinational effort to help save Pacific sea turtles; a Memorandum of Understanding signed by Indonesia, Papua New Guinea, and the Solomon Islands to coordinate efforts to protect and save sea turtles in their collective countries and the Indian Ocean and Southeast Asia Memorandum of Understanding. In 2007, the Inter-American Tropical Tuna Commission adopted a resolution to address sea turtle bycatch in fisheries for tuna and tuna-like species in the eastern tropical Pacific (Resolution C-07-03).

4.4. Olive Ridley Turtle

4.4.1 Global status

Although the olive ridley turtle is regarded as the most abundant sea turtle in the world, olive ridley nesting populations on the Pacific coast of Mexico are listed as endangered under the ESA; all other populations are listed as threatened.

4.4.2 General distribution

Olive ridley turtles occur throughout the world, primarily in tropical and sub-tropical waters. Nesting aggregations in the Pacific Ocean are found in the Marianas Islands, Australia, Indonesia, Malaysia, and Japan (western Pacific), and Mexico, Costa Rica, Guatemala, and South America (eastern Pacific). Like leatherback turtles, most olive ridley turtles lead a primarily pelagic existence (Plotkin *et al*. 1993), migrating throughout the Pacific, from their nesting grounds in Mexico and Central America to the deep waters of the Pacific that are used as foraging areas (Plotkin *et al.* 1994). While olive ridleys generally have a tropical to subtropical range, with a distribution from Baja California, Mexico to Chile (Silva-Batiz *et al*. 1996), individuals do occasionally venture north, some as far as the Gulf of Alaska (Hodge and Wing 2000). Olive ridleys are usually found in warm waters, 23-28° C, often within equatorial or nearby waters (Polovina, *et al*. 2004). A more complete review of current information can be found in the 5-Year Status Review document published in 2007 by the US Fish and Wildlife Service and NMFS at www.nmfs.noaa.gov/pr/pdfs/species/oliveridley_5yearreview.pdf.

Olive ridleys live within two distinct oceanic regions including the subtropical gyre and oceanic currents in the Pacific. The gyre contains warm surface waters and a deep thermocline preferred by olive ridleys. The currents bordering the subtropical gyre, the Kuroshio Extension Current, North Equatorial Current and the Equatorial Counter Current all provide for advantages in movement with zonal currents and location of prey species (Polovina, *et al*. 2004).

Satellite tracking of ten juvenile olive ridleys caught in Hawaii-based longline gear over a period of five years from 1997-2001, provides more insight into the movement patterns of this species. The olive ridley turtles moved between 130° W and 150° W longitude and south of 28° N latitude. The overall latitudinal range for these turtles was 8º N and 31º N (Polovina, *et al*. 2004). In another study, two olive ridleys were equipped with a depth recorder to record diving depth. Dives to a depth of 150 m occurred approximately once a day for 20 percent of the days surveyed, and 10 percent of the time was spent at a depth greater than 100 m (Polovina, *et al*. 2002).

4.4.3 Population status and trends

Olive ridleys are the most abundant sea turtle, but population structure and genetics are poorly understood for this species. It is estimated that there are about 800,000 females nesting annually (NMFS 2007d). Unlike other sea turtle species, most female olive ridleys nest annually. According to the Marine Turtle Specialist Group of the IUCN, there has been a 50% decline in olive ridleys worldwide since the 1960s, although that have recently been substantial increases at some nesting sites (NMFS and USFWS 2007d). In the Western Atlantic, the two major arribada beaches had estimated nest numbers of 335 and 1,000 to 2,000 nests in Suriname and French Guiana, respectively (NMFS and USFWS 2007d). In the Eastern Atlantic it is difficult to estimate nesting populations in some areas, but at least 100,000 female olive ridleys nest annually at five of eight known arribada beaches (NMFS and USFWS 2007d). A main nesting population occurs along the north-east coast of India in the Indian Ocean. Shanker *et al.* (2003) estimated the annual number of nesting females at two arribadas to be between 11,000 and over 300,000 individuals. Another major nesting population exists in the Eastern Pacific on the West Coast of Mexico and Central America. Both of these populations use the North Pacific as foraging grounds (Polovina *et al*. 2004).

4.4.4 Populations within the action area

Genetic analysis indicates that 75 percent of the Hawaii-based longline fisheries interactions with olive ridleys are from the Eastern Pacific subpopulations and 25 percent are from the Indian and Western Pacific rookeries (Dutton 2005). Based upon this, it is likely that the proposed action would have a greater impact on eastern Pacific olive ridley turtles, although either population could be affected. Because the proposed action is most likely to occur primarily east of 140° west longitude, thus closer to the Eastern Pacific nesting and foraging sites, it is reasonable to assume that this population would be more likely to be affected by the proposed action.

4.4.4.1 Eastern Pacific Ocean

The largest known arribadas in the eastern Pacific are off the coast of Costa Rica (~475,000 - 650,000 females estimated nesting annually) and in southern Mexico (~1,000,000+ nests/year at La Escobilla, in Oaxaca (Marquez-M. *et al*. 2005)). Arribadas occur in the Eastern Pacific beaches from June through December (NMFS 2007d).

4.4.4.1.1 Mexico and Central America

Eastern Pacific olive ridleys nest in the world's largest arribadas on the west coast of Mexico and Central America. The nationwide ban on commercial harvest of sea turtles in Mexico, enacted in 1990, has improved the situation for the olive ridley. Surveys of important olive ridley nesting beaches in Mexico indicate increasing numbers of nesting females in recent years (Marquez *et al*. 1995; Arenas *et al*. 2000). On the Mexican coast alone, the annual total of nests was estimated to average between 1.0 and 1.2 million from 2004-2006 (NMFS and USFWS 2007d). An independent estimate based on the number of turtles observed in the water at sea produced an estimate of 1.2 to 1.6 million turtles in the eastern tropical Pacific in 1998-2006 (Eguchi *et al*. 2007).

4.4.4.1.2 Costa Rica

In Costa Rica, 25,000 to 50,000 olive ridleys nest at Playa Nancite and 450,000 to 600,000 turtles nest at Playa Ostional each year (NMFS and USFWS 1998d). In an 11-year review of the nesting at Playa Ostional, (Ballestero *et al*. 2000) report that the data on numbers of nests deposited is too limited for a statistically valid determination of a trend; however, there does appear to be a six-year decrease in the number of nesting turtles. The greatest single cause of olive ridley egg loss comes from the nesting activity of conspecifics on *arribada* beaches, where nesting turtles destroy eggs by inadvertently digging up previously laid nests or causing them to become contaminated by bacteria and other pathogens from rotting nests nearby. In addition, some female olive ridleys nesting in Costa Rica have been found afflicted with the fibropapilloma disease (Aguirre *et al*. 1999).

4.4.4.2 Western Pacific Ocean

In the western Pacific, olive ridleys are not as well documented as in the eastern Pacific, nor do they appear to be recovering as well. There are small documented nesting sites in Indonesia, Thailand, Australia and Malaysia, but total nest numbers are likely to be in the hundreds (NMFS and USFWS 2007). In Indonesia, extensive hunting and egg collection, in addition to rapid rural and urban development, have reduced nesting activities, and locals report daily trading and selling of sea turtles and their eggs in the local fish markets (Putrawidjaja 2000). The main threats to turtles in Thailand include egg poaching, harvest and subsequent consumption or trade of adults or their parts (i.e. carapace), indirect capture in fishing gear, and loss of nesting beaches through development (Aureggi *et al*. 1999).

4.4.5 Threats

Threats to olive ridleys are described in the most recent five year status review (NFMS and USFWS 2007 d). Direct harvest and fishery bycatch are considered the two biggest threats.

There has been historical and current direct harvest of olive ridleys. In the 1950's through the 1970's, it is estimated that millions of olive ridleys were killed for meat and leather and millions of eggs were collected at nesting beaches in Mexico, Costa Rica, and other locations in Central and South America. Harvest has been reduced in the 1980's and 1990's, although eggs are still harvested in parts of Costa Rica and there is an illegal harvest of eggs in parts of Central America and India (NMFS and UWFWS 2007d).

Olive ridleys have been observed caught in a variety of fishing gear including longline, drift gillnet, set gillnet, bottom trawl, dredge and trap net. They are the species most commonly observed captured in the Hawaii-based DSLL fishery. Fisheries operating in coastal waters near *arribadas* can kill tens of thousands of adults. This is evident on the east coast of India where thousands of carcasses wash ashore after drowning in coastal trawl and drift gillnets fishing near the huge *arribada (*NMFS & USFWS 2007d*).*

Based upon available information, it is likely that olive ridley sea turtles are being affected by climate change. Similar to other sea turtle species, olive ridleys are likely to be affected by rising temperatures that may affect nesting success and skew sex ratios and rising sea surface temperatures that may affect available nesting beach areas as well as ocean productivity.

At this time, it is not possible to reliably predict the magnitude of future climate change and the impacts on olive ridley sea turtles. The existing data and current scientific methods and analysis are not able to predict the future effects of climate change on this species or allow us to predict or quantify this threat to the species (Hawkes *et al.* 2009). Given this lack of available information and within the context of the temporal scale of the proposed action, climate change related impacts are not considered significant.

4.4.6 Conservation

While it is known that some illegal captures of olive ridley eggs and likely adults still occurs, this threat to the species is considered much reduced and conservation efforts are focused on reducing bycatch in commercial fisheries. In some parts of Central America, fishing is prohibited offshore of *arribadas* to protect nesting adults (Frazier *et al.* 2007). Similarly, there are restrictions on fisheries on the east coast of India, the site of very large *arribadas* (Shanker *et al.* 2004). Unfortunately, enforcement of the fishing regulations is very limited in both areas.

Olive ridleys are highly migratory and do not nest at U.S. beaches. Conservation and recovery requires multi-lateral cooperation and agreements. Among the existing international instruments are the Indian Ocean Southeast Asia Marine Turtle Memorandum of Understanding, the Inter-American Convention for the Protection and Conservation of Sea Turtles and CITES (NMFS and USFWS 2007d). As a result of these actions and others, the harvest of eggs and adults at nesting beaches has been reduced (Gilman *et al.* 2007; NMFS and USFWS 2007d). As described in greater detail below, there have been international efforts to exchange traditional "j" hooks typically used in longline fisheries, with circle hooks that have been shown to reduce both the capture rate and mortality of turtles that interact with longline gear. These efforts should benefit olive ridleys by reducing the impact of longline fisheries on the populations, particularly in the Pacific.

5. Environmental Baseline

Because impacts to sea turtles in the Pacific Ocean tend to impact all species, and the available information does not allow us to evaluate impacts on each individual species, the following is a description of known fishery and non-fishery related threats to sea turtles, generally, in the Pacific.

5.1 Fisheries impacts

The impact of fisheries, particularly longline fisheries, on sea turtles is difficult to estimate. Fisheries operating in U.S. waters of the Pacific or U.S. fisheries in the Pacific are usually observed by NMFS in order to monitor bycatch of sea turtles and other species. It has been estimated that of the 40 countries that engage in longline fishing in the Pacific, only 15 have observer programs (Beverly and Chapman 2007). Also, bycatch rates of turtle species can vary substantially, often by orders of magnitude, based upon the area fished, the gear used, and the distribution of turtles. In 2004, Lewison *et al.* provided an estimate of the captures of 200,000 loggerheads and 50,000 leatherbacks in global longline fisheries in the year 2000. Beverly and Chapman reviewed the methodology used in that paper and suggest that the catch per unit effort (CPUE) for the shallow-set longline fisheries may have been applied to all longline effort, even though deep-set effort is estimated to be six times higher than shallow-set effort. They then applied the applicable CPUE to the estimated annual effort and calculated the total annual sea turtle capture from all longline fisheries to be 47,920 (Beverly and Chapman 2007). While this is not an unsubstantial amount of capture, it is much lower than the estimated capture of 250,000 loggerheads and leatherbacks provided by Lewison *et al.* (2004) and points to the challenges of fully understanding the impacts of this fishery on a global scale.

For most of fishing fleets throughout the world, little or no data exists regarding the incidental capture of ESA listed species. Without such information, it is difficult to assess the impacts of these fisheries on populations. Given their highly migratory behavior, sea turtles are most likely to interact with fisheries on the high seas or foreign fisheries. Some limited bycatch information, including survival rates following entanglements, collected by observers and through fisher self-reporting does exist for some fisheries in the Pacific Ocean. The following sections present descriptions of fisheries known or believed to have sea turtle bycatch. Information is provided for known fisheries, including some of which are likely to have significant impacts on sea turtle populations, simply due to the enormous amount of effort, the broad areas fished and the basic nature of the fishing strategy.

5.1.1 The Drift gillnet (DGN) fishery

The DGN fishery operates primarily south of Point Conception, California. Participation has declined from 78 active vessels in 2000 to 46 in 2008 (SAFE 2009). In 2001, NMFS implemented a seasonal area closure of the DGN to protect leatherback sea turtles. The closure prohibits using large mesh DGN gear to target HMS from August 15 to November 15 in an area of approximately 200,000 square miles from 45° N. latitude out to 129° W. longitude to south to Point Conception and along a diagonal line to Point Sur, CA (50 CFR 660.713). This fishery is a limited entry fishery with no opportunity for increases in the number of permits issued. Permits may be transferred but only under strict guidelines administered through CDFG that ensure no increase in permit holders. The number of sets made in 2001 was 1,665. Only 761 sets were made in 2009 (Carretta and Enriquez 2010).

The DGN fishery typically begins in late May and continues through the end of January, although 90 percent of the fishing effort typically occurs from mid-August to the end of December. Effort in the fishery is initially concentrated in the southern portion of the fishing grounds, historically expanding to its full range by October before retreating back to the south because of the dissipation of oceanographic water temperature breaks caused by storm systems moving down from the north. However, the majority of fishing effort is concentrated south of Pt. Conception due to the current leatherback closure limitations. Some limited effort does take place to the south and west of the closure, in international waters off of Mexico and the U.S. EEZs, and north of the closure.

Vessel size in the DGN fishery currently ranges from 30–85 ft, with 60 percent of the vessels less than 50 ft in total length. Fishers use nets constructed from 3-strand twisted nylon, tied to form meshes that range from 16 to 22 inches stretched, and average 19 inches stretched. The depth of a drift gillnet is measured in meshes. They usually range from 95 to 155 meshes deep with the majority between 125 and 140 meshes deep. Nets are hung with the apex of the square meshes oriented vertically. Although termed "gillnets," the nets actually entangle fish, rather than trap them by the gills. Nets are also size selective; large fish such as swordfish get entangled while smaller fish pass through the mesh. Net length ranges from 4,500 ft to 6,000 ft and averages 5,760 ft and net depth ranges from 145 ft to 165 ft and averages 150 ft. The top of the net is attached to a float line and the bottom to a weighted lead line. Additional information on this fishery and effort levels can be found at the HMS Stock Assessment and Fishery Evaluation Report, September 2010 (http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents).

The 2004 opinion on the HMS FMP includes an incidental take statement (ITS) for anticipated entanglement of four species of sea turtles in the DGN fishery. The ITS is three leatherbacks entangled per year in the DGN of which two are likely to be killed. There has been only one observed capture of a leatherback in the DGN fishery since the leatherback conservation area closure was put in place in 2001, which occurred in 2009. The turtle was released alive. Captures of hard-shelled species of sea turtles are less common in the DGN fishery and appear, from the observer records, to be related to oceanographic conditions. The ITS for green sea turtles and olive ridley sea turtles is four entaglements per year with one associated mortality each, but only in years with oceanographic conditions similar to those observed in 1999. There have been no observed captures of either of these species since the 2004 opinion was published. The ITS for loggerheads is five entanglements per year with two associated mortalities, but only in "El Niño" years. One loggerhead was observed entangled in gear in the DGN fishery in October 2006, during a period characterized as being "El Niño" like conditions. Between 1997 and 2004, observer coverage on this fishery averaged 20%; from 2005 through 2009, observer coverage averaged 17%.

5.1.2 Hawaii pelagic fisheries

In 2004, the Hawaii-based shallow longline fishery was re-opened under strict sea turtle mitigation measures and caps on the levels of captures and mortalities of loggerhead and leatherback sea turtles. In 2004 and 2005, the fishing year was completed without reaching the turtle caps. However, in 2006, an unexpected high level of loggerhead captures occurred, forcing the fishery to be shut down on March 20, 2006 (see Table 6). In 2008, there were no captures of loggerheads. This fishery is observed at 100%.

In 2009, NMFS published Amendment 18 to the Hawaii pelagic FMP. This amendment removes the set limit for the shallow-set longline fishery. The set limit adopted in 2004 was 2,120 per year. Without the set limit, it is anticipated that up to 5,550 sets could be made annually. Based upon this maximum effort estimate, Amendment 18 also includes revised limits on the annual incidental capture of loggerheads. The new turtle cap for loggerheads is 46 interactions per year, the cap for leatherbacks remains 16. The number of sea turtle interactions in the SSLL since it re-opened in 2004 is shown in Table 6. (On January 31, 2011, the U.S. District Court of Hawaii ruled against NMFS in a lawsuit over Amendment 18 and vacated the parts of the 2008 biological opinion and ITS that addressed loggerhead and leatherback sea turtles. This ruling has the effect of reinstating the previous cap of 17 loggerheads, although the leatherback cap was unchanged by Amendment 18. The court ordered NMFS to re-initiate consultation on Amendment 18 after publication of the final rule for listings of loggerheads as DPS's. The final rule is expected to be published in late 2011.)

Table 6. Sea turtle interactions in the shallow-set Hawaii-based longline fishery

	Leatherbacks	Loggerheads	Greens	Olive Ridley
Annual limits	16	46	*n/a*	*n/a*
2009	9	3	1	0
2008	2	0	1	2
2007*	5	15	0	1
2006	1	17**	0	0
2005	8	12	0	0
2004	1	1	0	0

*Due to confidentiality rules, there was no report in the fourth quarter and no annual report in 2007.
**Fishery was closed on March 20, 2006 when it reached the 2006 annual limit for loggerhead captures.

Based upon the incidental take statement in the October 15, 2008 opinion, Table 7 shows the anticipated entanglement and mortality in the Hawaii-based shallow-set longline fishery over the next three years.

Table 7. Number of sea turtle interactions and mortality expected during fishing operations under Amendment 18 to the Hawaii-based Pelagics FMP

	Leatherback	Loggerhead	Green	Olive ridley
Annual entanglement	16	46	1	4
Annual mortality	4	10	1	1
Entanglement over three years	48	138	3	12
Mortality over three years	11	29	1	3

The Hawaii-based deep-set longline fishery has been observed taking ESA listed sea turtle species, although at much lower rates than the SSLL. Interaction numbers are given in Table 8.

Table 8. ESA listed species interactions in the Hawaii-based deep-set longline fishery targeting tuna

	Observer coverage	Leatherback	Loggerhead	Green	Olive ridley
2009	20.6%	1	0	0	1
2008	21.7%	4	0	0	3
2007	20.1%	1	1	0	7
2006	21.2%	2	0	2	11
2005	26.1%	1	0	0	4
2004	24.6%	3	0	1	13

From October 2003 through the end of 2005, the Hawaii-based bottomfish fishery was monitored under a mandatory observer program administered through the Pacific Islands Regional Office. Observer coverage in 2004 was 18.3% and in 2005 it was 25.0%. No ESA listed sea turtles or marine mammals were observed captured in this fishery. There are no observers in the Hawaii handline, pole, or troll fisheries and no data on turtle interactions, however the 2004 ITS for this component of the fishery is one leatherback capture. An observer program commenced in 2006 for the American Samoa based longline fishery, 3 green turtles were observed (8.1% coverage) all dead. No other sea turtle species were observed captured.

5.1.3. Longline fisheries in the western and central Pacific Ocean

The western and central Pacific Ocean (area west of 150ºW longitude, and between 10ºN and 45ºS) contains the largest industrial tuna fisheries in the world. Much of the effort takes place in the EEZs of Pacific Island countries, in the western tropical Pacific area (10ºN - 10ºS). Annual tuna catches in this area have averaged around 1.5 million metric tons, with around 60% of the catch captured by purse seine vessels, and the rest captured by longline vessels and other gears (e.g. pole-and-line, troll, ring-net).

The tuna fisheries are regulated by a number of international bodies and individual countries. The two main international regulatory bodies are the Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission. Both of these commissions have adopted management measures or resolutions designed to limit the amount of tuna fishing effort in the Pacific.

Approximately 5,000 commercial longliners operate throughout the western and central Pacific (45ºN to 45ºS), using up to 3,000 baited hooks per line to catch tuna. The proportion of the number of vessels originating from countries throughout the world have changed in the past decade and may consist of large freezer vessels that undertake long voyages and operate over large areas of the region to smaller domestically-based vessels operating in more tropical areas. The distant-water fleets operate throughout the western and central Pacific Ocean, targeting bigeye and yellowfin in tropical waters and albacore in the subtropical waters. Meanwhile, the offshore fleets generally fish in the tropical waters of the Federated States of Micronesia, Indonesia, Marshall Islands, Palau, and Solomon Islands and the adjacent international waters, where they will target bigeye and yellowfin tuna (Oceanic Fisheries Programme 2001).

Observers have been placed on both purse seiners and longliners in this area, and operate and report to the Oceanic Fisheries Programme of the Secretariat of the Pacific Community (SPC). Considering the low observer coverage (<1%) for the longline fisheries, patterns of observed interactions show that sea turtles are more likely to encounter gear in tropical waters and that they are much more likely (by an order of magnitude) to encounter gear that is shallow-set versus deep-set. When encountered on deep-set gear, sea turtles were likely to be captured on the shallowest hooks.

From available observer data, the longline fisheries operating in the western and central Pacific are estimated to capture 2,182 sea turtles per year, with 500-600 expected to die as a result of the encounter (23-27% mortality rate). Based on the data, 1,490 turtles (0.06 turtles/1,000 hooks) are estimated captured by offshore/fresh tuna vessels using shallow-night sets, 129 turtles (0.007 turtles/1,000 hooks) are estimated captured by offshore/fresh tuna vessels on deep-day sets, and 564 turtles (0.007 turtles/1,000 hooks) are estimated captured by distant water freezer vessels on deep-day sets. The species observed captured include (ranked by highest occurrence first): olive ridley, green, leatherback, loggerhead and hawksbill. Given the low observer coverage, this estimate has very wide confidence intervals (Oceanic Fisheries Programme 2001).

Over the past several years, new gear technology has been developed for longline fisheries that have been documented to reduce sea turtle bycatch and mortalities (Watson *et al.* 2005; Gilman *et al.* 2006c; Read 2007). It has been found that the use of 18/0 circle hooks with mackerel bait significantly reduce sea turtle interactions in shallow set longline gear; reductions in leatherback interactions averaged 65% and reductions in loggerhead interactions averaged 90% (Watson *et al.* 2005; Gilman *et al.* 2006). The U.S. has required the use of circle hooks in the Hawaii-based shallow-set longline fishery and parts of the Atlantic pelagic longline fishery. Experiments to test this gear have been carried out by a number of countries fishing in the Pacific (Read 2007), the Mediterranean (Piovano *et al*. 2009), and the South Atlantic (Sales *et al.* 2009). It is believed that the adoption of modified gear in Pacific fisheries could substantially lower the impact of longline fisheries on sea turtles. As shown above in Table 8, capture of sea turtles, particularly loggerheads and leatherbacks, was lower in the Hawaii- based SSLL fishery after the implementation of an amendment in 2004 requiring circle hooks and mackerel bait. There have been not been similar findings on the use of circle hooks and bait switching being effective in reducing the number of sea turtles captured in deep-set longline fisheries, however it is believed that the severity of injury would be less for a turtle hooked on a circle hook than a j-hook, assuming the animal is retrieved alive.

5.1.4. Australian longline fishery in and beyond the Australian Fishing Zone

Australia has two fisheries that target pelagic fish within and beyond its Australian Fishing Zone (AFZ) using longlines: (1) the Eastern Tuna and Billfish Fishery (ETBF), which extends along the east coast of Australia from Cape York, Queensland to the South Australia-Victorian border, targeting yellowfin tuna, bigeye tuna, and swordfish; and (2) the Southern and Western Tuna and Billfish Fishery (SWTBF), which extends from Cape York, Queensland across the northern coastline, down the western coastline of Western Australia and east to the South Australian-Victorian border, also targeting bigeye, yellowfin, and swordfish. Hooks are often set around sea mounts. Since Japanese longliners were denied access to fishing within the AFZ since 1997, both fleets have developed rapidly. In 2001, the ETBF consisted of approximately 150 active vessels, which deployed 11,250,000 hooks, while during that same year, the SWTBF consisted of 44 active vessels deploying 6,183,000 hooks. Both fisheries generally set shallow, at maximum depths of between 20 and 100 meters, although occasionally gear is set to depths greater than 150 meters (Robins *et al*. 2002a).

Sea turtle catch rate estimates in these two fisheries were calculated using data from skipper logbooks and interviews. Since 1997, Australian pelagic longline skippers have been required to log all sea turtle interactions. From 1997 to 2001, skippers logged a total of 272 turtles captured in both fisheries. Without verified catch data, however, it was difficult for researchers to determine the accuracy of the data. In 2001, skippers were interviewed regarding their sea turtle bycatch, and through these interviews, researchers determined that logbook data was likely inadequate, since very few fishers indicated that they had never caught sea turtles (Robins *et al*. 2002a).

Sea turtle catch rates and total turtle take by both fisheries were estimated from fisher interviews. The average sea turtle catch rate was 0.024 turtles/1,000 hooks, with a standard deviation of 0.027. Given this catch rate and the amount of effort in the fishery yields an estimated total of 402 sea turtles (95% confidence limits of 360 to 444) captured by the ETBF and SWTBF. Of the sea turtles identified to species, leatherbacks were most commonly reported as captured, with 66% in the ETBF and 90% in the SWTBF. However, 70% and 41% of all reported turtles were not reported to species in the ETBF and SWTBF, respectively. Therefore, these percentages may be underestimates. Because of the greater difficulties in identifying hard-shelled species, the proportion of other species composition in these fisheries was undeterminable (Robins *et al*., 2002a).

5.1.5 Japanese tuna longliners in the eastern tropical Pacific

The most recent sea turtle bycatch information for Japanese tuna longliners is based on data collected during 2000. At a bycatch working group meeting of the IATTC, held in Kobe, Japan on January 14-16, 2004, a member of the Japanese delegation stated that based on preliminary data from 2000, the Japanese tuna longline fleet in the eastern tropical Pacific was estimated to capture approximately 6,000 turtles, with 50 percent mortality. Little information on species composition was given; however, all species of Pacific sea turtles were captured, mostly olive ridleys, and of an estimated 166 leatherbacks captured, 25 were dead (Meeting Minutes, 4th Meeting of the Working Group on Bycatch, IATTC, January 14-16, 2004).

5.1.6 Costa Rican longline fisheries

Several studies have been undertaken in recent years in order to document the incidental capture of sea turtles in Costa Rican longline fisheries. The longline fleet consists of a “medium” artisanal fishery, which targets mahi mahi and tunas within the country’s EEZ, and an “advanced” fleet, which targets billfish and tunas within and outside the EEZ.

Two studies in 1997 and 1998 on two longline fishing cruises (one experimental) documented a high incidental capture of sea turtles. On one cruise east of the Galapagos Islands targeting billfish and shark (mean depth of 25-50 meters), a total of 34 turtles (55% olive ridleys and 45% east Pacific green turtles) were captured on two sets containing 1,750 hooks (19.43 turtles per 1,000 hooks). Mortality was 8.8%. One additional set caught two leatherbacks. The second cruise took place within the EEZ of Costa Rica and targeted billfish and mahi mahi. Researchers documented the incidental capture of 26 olive ridleys, with 1,804 hooks deployed (14.4 turtles per 1,000 hooks). Mortality was 0%; however, of the turtles captured, 88.5% were hooked in the mouth (Arauz *et al*. 2000).

An observer program was put in place on advanced artisanal vessels from August, 1999 through February, 2000 within the EEZ of Costa Rica. In this fishery, “mother lines” are set from between 12 and 15 miles with hooks attached every 5 to 10 meters, for a total of 400-800 hooks/set. Seventy seven longline sets were observed on 9 cruises; seven of the cruises targeted mahi mahi (daytime soak) and 2 of the cruises targeted yellowfin tuna (night-time soak). Of the nearly 40,000 hooks deployed, turtles represented 7.6% of the total catch, with olive ridleys constituting the second most abundant species captured (catch per unit effort of 6.36 turtles/1,000 hooks). Other turtle species were observed captured, except leatherbacks, which were not observed captured during the artisanal fishery.

5.1.7 Peruvian artisanal longline fishery for shark and mahi mahi

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. An observer program was initiated in 2003 to document sea turtle bycatch in the artisanal longline fishery.

From September, 2003 to November, 2004, observers were placed on artisanal longline vessels operating out of the port of Ilo, home to one of the largest year-round artisanal longline fleets. There are two seasons for this fleet: from December through March, the fleet targets mahi mahi, making up to 6-day trips, in an area 20-70 nm from the coast; and from April through November, the fleet targets mako and blue shark, making up to 20-day trips, in an area 250-500 nm from the coast. The fleet uses surface longlines.

During the observation period, 588 sets were observed during 60 trips, and 154 sea turtles were captured as bycatch. Loggerheads were the species most often caught (73.4%), followed by green turtles (18.2%), olive ridleys (3.8%), and leatherbacks (2.6%). Species were most often entangled (74%); the rest were hooked. Of the loggerheads captured, 68% were entangled, 32% were hooked. Of the two fisheries, sea turtle bycatch was highest during the mahi mahi season, with 0.597 turtles/1,000 hooks, while the shark fishery caught 0.356 turtles/1,000 hooks (Alfaro-Shigueto *et al*., 2005). Sea turtles are rarely released into the sea after being caught as bycatch in this fishery; therefore, the mortality rate in this artisanal longline fishery is likely high because sea turtles are retained for future consumption or sale.

5.1.8. Mexican longline fisheries

The Mexican longline fishery for sharks has been observed since at least 1994 and capture of all species, except leatherbacks and hawksbill sea turtles, have been observed. Table 9 shows the results of this data; however caution should be noted in interpreting the data since there is no information on what percentage of the fleet was observed, where the effort was located, or any details regarding the fishery. Perhaps the most relevant information from this table comes from the rate of capture of turtles per 1,000 hooks (SAGARPA, Instituto Nacional de la Pesca, 2003). Mortality rates ranged from 2-10% (Santana-Hernández 2003).

Table 9. Number of observed sea turtles captured per year (mortality, in parenthesis, is a subset of the take) and rate of incidental capture of turtles each per 1,000 hooks by longline boats in the Mexican Pacific Ocean.

Year/# species	1994	1995	1997	1998	2000	2001	2002	2003
green/black	1	0	12	1	2	1	16 (3)	6
loggerhead	0	0	4	0	13	0	0	0
olive ridley	18 (2)	5 (1)	42	19	23 (1)	0	19	1
unidentified	0	0	0	6	0	0	0	0
TOTAL	19	5	58	26	38	1	35	7
Rate of capture per 1,000 hooks	.6968	.1598	.2515	.1750	.2458	.0218	.2473	.6092

There is also a Mexican longline fishery for swordfish, but little is known regarding the incidence of sea turtle bycatch. In 1999 and 2000, observers recorded target species and bycatch species on board drift gillnet and longline vessels targeting swordfish off Baja California, Mexico. During 26 trips and 132 sets, observers recorded 10,774 organisms, with 0.44% comprised of sea turtles, all of which were released without apparent harm (Instituto Nacional de la Pesca, 2001).

5.1.9 Tuna purse seine fishery in the eastern tropical Pacific

The international purse seine fleet in the eastern tropical Pacific Ocean (ETP) represents the majority of the fishing effort and carrying capacity in the ETP tuna fishery, with much of the total capacity consisting of purse seiners greater than 400 short tons (st) (363 mt). The latest information from the Inter-American Tropical Tuna Commission (IATTC) shows that the number of active purse seiners of all sizes is 239 vessels, with Mexico and Ecuador comprising the majority of the fleet (66 and 86 vessels, respectively) (Source: IATTC, 2005 (www.iattc.org)).

The most recent data from the IATTC indicate that between approximately 5 and 172 total sea turtles per year were killed by vessels over 400 st (364 mt) in the ETP purse seine fishery from 1997-2008. The primary species captured were olive ridleys (Table 10; M. Hall, IATTC, personal communication, 2006), likely because they are proportionately more abundant than any other sea turtle species in the ETP and they have been observed to have an affinity for floating objects (Arenas and Hall, 1992). The mortality estimates contain fractions because while the IATTC has a known number of sets and turtle mortality from their observer database, they only have a known number of sets (not turtle mortality) from the national observer programs. Therefore, the mortality is pro-rated to make up for the sets for which the IATTC has no known turtle mortality data. The numbers of sea turtles killed by the fishery dropped significantly in 2002, and the years following, likely as a result of increased awareness by fishermen through educational seminars given by the IATTC and conservation measures implemented through Resolutions adopted by the IATTC. In 2007, the IATTC passed an even stronger Resolution on Bycatch, so sea turtle interactions and mortalities in this fishery should continue to decrease.

Table 10. Estimated sea turtle mortality by species for the ETP tuna purse seine fishery (including US) from 1997 to 2008. Includes only large (364 metric ton capacity and greater) vessels.

Name	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Green	13.0	9.0	10.9	6.0	7.8	3.0	0.0	0.0	1.4	2.0	1.0	0.0
Hawksbill	0.0	3.0	2.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0
Leatherback	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loggerhead	4.6	1.0	4.0	1.8	1.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
Olive Ridley	93.8	107.6	108.9	85.6	66.1	32.8	23.2	13.0	149.0	15.0	10.0	3.0
Unidentified	42.0	41.0	46.0	28.5	41.0	13.0	8.0	5.9	11.1	1.0	9.0	1.0
Total	153.4	161.6	171.8	123.0	116.9	48.9	31.2	18.9	27.5	19.0	23.9	5.0

[Source: M. Hall, IATTC, 2009]

The data contained in Table 10 indicates that some sea turtles killed by the ETP purse seine fishery were "unidentified," although the reasons for this were not given. Assuming that these unidentified turtle mortalities occurred in the same proportions as the identified turtle mortalities, 86% would be olive ridleys, 10.8% would be green turtles, 2.1% would be loggerheads, 1% would be a hawksbill, and 0.1% would be leatherbacks.

The US fleet (large vessels only) has 100 percent observer coverage; therefore, the fate of every sea turtle captured is documented. Because the US fleet does not set on dolphins, sea turtles are captured in school sets and log/FAD sets. The fate of sea turtles that interact with the US purse seine fleet during such sets may only be comparable to the non-U.S. fleet that sets on logs/FADs and tuna schools. Table 11 shows sea turtle interactions with the US purse seine fleet from 1998 through 2008. Similar to the entire purse seine fleet (Table 10), the majority of the sea turtles captured by the fishery are olive ridleys, and as shown in Table 11, most sea turtles are released unharmed.

Table 11. Sea turtle interactions with the US tuna purse seine fleet (large (>363 mt (400 st)) vessels only) in the ETP, 1998-2008.

Name	Fate	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Green	Released unharmed	3	5	2	2	1	5	0	1	3	2	0
Hawksbill	Released unharmed	0	0	0	1	1	0	0	0	0	0	0
Loggerhead	Released unharmed	0	1	5	0	0	0	0	0	0	0	
Olive Ridley	Released unharmed	38	27	3	16	10	34	23	7	15	8	0
	Escaped/evaded net	0	0	1	0	0	0	0	0	0	0	0
	Light injuries*	4	6	2	0	0	7	1	1	0	0	0
	Grave injuries**	1	0	0	3	0	0	0	0	1	0	0
	Killed	0	0	0	0	0	1	0	0	0	0	0
Unidentified	Released unharmed	2	0	3	6	1	10	5	0	1	0	0
	Escaped/evaded net	2	1	1	0	0	0	0	0	0	0	0
	Light injuries*	0	0	0	1	0	0	0	0	0	0	0
	Other/Unknown	1	0	0	0	0	1	0	0	0	0	0
	Killed	0	0	0	0	0	0	0	1	0	0	0
Total		51	40	17	29	13	58	29	10	20	0	0

*Light injuries are considered to be non-lethal injuries.
**Grave injuries are considered to be eventually lethal to the turtle.
[Source: M. Hall, IATTC, 2009]

Since 1999, seminars have been given by the IATTC and NMFS (for the U.S. fleet) to skippers and their crews to educate them on, among other issues, status of sea turtles, and handling and recovery of turtles captured by purse seiners in the ETP. In addition, during the 69th meeting of the IATTC held in Manzanillo, Mexico from June 26-28, 2002, the IATTC passed a Resolution on Bycatch C-02-05. The Resolution has been reaffirmed and strengthened over the years. At the 70th meeting of the IATTC held in Antigua, Guatemala, from June 24-27, 2003, a Consolidated Resolution on Bycatch was adopted. Under the resolution, purse seine fishermen are required to promptly release unharmed, to the extent practicable, all sea turtles. In addition, crews are required to be trained in techniques for handling turtles to improve survival after release. Vessels should be encouraged to release sea turtles entangled in FADs and recover FADs when they are not being used in the fishery. Specific to the purse seine fishery operation, whenever a sea turtle is sighted in the net, all reasonable efforts should be made to rescue the turtle before it becomes entangled, including, if necessary, the deployment of a speedboat. If a sea turtle is entangled in the net, net roll should stop as the turtle comes out of the water and should not start again until the turtle has been disentangled and released. If a turtle is brought aboard the vessel, all appropriate efforts to assist in the recovery of the turtle should be made before returning it to sea (IATTC Resolution C-04-05, Action #4). In 2007, the resolution was strengthened to include implementing the FAO Guidelines to reduce bycatch and require countries to submit annual reports to the IATTC on progress towards implementation as well as observed sea turtle bycatch. The IATTC will continue to collect information on sea turtle bycatch in the fisheries it regulates and report this back to the parties. As well as support research on ways to reduce bycatch which will be shared with the parties (IATTC Resolution C-07-03)

5.1.10 Purse seine fisheries in the western tropical Pacific Ocean (WTP)

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

Animal-associated, drifting log and anchored-FAD sets had the highest incidence of sea turtle encounter (1.115, 0.807, and 0.615 encounters per 100 sets, respectively). In contrast, drifting FAD sets were observed to have only 0.07 encounters per 100 sets. With less than 5% observer coverage, confidence intervals for these estimates are also very wide (Oceanic Fisheries Programme, 2001).

5.1.11 Mexican (Baja California) fisheries and direct harvest

Sea turtles have been protected in Mexico since 1990, when a federal law decreed the prohibition of the "extraction, capture and pursuit of all species of sea turtle in federal waters or from beaches within national territory ... [and a requirement that] ... any species of sea turtle incidentally captured during the operations of any commercial fishery shall be returned to the sea, independently of its physical state, dead or alive" (*in* Garcia-Martinez and Nichols, 2000). Despite the ban, studies have shown that sea turtles continue to be caught, both indirectly in fisheries and by a directed harvest of eggs, immatures, and adults. Turtles are principally hunted using nets, longlines and harpoons. While some are killed immediately, others are kept alive in pens and transported in trucks, pick-ups, or cars. The market for sea turtles consists of two types: the local market (consumed locally) and the export market (sold to restaurants in cities such as Tijuana, Ensenada, Mexicali, and U.S. cities such as San Diego and Tucson). Consumption is highest during holidays such as Easter and Christmas (Wildcoast *et al*. 2003).

Based on a combination of analyses of stranding data, beach and sea surveys, tag-recapture studies and extensive interviews, all carried out between June, 1994 and January, 1999, Nichols (2002) conservatively estimated the annual capture of sea turtles by various fisheries and through direct harvest in the Baja California, Mexico region. Although there are no solid estimates of fisheries-related sea turtle mortality rates for the region, sea turtles are known to interact with (and be killed by) several fisheries in the area. As in other parts of the world, shrimp trawling off Baja California is a source of sea turtle mortality, although since 1996, shrimp fishermen are required to use TEDs. Prior to this requirement, Figueroa *et al*. (1992 *in* Nichols, 2002) reported that nearly 40% of known mortality of post-nesting green turtles tagged in Michoacán was due to shrimp trawlers. Based on stranding patterns, Nichols, *et al*. (2000) speculated that mortality of loggerheads due to local fishing in Baja California may primarily be due to a net-based fishery, likely the halibut (*Paralichthys californicus*) gillnet fishery, which reports regular loggerhead bycatch and coincides with the movement of pelagic red crab into the shallower continental shelf. Fishermen also report the incidental capture of sea turtles, primarily loggerheads, by pelagic longlines and hook sets used to catch sharks and pelagic fish. Lastly, sea turtles have occasionally been found by fishermen entangled in buoy and trap lines, although this is apparently a rare occurrence (Nichols 2002). Although fishermen may release sea turtles alive after being entangled in or hooked by their gear, based on information on the directed harvest and estimated human consumption of sea turtles in this region, incidentally caught sea turtles are likely retained for later consumption.

Sea turtle mortality data collected between 1994 and 1999 indicate that over 90% of sea turtles recorded dead were either green turtles (30% of total) or loggerheads (61% of total) (Table 12), and signs of human consumption were evident in over half of the specimens. Most of the loggerheads were immature, while size ranges for both green and olive ridleys indicated representation from both immature and mature life stages (Nichols 2002).

Table 12. Recorded sea turtle mortality by species during 1994-1999 on the Gulf of California coast and the Pacific coast of Baja California, Mexico.

Species	Gulf of California	Pacific	Totals
green turtle	30	276	306
leatherback	1	0	1
loggerhead	3	617	620
olive ridley	1	35	36
unidentified	0	57	57
Total	35	985	1,020

Source: Nichols (2002).

A more focused study was conducted from June to December, 1999 in Bahia Magdalena, a coastal lagoon to determine the extent of sea turtle mortality. Researchers searched for sea turtle carapaces in local towns and dumps as well as coastal beaches. The majority (78%) of the carapaces were found in towns and dumps and green and loggerhead turtles most frequently observed. Both species found were generally smaller than the average size of nesting adults. Researchers estimated that the minimum sea turtle mortality rate for the Bahía Magdalena region was 47 turtles per month, or 564 turtles per year. Based on observations, approximately 52% were green turtles, 35% were loggerheads, 2% olive ridleys, and 1% hawksbills (10% unidentified) (Gardner and Nichols 2002). A study conducted from 1995 to 2002 in Bahía de Los Angeles, a large bay that was once the site of the greatest sea turtle harvest in the Gulf of California, revealed that the populations of green turtles in the area had decreased significantly since the early 1960s. Despite the 1990 ban, sea turtle carcasses were found at dumpsites, so human activities continue to impact green turtles in this important foraging site (Seminoff *et al*. 2003).

Based on surveys conducted in coastal communities of Baja California, extrapolated to include the entire coastal peninsula, Nichols (2002) estimated the annual mortality of green turtles in this region to be *greater* than 7,800 turtles, impacting both immature and adult turtles. Mortality of loggerhead turtles, based on stranding and harvest rates, is estimated at 1,950 annually, and affects primarily immature size classes. The primary causes for mortality are the incidental capture in a variety of fishing gears and direct harvest for consumption and [illegal] trade. With the local declines of green turtles, a market for loggerhead meat has developed in several Pacific communities. Olive ridleys are not found as commonly in Baja California waters as loggerheads and greens; however, they are consumed locally and occasionally strand on beaches. No annual mortality estimates of olive ridleys in the area were presented. Lastly, anecdotal reports of leatherbacks caught in fishing gear or consumed exist for the region; however, these instances are rare, and no annual mortality estimates of leatherbacks were presented (Nichols, 2002). An estimate by Wildcoast *et al*. (2003) reiterates that there is likely high mortality of turtles in the Californias (defined here is the region encompassing the Gulf of California including the coast of Sonora and Sinaloa, Mexico; Baja California and Baja California Sur, Mexico, and California, USA) estimating 15,600 to 31,200 sea turtles consumed annually (no differentiation between species).

The latest research on fisheries mortality and poaching of sea turtles in Mexico focused again on the Bahia Magdalena region of Baja California. In this area, small-scale artisanal fisheries are very important. The most commonly used fishing gear are bottom set gillnets and have been documented interacting at high rates with loggerheads and green turtles. From April 2000 to July 2003 throughout this region (including local beaches and towns), Koch *et al*. (2006) found 1,945 sea turtle carcasses. Of this total, 44.1% were loggerheads and 36.9% were green (also known as "black") turtles. Of the sea turtle carcasses found, slaughter for human consumption was the primary cause of death for all species (91% for green turtles, 63% for loggerheads). Mortality due to fisheries bycatch was difficult to document, simply because evidence of trawl and gillnet interactions is rarely seen on a sea turtle carapace. Less than 1% of mortality was documented as due to fisheries bycatch. Over 90% of all turtles found were juveniles or subadults. Koch *et al*. (2006) estimate conservatively that at least 15,000 sea turtles are killed per year for the Baja California peninsula. Again, no differentiation is made between species; however, the percentages of the various sea turtle species found in Bahia Magdalena may provide an idea of the species composition captured throughout the peninsula.

In 2003 the Grupo Tortuguero's ProCaguama (Operation Loggerhead) was initiated to partner directly with fishermen to assess and mitigate their bycatch while maintaining fisheries sustainability in Baja California, Mexico. ProCaguama's fisher-scientist team discovered the highest turtle bycatch rates documented worldwide and has made considerable progress in mitigating anthropogenic mortality in Mexican waters (Peckham et al. 2007, 2008). As a result of the 2006 and 2007 trinational fishermen's exchanges run by ProCaguama, Sea Turtle Association of Japan, and the Western Pacific Fisheries Management Council, in 2007 a prominent BCS fleet retired its bottom-set longlines, sparing hundreds of loggerheads each season since. Prior to this closure, the longline fleet interacted with an estimated 2,000 loggerheads annually, with nearly all (~90%) of the captures resulting in mortalites (Peckham *et al.*, 2008). Because this fishery no longer exists, conservation efforts have resulted in the continued protection of nearly 2,000 juvenile and subadult loggerheads per year.

5.1.12 Directed capture/trade of sea turtles in Southern Peru

Sea turtles have been protected in Peru since 1977; however, there is little governmental control over the illegal taking and killing of sea turtles. Researchers focused observations on the Pisco-Paracas area of southern Peru to determine the extent of the hunting and trade of sea turtles, as it is a recognized foraging area for sea turtles and is also a known area for the sea turtle trade, particularly the San Andrés port. Fishermen sell sea turtle (sometimes alive) for its meat, oil, or shell to a dealer, who may sell in the nearby market of Pisco. The observation period occurred from July, 1999 through June, 2000. An estimated 204 ±17.6 sea turtles were killed at San Andrés. Species composition was: 67.8% green turtles, 27.7% olive ridleys, and 2.9% leatherbacks. Peak captures were during the Peruvian spring (October – December), while leatherbacks were only captured in December and February. This estimate is considered a minimum since sea turtles are not always butchered on the beach and therefore may not be observed by researchers. Sea turtles were most often captured by fishermen and retained for future sales. Most of the animals were caught in a medium sized (600 m x 10m) multifilament nylon drift gillnet set for small sharks and rays, with a stretched mesh size up to 20 cm (de Paz *et al.* 2005).

5.2. Scientific research permits

5.2.1. Scientific Research Permit #1514

This permit allows Pacific Islands Region staff to measure, photograph, tissue sample, flipper tag, Pop-up Satellite Archival Tag (PSAT), release, salvage (if dead) of sea turtles incidentally captured during longline fishing operations carried out under the Western Pelagics fishery management plan. Captures of these animals is covered under the ITS issued in the 2004 biological opinion on the Pelagics FMP.

5.2.2 Scientific Research Permit #1596

The permit was issued under Section 10 of the ESA to the Southwest Region and authorized the annual non-lethal capture of up to 78 leatherbacks. The research area, the U.S. West Coast, is an important forage area for leatherbacks in the Pacific. The purpose of the research activities is to continue long-term monitoring of the status of the species off the coasts of California, Oregon, and Washington. The research will study the species to determine their abundance, distribution, size ranges, sex ratio, health status, diving behavior, local movements, habitat use, and migration routes. Animals will be located through aerial surveys at a high altitude to prevent harassment and subsequently captured by hoop net from a research vessel. The primary goal is to address priorities outlined in the U.S. Pacific leatherback Recovery Plan. The Permit Holder will identify critical forage habitats, genetic stock structure, migratory corridors and potential fishery impacts on this species in the Pacific. This information is necessary to make informed management decisions concerning these turtles and their habitat.

5.2.3. Scientific Research Permit #1537

The permit was issued to the Guam Division of Aquatic & Wildlife Resources (DAWR) authorizing research on green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles in the waters of Guam. This permit authorizes hand or net capture, measure, flipper tag, Passive Integrated Transponder tag (PIT tag), tissue sample, and release these sea turtles. It also authorizes the attachment of a satellite transmitter to a subset of individuals of each species and release them. This permit is issued for a 5-year period. Sixty-three green turtles and 30 hawksbill turtles are authorized to be captured.

5.2.4 Scientific Research Permit #1556

The permit authorizes in-water tow dive assessment and the capture of sea turtles. Collected turtles will be captured, handled, measured, tissue-sampled, flipper and PIT tagged, photographed, and released. The permit authorizes the capture of 100 green and 40 hawksbill turtles. The permit is issued to Commonwealth of Northern Mariana Islands Division of Fish and Wildlife in the North Marianna Islands.

5.2.5. Scientific Research Permit #1591

The objective of the permitted activity, as described in the application, is to continue long-term monitoring of the status of sea turtles in San Diego Bay. Researchers in the SWFSC will study the species present at this temperate foraging area to determine their abundance, size ranges, growth, sex ratio, health status, diving behavior, local movements, habitat use, and migration routes. A primary goal is to integrate data from genetic analysis, flipper tagging, and satellite telemetry to identify nesting beach origins of turtles occurring in San Diego Bay and contribute to the overall understanding of sea turtle stock structure in the Pacific Ocean. Further, researchers will compare current data with those collected in San Diego Bay since 1989 to determine growth rates of juveniles and adults, determine tag retention rates, and examine population abundance trends. Genetic studies based on blood and tissue samples are part of an international collaboration to define stock structure of sea turtles in the Pacific Ocean.

5.2.6. Scientific Research Permit #1581

This permit authorizes the capture of green and hawksbill turtles for scientific research as part of long-term monitoring of the status of these two species in the Hawaiian Islands to determine there abundance, size ranges, health/disease status, diving behavior, habitat use, foraging ecology, local movements, and migration routes. Up to 600 green and 10 hawksbills may be captured annually and sampled. In addition, PIT tags or flipper tags may be attached. No mortality is expected as a result of these procedures. The permit is issued to George Balaaz of the Pacific Islands Fisheries Science Center.

5.3 Climate effects

The four species addressed in this biological opinion are already likely beginning to be affected by global climate change. The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (Trenberth et al. 2007). The effects of climate change on sea turtles are just beginning to be studied, however the ability to link climate change and changes in behavior is difficult given the paucity of historical data and the scope of climate change and its effects on localized areas. However, a number of studies have speculated on the possible current and future effects of climate change on sea turtles. As described in the individual status sections above, impacts on sea turtles are likely to come from rising temperatures, rising sea levels, increased typhoon frequency and severity and changes in ocean temperature and chemistry.

Climate change may affect turtle nesting habitat. Long-term climate change (e.g., rising average temperatures) will likely result in rising sea levels due to loss of glaciers and snow caps (IPCC 2007) coupled with thermal expansion of warming ocean water which may lead to the loss of usable beach habitat. (Baker *et al.* 2006). As waters rise, it may lead to additional fortification of beaches to protect waterfront properties. This could result in substantially reduced suitable areas for nesting (Schlacher *et al.* 2008) or the loss of entire beaches (Airoldi *et al.* 2005). An increase in the severity of hurricanes and typhoons in nesting areas could also occur (IPCC 2007; Webster *et al.* 2005), causing further erosion or loss of nesting habitat and reduced hatchling success. This is likely to affect different species differently. Leatherbacks do not have the same high level of nesting site fidelity as hard shelled turtles, so they may be able to better adapt to the loss of habitat by seeking out new nesting areas, whereas hard shelled turtles may be more impacted by nesting beach loss (Pike and Stiner 2007). It has been observed that sea turtles are expanding their nesting range to higher latitudes, possibly in response to warming that is currently occurring (Bowen *et al.* 2003; Babon *et al.* 2004). Sea turtles may be able to adapt the timing of their nesting and/or colonize new beaches for nesting, but whether this can happen and quickly enough to adapt to changing climate remains to be seen (Hawkes *et al.* 2009). It should be noted that there is insufficient available data to determine a correlation between past sea level rise and sea turtle population dynamics (VanHoutan 2010).

Various studies suggest that sea level rise will result in a loss of sea turtle nesting beaches by 2100 (Fish et al. 2005; Baker et al. 2006; Fuentes et al. 2009). However, a study by Webb and Kench (2010) which considered the effects of geomorphological dynamics on 27 atoll islands in the central Pacific and found that over a 19 to 61 year period, 43% of the islands remained stable and 43% actually increased in area (only 14% of the islands in the study had a net reduction). Thus, it is reasonable to believe that changes in beaches and sea turtle nesting habitat will not be uniform or predictable and may not lead to net loss in nesting areas.

Changes in water and air temperature may affect nesting timing and success. Turtle clutches are sensitive to temperature changes. Very high air temperatures while eggs are incubating in the sand may kill the offspring. The sex of developing turtles within the nest is temperature dependent. That is, eggs incubated at higher temperatures produce more females while eggs incubated at lower temperatures result in more males (Chan and Liew 1996). Sex ratio of hatchlings varies by nest locations and within and among seasons. However, in some areas, nests are producing clutches of nearly entirely females (60 to 99% females) and it has been suggested that this is may be due to a general rise in global temperatures that is having a localized effect on hatchlings (Chan and Liew 1995; Godfery et al. 1996; Kaska et al. 2006). There is insufficient monitoring data from the past to indicate that this skewed sex ratio is anomalous and caused by climate change. If climate change is causing the sex bias in nests, then increased air temperatures may result in a bias of the sex ratio of offspring, which over the long-term could lead to reduced nesting success (insufficient males to fertilize eggs). Thus, while the number of nesting females may be stable or increasing now, the eggs being produced may not be viable or the hatchling output may not produce a balanced sex ratio necessary for future successful reproduction.

Oceanographic changes linked to climate may also affect sea turtle prey availability, migration and nesting (Solow et al. 2002; Chaloupka et al. 2008). Over the long term, climate models suggest a number of possible changes in oceanographic conditions, including the slowing down of the thermohaline circulation, higher precipitation storms, rising sea surface temperatures and rising sea levels (IPCC 2007). These types of changes may also effect hatchling and juvenile in a number of ways including: changes in spatial distribution of predators such as bird and fish species into nesting areas where hatchlings could become prey (Hawkes et al. 2009); changes in surface currents may affect the distribution of hatchlings and juveniles across oceanic basins (Hamann *et al.* 2007); the pelagic development stage for juvenile turtles could also be affected as forage resources may become more or less available (Hays *et al.* 2005) so the period of the life stage from hatchling to larger juvenile/adult may be longer or shorter than presently (Verity *et al.* 2002).

It is possible that long-term climate change could affect sea turtles' range and lead to expansions and changes in migration routes (Robinson et al. 2008). Leatherbacks are particularly sensitive to isotherm temperatures and travel and forage within specific ranges. In the Atlantic, leatherbacks have extended their typical range north by 330km in the last 17 years as warming has caused the northerly migration of the 15°C SST isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays 2006). Short term oceanographic changes may also affect foraging behavior. For example, leatherbacks that may be exposed to the DSLL fishery travel from nesting areas in the western Pacific to the eastern north Pacific in order to forage on large concentrations of prey, particularly jellyfish. Short term variability in climate such as El Niño events may limit prey due to a reduction in upwelling brought by warm surface waters and limited or no wind, which may affect the migratory patterns of this population of leatherbacks.

Shifts in the abundance of foraging resources have also been linked to observed modifications in phenology for sea turtles. These include longer re-migration intervals and temporal shifts in nesting activity (Weishampel et al. 2004; Hawkes et al. 2007). The timing of nesting is believed to be tied to resources. The availability of forage, affected by environmental conditions, may affect when female and male sea turtles migrate to breeding grounds (Wallace *et al.* 2006). It is not known how differences in water temperatures may affect the length of the nesting season, its timing, or the internesting interval, but these are possible responses as climate changes (Hawkes *et al*. 2009). Another possible impact of climate-change induced temperature rise is a change in ocean chemistry and how rising sea levels may affect coral reef and seagrass ecosystems, which provide habitat for green sea turtles.

The effects of changes on sea turtles are difficult to predict given current available data. At this time it is only possible to speculate the relationships between climate change impacts and sea turtle behavior and specific study on the effects of climate change in the action area has not been carried out.

Additional study will be necessary to determine how climate may be affecting sea turtles and the entire marine eco-system in the Pacific and elsewhere (Kintisch 2006). The Pacific Ocean exhibits a higher level of climate variability than the Atlantic or the Indian Oceans (Saba 2008), so studies carried out in other ocean basins may not be directly applicable to the Pacific, which is the action area.

This section has reviewed the available literature on climate change and behavioral changes that have been observed in some sea turtle populations. Attempting to link climate change to recent biological trends is complicated. As with all ecosystems, there are complex inter-relationships that influence biological changes and attempting to isolate a cause and correlate it to an observed effect is difficult. Parmesan and Yohe (2003) looked at approximately 2,000 species globally and found significant, non-random patterns of change (e.g., changes in geographical range, phenology, and other biological factors) that are consistent with observed climate warming. The available information support the probability that observed changes in sea turtle phenology, sex ratio, and foraging behavior in certain studied populations may be influenced by large scale climate change. However, how it is not known how these changes may impact the species at the population level. Also, sufficient information within the action area with which to access the impacts of climate change are lacking. Therefore, any recent impacts from climate change in the action area are not quantifiable or describable to a degree that could be meaningfully analyzed in this consultation, but are believed to be insignificant at this time.

5.4. Conservation efforts in the Pacific

There are a number of international actions being carried out to conserve sea turtles, primarily through reduction of bycatch in commercial fisheries and protection of nesting beaches. Many of these have been detailed above in the status of the species sections. There are also large scale international efforts to conserve and recovery sea turtles in the Pacific, these include the Inter-American Convention for the Protection and Conservation of Sea Turtles, the Convention on International Trade in Endangered Species, the Food and Agriculture Organization’s Technical Consultation on Sea Turtle-Fishery interactions, and others. These agreements or guidelines have helped to reduce threats at nesting beaches such as direct capture of adults and eggs and also habitat destruction. In addition, the Inter-American Tropical Tuna Commission and the Western and Central Fisheries Management Commission have adopted resolutions aimed at reducing bycatch in commercial tuna fisheries. Over the past five years, the U.S. and other countries have begun using large circle hooks and different bait in longline fisheries to reduce sea turtle bycatch and mortality. In the Hawaii-based shallow-set longline fishery, the 2004 amendment to their FMP required the use of 18/0 circle hooks and mackerel bait. Overall sea turtle bycatch has been reduced by approximately 90% from traditional “j” hooks and squid bait (Gilman *et al.* 2007). Additional experiments among foreign fleets are ongoing (Read 2008), but this gear modification is considered an important development in reducing sea turtle bycatch and aiding in their conservation.

6. EFFECTS OF THE ACTION

6.1. Exposure

All four species of sea turtles described in this biological opinion have been observed incidentally captured in longline fisheries in the Pacific. As noted previously, the current DSLL fishery is subject to 100 percent observer coverage; however, these records are confidential, and not considered sufficient to estimate possible impacts of a larger DSLL fleet (up to six vessels) over an expanded area. The current participant in the fishery has testified at meetings of the Pacific Fisheries Management Council that while participating in this fishery his operations incidentally captured and killed an olive ridley sea turtle, which is an expected occurrence because olive ridleys are the sea turtle species most frequently incidentally caught and killed in the Hawaii based DSLL fishery as well as the most abundant sea turtle species in the area where he was fishing. The current West Coast DSLL observer program provides insufficient data to calculate meaningful projections of the likely effects of the proposed action given the very low effort and the rarity with which incidental captures of sea turtles are observed. Therefore, a variety of resources were used in determining which species may be exposed and affected by the DSLL fishery if it expands to include more participants, as described in proposed action for this biological opinion. Records from the existing Hawaii-based DSLL fishery were reviewed, along with records from the Hawaii- and West Coast-based SSLL fisheries, and finally a review of the abundance and distribution of the species was considered.

In 2005, the Pacific Islands Regional Office (PIRO) conducted a Section 7 consultation on the Hawaii-based DSLL fishery. This fishery set an estimated 35,055,119 hooks in 2005 and the projected levels of sea turtle captures in the Hawaii-based DSLL fishery were based upon that level of effort and observed captures in 2004 and 2005, which are shown in Table 13.

Table 13. Number of turtles expected to be captured and killed in the Hawaii-based deep-set longline fishery over a period of three consecutive years (NMFS 2005).

Species/Stock	Number captured	Number killed (a subset of captures)
Greens	21	18
Loggerheads (proposed NPO DPS)	18	9
Leatherbacks	39	18
Olive Ridleys	123	117

Utilizing the anticipated rate of sea turtle captures calculated by PIRO and scaling to the level of the proposed action (i.e., 800,000 hook effort), the following rates of sea turtle incidental capture are anticipated over the next three years in the West Coast-based DSLL tuna fishery: three olive ridley sea turtles, one leatherback sea turtle, one green sea turtle, and one loggerhead sea turtle as shown in Table 14. These rates may over-estimate the actual captures since a conservative approach was captured by PIRO in developing the anticipated annual interactions for each of the four species expected to interact with the DSLL fishery (NMFS 2005). Also, the distribution of sea turtles at the time and area of the Hawaii-based DSLL may not be the same as the distribution of sea turtles in the proposed action area for the West Coast-based DSLL tuna fishery. The projected captures are provided for the following three years for two reasons: 1. the time period covered by this biological opinion is three years because SFD anticipates that the

DSLL fishery will remain largely unchanged over the next three years; and 2. sea turtle capture rates are expected to be very low in the DSLL fishery, therefore it was necessary to pool years to accurately reflect anticipated captures to be used for this analysis.

Table 14. Projected captures of sea turtles in the West Coast-based DSLL fishery over three years.

Species/Stock	Estimated interactions in three years
Green	1
Loggerhead (proposed North Pacific Ocean DPS)	1
Leatherback	1
Olive Ridley	3

In order to estimate the likelihood of sea turtle captures in the proposed DSLL fishery, other fisheries that occur in the same general area were also considered, including the California and Hawaii-based SSLL fisheries. However, there were very few observed SSLL sets made in the waters south of 35° N. latitude and east of 140° W. longitude, the area where most of the DSLL fishery activity is expected to occur. The effort in the California SSLL is closer to the primary area of effort of this proposed action, but most of the 469 observed SSLL sets were made between October 2001 and February 2004 which does not match the timing of the DSLL that is the subject of this biological opinion (i.e., December through May). No other longline fisheries occur in the area described as likely to have the highest level of DSLL activity (i.e., from the equator to 35° N. latitude and east of 140° W. longitude).

Details on the impacted life stage for each of the species are provided in the following section.

6.1.1 Green turtles

The green turtles that may be exposed to this fishery would come from either the endangered Mexican or threatened Hawaiian nesting aggregations. The Mexican aggregation of green turtles forage off Baja, California, Mexico between Punta Abreojos and Bahia Magdalena (Nichols 2003), nesting 1500 k to the south on the Mexico mainland. They have a varied diet depending upon where they are and will eat red crab, but are primarily herbivores in the benthic stage, and eat a variety of marine animals (mollusks, crustaceans, sponges, jellyfish, and echinoderms in the pelagic stage (Marquez 1990 in Etnoyer et al 2006). Unlike most greens, which become exclusively herbivores as adults, E. Pacific greens have been observed feeding on large quantities of red crabs off the Baja peninsula. The E. Pacific green has been referred to as *Chelonia mydas agassizi,* or a black sea turtle.

Genetic analysis of green turtles captured in the Hawaii-based DSLL indicate that 57% came from the Mexican nesting population and 43% came from the Hawaiian nesting population (NMFS 2005). If the West Coast based DSLL continues to concentrate operations east of 140° W. longitude, then it is more likely that the captured green turtle would be from the Mexican nesting population.

It is anticipated that one green turtle will be incidentally captured in three years during the proposed West Coast based DSLL fishery. Based upon observations from the Hawaii-based

DSLL fishery, the green turtle captured in the West Coast DSSL would most likely be an adult or sub-adult from the Mexican nesting population. It is assumed that green turtles in the action area have a 50:50 sex ratio so the animal could be a male or female.

6.1.2. Loggerhead turtles

The loggerheads most likely to be exposed to this action originate from the proposed North Pacific DPS (75 FR 12598) or the Japanese nesting aggregations. Genetic analysis of loggerheads captured in the Hawaii-based SSLL and DSLL indicate that all of the turtles came from nesting beaches in southern Japan (NMFS 2005). Young loggerheads will travel across the North Pacific to feed in the waters off of western Baja, California, Mexico and may spend decades in the open ocean and/or near Baja before returning to their natal areas in Japan to mate and lay eggs. Juvenile loggerheads are known to forage in the coastal waters off the Baja Peninsula, feeding primarily on red crab that become abundant in the spring and summer as cold water run-off causes blooms of crab (Nichols 2002). Loggerheads foraging within the coastal area are unlikely to be exposed to the proposed action, since the fishery occurs at least 200 miles from the coast. However, juvenile loggerheads moving into and out of the area may be exposed to the fishery. Satellite tracking indicates that loggerheads tagged and released from North Pacific fisheries and Japan travel in the North Pacific Transition Zone (NPTZ) and the Kuroshio Extension Current, perhaps spending years as juveniles feeding in these large Pacific currents (Polovina, *et al.* 2004; Polovina, *et al.* 2006). Satellite tracks of juvenile loggerheads in the NPTZ end at approximately 130° W. longitude, which is the eastern boundary of the Sub-Arctic and Sub-Tropical gyre in which the NPTZ is found (Polovina, *et al*. 2004). This area is within the proposed action area and on the western edge of the California Current. Therefore, loggerheads either moving into foraging areas off Baja, California Sur, Mexico, or foraging in the NPTZ may be exposed to fishing under this proposed action.

Loggerheads are generally shallow divers. Polovina *et al.* (2003) tracked loggerheads in pelagic waters and determined that most dives were less than 100 meters deep, with the majority being less than 40 meters. This dive pattern likely contributes to the low level of loggerhead bycatch in the Hawaii-based DSLL fishery (see Table 8 above). Based upon the pattern of interaction in the Hawaii-based DSLL fishery, where loggerheads are reported hooked in the mouth or ingested the hook, it is possible that loggerheads are biting baited hooks that are the most shallow or may be biting hooks as gear is set or retrieved. This may explain the relatively low mortality rate for this species.

It is anticipated that one loggerhead turtle will be incidentally captured in three years during the proposed West Coast based DSLL fishery. Based upon observations from the Hawaii-based DSLL fishery, the loggerhead turtle would most likely be an oceanic juvenile from the Japanese nesting population. The sex ratio of loggerhead in the area is not known, so it is assumed that loggerhead turtles in the action area have a 50:50 sex ratio so the animal could be a male or female.

6.1.3 Leatherback turtles

There are two populations of leatherbacks in the Pacific, identified by nesting areas, these are the eastern Pacific and the western Pacific leatherbacks. Eastern Pacific leatherbacks are not likely to be exposed to the proposed action as satellite tagging of post-nesting females indicates that they do not travel north of the equator. Further, leatherbacks that have been incidentally captured in U.S. longline fisheries in the North Pacific are all from the western Pacific population, with no individuals with the eastern Pacific genome. The leatherbacks exposed to the proposed action may be from any of the nesting beaches in the western Pacific. At this time, there are no identified genetics markers for individual nesting areas (e.g., Jamursba-Medi or Wer-mon). Leatherbacks from western Pacific nesting sites have been tagged and tracked to identified feeding areas along US West Coast, particularly in the late summer and fall (Benson et al 2007). Satellite tagged post-nesting animals suggest that by January, leatherbacks have moved into central north Pacific, west of 140° west, thus the possibility of exposure to the DSLL is low. However, if the fishery changes so that more fishing occurs in the fall, this could increase likelihood of exposure to leatherbacks.

Leatherbacks are deep divers and may dive to great depths to find food. This may increase the exposure to the baited hooks. Most leatherback interactions with longline gear involve entanglement, unlike loggerheads which remove fish from the baited hooks (usually only in SSLL gear). The entanglements may be related to the constant movement of leatherbacks and their general tendency to not prey on fish.

It is anticipated that one leatherback turtle will be incidentally captured in three years during the proposed West Coast based DSLL fishery. Based upon observations from the Hawaii-based DSLL fishery, the leatherback turtle would most likely be a juvenile or sub-adult. The animal would most likely to be from the Western Pacific (Indonesia, Papua New Guinea, and the Solomon Islands) nesting aggregation based upon satellite tracking of Pacific leatherbacks (Benson et al 2007). The sex ratio of loggerhead in the area is not known, so it is assumed that leatherback turtles in the action area have a 50:50 sex ratio so the animal could be a male or female.

6.1.4 Olive ridley turtles

There are two nesting aggregations of olive ridleys in the Pacific Ocean: the Marianas Islands, Australia, Indonesia, Malaysia, and Japan (western Pacific), and Mexico, Costa Rica, Guatemala, and South America (eastern Pacific). Like leatherback turtles, most olive ridley turtles lead a primarily pelagic existence (Plotkin *et al*. 1993), migrating throughout the Pacific, from their nesting grounds to the north Pacific; both the western Pacific and eastern Pacific populations use the North Pacific as foraging grounds (Polovina, *et al*. 2004). Olive ridleys live within two distinct oceanic regions including the subtropical gyre and oceanic currents in the Pacific. The gyre contains warm surface waters and a deep thermocline preferred by olive ridleys. The currents bordering the subtropical gyre, the Kuroshio Extension Current, North Equatorial Current and the Equatorial Counter Current all provide for advantages in movement with zonal currents and location of prey species (Polovina, *et al*. 2004). These areas are near or within the proposed action area. Recent genetic information indicates that 75 percent of the Hawaii-based longline fisheries interactions with this species are from the eastern Pacific subpopulations, and 25 percent are from the Indian and western Pacific rookeries (personal communication with Peter Dutton, Southwest Fisheries Science Center, Biologist and lead of the Marine Turtle Research Program, 2005). Given the location of the proposed action, it is reasonable that eastern Pacific olive ridleys are more likely to be exposed to the action.

Studies on diving olive ridleys indicates that animals occasionally dive to a depth of 150 m and 10 percent of the time was spent at a depth greater than 100 m (Polovina, *et al*. 2002). The target depth for tuna is generally 100 to 300 m, thus olive ridleys are considered likely to encounter DSLL fishing gear due to their pattern of deep dives.

It is anticipated that three olive ridley turtles will be incidentally captured in three years during the proposed West Coast based DSLL fishery. Based upon observations from the Hawaii-based DSLL fishery, the olive ridley turtle that is captured in the West Coast DSLL is most likely to be an adult or sub-adult from the eastern Pacific nesting population. The sex ratio of olive ridleys in the area is not known, so it is assumed that olive ridley turtles in the action area have a 50:50 sex ratio so the animal could be a male or female.

6.2 Response

There is limited information available from the current California based DSLL fishery, however, there is a long record of observer data from the Hawaii-based DSLL. NMFS assumes that sea turtles exposed to the DSLL of the proposed action will respond in the same manner as has been observed in the Hawaii-based DSLL based upon the similarity of gear types and methods being employed.

Sea turtles may be directly impacted by DSLL by entanglement and/or becoming hooked by the gear. Incidentally entangled or hooked turtles may die or may be released injured, with or without trailing gear and/or hooks still on the body. Lethal interactions due to drowning are more common in deep-set gear as the animals are less likely to reach the surface in deep-set gear than shallow-set longline gear. Turtles may also be killed due to lethal injuries (e.g., turtle is strangled by line or deeply swallows a hook). If animals are not killed, they may still suffer from unknown impacts due to the stress of the encounter that may have physiological or behavioral effects on the animal.

Sea turtles that are released alive but with gear still attached, may suffer post-hooking mortality depending upon the amount and type of gear left on the animal. At a 2004 workshop, NMFS developed criteria for estimating the likelihood of a turtle's mortality following an entanglement and/or hooking in longline gear (see NMFS 2007 for more information). At this time, the criteria established at that workshop are used for this opinion and all NMFS biological opinions on longline fisheries, both deep-set and shallow-set fisheries.

Detailed information on the nature of hookings, entanglements, trailing gear left on a released animal, and forced submergence can be found the in the 2004 biological opinion on the HMS FMP and is incorporated by reference here.

As noted above, the Hawaii-based DSLL observer data is used in this opinion to evaluate the likely response of turtles that may be exposed to the DSLL fishery that is the proposed action. In 2005, the Pacific Islands Regional Office (PIRO) conducted a section 7 consultation on the Hawaii-based DSLL fishery. The Pacific Islands Regional Office provided detailed information on the observed takes of sea turtles in the Hawaii-based DSLL from 2003 to 2006 in order to help us better understand the nature of the DSLL interactions with sea turtles. This is shown in Tables 15 and 16 based upon observer records (NMFS 2007); See Table 8 for the most recent observed number of takes in this fishery. Table 17 provides the post-hooking mortality rate estimates for the DSLL using a longer record that what is provided in Tables 15 and 16. These rates are based upon ten years of observer data and applying guidance on post-hooking mortality (NMFS 2006). As shown above in Table 8, interaction rates in the DSLL vary by year, with olive ridleys being the most commonly encountered species. Because olive ridleys are the most abundant sea turtle species found in the North Pacific and regularly dive to deep depths, it is reasonable that they are most often observed interacting with DSLL gear. By comparison, loggerheads, which have a lower abundance in the North Pacific and generally make shallow dives (rarely deeper than 40 meters) are the least commonly observed turtle species in the DSLL fishery. Most of the interactions with hard-shelled sea turtles involved being hooked primarily in the mouth due to their attraction to the bait on the hooks (see Table 16). Leatherbacks are more commonly hooked externally (i.e., on the flippers, shoulders, or shell) and/or entangled. The Hawaii-based DSLL does not require circle hooks and uses a combination of “J” hooks, tuna hooks, and circle hooks.

Table 15. Condition of turtles observed interacting with the Hawaii-based DSLL (2003-2006) (NMFS 2007)

	Green (dead)	Green (injured)	Loggerhead (dead)	Loggerhead (injured)	Leatherback (dead)	Leatherback (injured)	Olive Ridley (dead)	Olive Ridley (injured)
Total	4	0	1	2	3	4	38	1

Table 16: Nature of interactions with DSLL in the Hawaii-based fishery (2003-2006) (NMFS 2007)

Species	Entangled	Hooked	Location of hook			
			Unknown	Mouth	Front Flipper	Ingested
Green (4)		100%	25%	25%	50%	
Loggerhead (4)	25%	75%		67%		33%
Leatherback (7)	43%	86%			100%	
Olive Ridley (39)		100%	5%	64%	10%	21%

Table 17: Average mortality rates, Hawaii-based DSLL from 1994-2004*

Species	Immediate and post hooking mortality
Green	86%
Loggerhead	44%
Leatherback	34%
Olive Ridley	96%

*From NMFS 2005

Based upon the immediate and post-hooking mortality rates observed in the Hawaii-based DSLL, it is likely that most of the green and olive ridley sea turtles entangled or hooked by the HMS DSLL would be killed. The loggerhead or leatherback would have a lower chance (less than 50%) of being killed, either immediately or post-hooking, based upon the limited observed captures in the Hawaii-based DSLL. However, because we anticipate that only one loggerhead and one leatherback will be captured in this fishery, we conduct our analysis of impact with the assumption that the animal would be killed (since the probability of mortality is not zero).

6.3 Risk to individuals and populations

Data from the DSLL fishery that is the proposed action is very limited and entanglements/hookings of sea turtles are a rare event, therefore, we rely upon the observer data from the much larger Hawaii-based DSLL fishery. Based upon the immediate and post hooking mortality rates detailed above and because we can not eliminate the possibility of mortality for any of the four species likely to be captured, we assume that one green, one loggerhead, one leatherback, and three olive ridley sea turtles will be captured in the fishery and killed over the course of three years of fishing.

We next consider how these losses to the population (see Table 14) from which these turtles are likely to be captured may affect that nesting population over the next three years. Finally, we consider how this loss would affect the species population in the Pacific and globally, as currently listed under the ESA.

6.3.1 Green turtles

As described above, in the effects of the action section, we assume that the Hawaii-based DSLL is the best proxy for estimating the effects of the proposed action and it is reasonable to assume that one green turtle is likely to be incidentally captured and killed over the next three years. As described above, due to the low number of anticipated captures in the proposed action, this biological opinion considers the effects of the action over three years, rather than assuming one mortality per year, in order to reasonably assess the likely impacts of the action. Based upon the relatively few green turtle captures in the Hawaii-based DSLL, we assume that the green turtle incidentally captured would be an adult or sub-adult and may be either a female or male (observed sex ratio in the Hawaii-based DSLL is approximately 50:50 (NMFS 2005)).

As described in the status section on green turtles, the nesting populations most likely to be affected by the proposed action are the Eastern Pacific and the Hawaii component of the Central Pacific. Both of these populations have shown overall stability or increases in the past decade. In the Eastern Pacific, three of the four nesting populations are stable or increasing with annual female counts of well over 3,000. In Hawaii, the population has increased substantially largely due to conservation efforts at the nesting beaches and is currently growing at 5.7% annually for the past 30 years (Balazs and Chaloupka 2006). Annual counts of females are over 400 and there have been observed increases in in-water abundance trends.

As described in the threats section above, green turtles continue to face threats particularly coastal development and loss of nesting and foraging habitat; harvest of eggs and adults at nesting sites; incidental capture in fisheries; and climate change which may affect distribution and abundance of prey and possibly nesting sites.

While these threats are impossible to quantify, increases and/or stabilization of populations in the Pacific suggest that conservation efforts are likely to be aiding the Pacific population. Beach protection efforts in Hawaii and increases in annual nesting females strongly suggest that conservation actions can lead to increase trends in nesting populations. It is assumed that conservation efforts are resulting in an increase or stabilization in the total number of males in the two populations.

Viewed within the context of the status of the species and environmental baseline within the action area, the impact of the mortality of one green turtle in three years is unlikely to have a detectable effect on the numbers, reproduction, or distribution of the Eastern Pacific and Hawaii-Central Pacific populations of green sea turtles.

As a result, NMFS does not expect that the impacts of the death of up to one adult female green sea turtle in the DSLL fishery are sufficient to reduce appreciably both the likelihood of survival and recovery of the Eastern Pacific and Hawaii-Central Pacific populations of green sea turtles. Because we expect no reductions in the likelihood of survival and recovery to these two populations, we therefore also expect no impacts to the green sea turtle species as globally listed.

6.3.2 Loggerhead turtles

As described in the status of the species section above, the global population of loggerheads has recently been analyzed and nine DPS's proposed. We therefore analyze the impacts of the loss of up to one oceanic juvenile from the North Pacific Ocean DPS since this is the DPS most likely to be in the proposed action area. Because the species is still listed as a global population, we also consider the impacts on the global species, as it is currently listed. It is assumed that loggerhead turtles in the action area have a 50:50 sex ratio so the loggerhead likely to be captured could be a male or female. While this DPS has been proposed to be listed as endangered, the nesting populations in Japan have shown signs of increasing. In 2008, the highest numbers of nesting females in a decade were reported. Nesting beach numbers is not necessarily indicative of population trends for the entire population since only adult females nest. Male sea turtles and females that are not sexually mature do not come onshore during nesting, so there is no way to know that status of these components of the population. Counting nesting females or nest is considered the best available information currently available on which to evaluate the status of this DPS. The most significant threats facing loggerheads in the North Pacific include coastal development and bycatch in commercial fisheries. As noted in the conservation section of the status of the species section, conservation actions to protect nesting beaches have occurred and are increasing and significant progress has been made in the past few years to reduce the amount of incidental capture in commercial fisheries. The capture of loggerheads in fisheries utilizing large circle hooks has declined significantly compared to captures using traditional "j" hooks (Gilman *et al.* 2007), although more work is needed to assess the impact of coastal fisheries near nesting beaches in Japan. One of the most significant single actions to reduce bycatch of loggerheads was the commitment of a prominent longline fisherman in Baja California Sur, Mexico to retire his fleet. It is estimated that this action alone spared up to 2,000 juveniles annually. The work that led to this action is continuing in hopes of further reducing loggerhead mortalities. These actions are likely to improve to status of loggerheads by reducing the mortality of juveniles. The effects of these actions may not be apparent in the near future, due to the species' long period to maturation and that our only metric of the status of the species is the number of adult females at nesting beaches. However, these actions are likely to lessen the impact of the loss of one loggerhead over the next three years.

In addition to considering the impacts of the proposed action qualitatively, we considered the effects in the context of a model developed by the Pacific Islands Fishery Science Center for Amendment 18 to the Hawaii pelagics FMP. The model considered the susceptibility to quasi-extinction for loggerheads nesting in Japan. The model determined a level of additional mortality, in addition to existing sources of anthropogenic mortality that was likely to increase the risk of quasi-extinction of the population (Snover 2008). Utilizing the same assumptions that were made in the biological opinion for Amendment 18 (NMFS 2008) regarding the age and sex of loggerheads likely to be captured and killed in the fishery and converting this to a female adult equivalent, the equivalent of 0.33 mortality rate per year, or one loggerhead death in the DSLL over three years, did not increase the increase the risk of quasi-extinction to a threshold established in the model. The threshold for NPO loggerheads, in total increases in annual adult female equivalent mortality, should be less than four animals. The Hawaii-based SSLL amendment was estimated to result in an annual increase of 2.51 adult female equivalents mortality. The additional adult female equivalent of 0.33 mortalities per year would still be under the threshold of four annual mortalities. We used the annual rate of mortality as this is consistent with the methods used in the model. Also, the model considered the increase in susceptibility to quasi-extinction based on annual mortality of adult female equivalents over the long-term, over three generations (100 years for loggerheads).

As described in the recent five year review of the status of loggerheads, the North Pacific Ocean DPS is considered at risk of extinction. This is due to threats at nesting beaches that may prevent the emergence and/or survival of hatchling, the risks of entanglements in fishing gear near nesting beaches, as well as incidental captures in fisheries on the high seas and coastal feeding areas. These losses are in the hundreds of animals per year. As noted above, international conservation efforts are underway to address these issues. Taken within the context of the status of the population and environmental baseline, the impact to the North Pacific Ocean loggerhead DPS from the loss of one individual over the next three years is unlikely to have a detectable effect on the numbers, reproduction, or distribution of the DPS.

As a result, NMFS does not expect that the impacts of the death of up to one adult female loggerhead in the DSLL fishery are sufficient to reduce appreciably both the likelihood of survival and recovery of the North Pacific Ocean loggerhead DPS. Because we expect no reductions in the likelihood of survival and recovery to the North Pacific Ocean loggerheads, we therefore also expect no impacts to the loggerhead sea turtle species as globally listed.

6.3.3 Leatherback turtles

In order to analyze the impact of the loss of up to one juvenile or sub-adult leatherback sea turtle, either male or female, we considered from which population the animal was most likely to come.

As noted above, genetic analysis conducted on leatherbacks incidentally captured in the Hawaii-based longline fisheries suggest that leatherbacks from the Western Pacific are most likely to be found in the proposed action area and interact with the fishery. Also, satellite tagging has been done at nesting beaches and foraging areas along the U.S. West Coast indicating that leatherbacks travel across the North Pacific and nest and mate in the Western Pacific (Benson *et al.* 2007). Unlike leatherbacks in the Eastern Pacific, the Western Pacific population of leatherbacks has a number of characteristics that may make it more resilient to additional small losses in its population. As described in the status of the species section, leatherbacks that mate and nest in the Western Pacific nest on a variety of beaches, sometimes nesting on more than one beach per season and the population will nest at different times of the year, providing some resilience to localized impacts. Nest counts have not shown a significant decline in recent years and may be stable since the 1990's. The current estimate of adult nesting females in the Western Pacific ranges from 2,110 to 5,735 (Dutton *et al.* 2007). As discussed above, the production of female hatchlings has increased as a result of nesting beach temperatures at some beaches, although more males are produced at other beaches. Sub-adult and adult females also forage in several areas of the Pacific Ocean, further buffering the sub-adult and adult life stages against localized impacts.

As described in the threats section of the status of the species and the environmental baseline, leatherbacks have been observed captured in a variety of ocean and coastal fishery gears including longlines, drift gillnet, set gillnet, trawl, and trap fisheries. At nesting sites, threats include legal harvests and illegal poaching of adults, immatures, and eggs; incidental capture in coastal fisheries and loss and degradation of nesting. At foraging sites, habitat may be degraded as a result of coastal development, pollution, marine debris and other anthropogenic effects. In addition to anthropogenic factors, natural threats to nesting beaches and marine habitats such as coastal erosion, seasonal storms, predators, temperature variations, and phenomena such as El Niño also affect the survival and recovery of leatherback populations.

While leatherbacks face many threats, conservation efforts are underway to help mitigate the impacts. These include efforts to modify fishing activities, particularly longline fisheries, to reduce incidental capture of leatherbacks. In addition, conservation efforts to limit or eliminate direct capture at nesting beaches, protect nests, as well as protect hatchlings, continue in both the Western and Eastern Pacific nesting areas. Aggressive nesting beach protection actions in the Caribbean are credited with protecting and restoring the nesting population.

As described in the status of the species, it is difficult to detect population level trends in the Western Pacific nesting population or for individual beaches. However, we considered the effects of the proposed action in the context of a risk analysis model developed by the Pacific Islands Fishery Science Center for Amendment 18 to the Hawaii pelagics FMP (Snover 2008, NMFS 2009). The model considered the susceptibility to quasi-extinction for leatherbacks in the Jamursba-Medi nesting population. This population was used as it is the only major nest site in the Western Pacific with sufficiently long term nest counts. Nesting at other sites, including Wer-mon, has only been documented recently. Nesting at Jamursba-Medi represents approximately 38% of all nesting in the western Pacific.

The model determined whether a level of additional mortality, in addition to existing sources of anthropogenic mortality that was likely to increase the risk of extinction of the population (Snover 2008). Utilizing the same assumptions that were made in the biological opinion for Amendment 18 (NMFS 2008) regarding the age and sex of leatherbacks likely to be incidentally captured and killed in the fishery and converting this to a female adult equivalent, the additional 0.33 mortality per year (i.e., equivalent to one mortality in three years) did not increase the risk of extinction to a threshold established within the model. The threshold for Jarmusba-Medi leatherbacks is total increases in annual adult female equivalent mortality should be less than 3 animals. The Hawaii-based SSLL was estimated to result in an annual increase of 1.56 adult female equivalent mortality. The additional adult female equivalent of 0.33 per year would still be under the threshold of three annual mortalities. We used the annual rate of mortality as this is consistent with the methods used in the model. Also, the model considered the increase in susceptibility to quasi-extinction based on annual mortality of adult female equivalents over the long-term, over three generations (63 years for leatherbacks).

As noted above, either a male or a female adult or sub-adult leatherback may be captured and killed as a result of the proposed action. It is impossible to quantify the possible effect of the loss of up to one male in three years from the Western Pacific nesting population. Male leatherbacks do not return to land once hatched, so the limited information on males is based upon in-water surveys. Sea turtles do not develop long-term pair bonds and individual males may mate with numerous females. The number of males necessary to maintain a healthy and genetically diverse population is unknown (Hamann *et al.* in Lutz *et al.* 2003). One of the primary threats to male leatherbacks is rising temperatures; changes in sex-ratios based upon temperature changes at beaches may cause the overall proportion of males within a population to decline (hatchling sex is determined by the temperature of eggs while in the nest (Chan and Liew 1996)), with more males being produced in cool nests and more females being produced in warm nests. Currently, nesting beach temperatures at Jamursba-Medi are within ranges expected to produce more females than males. Conversely, at Wermon, nesting beach temperatures are such that more males than females are likely to be produced. We do not know if the production at both beaches results in overall balanced production of males and females and how this may affect reproductive rates for the overall Western Pacific population.

We consider the impact to the female population in terms of the characteristics of the population that may make it more, or less, able to withstand the loss of one adult female in one year, and not have an effect on the viability of the population. Currently, the abundance of the western Pacific population is estimated to be several thousand breeding females, although there is uncertainty associated with the abundance counts based on the methods used for estimation. Western Pacific leatherback females utilize a variety of nesting beaches and nest throughout the year, providing some population resilience to localized impacts. Sub-adult and adult females also forage in several areas of the Pacific Ocean, further buffering the sub-adult and adult life stages against localized impacts.

Given the population and biological characteristics, current population estimates, and conservation efforts that are considered likely to result in a long-term increase in the number of leatherbacks in this population, that is, taken within the context of the status of the population and environmental baseline, the impact to the Western Pacific leatherbacks from the loss of one individual over the next three years is unlikely to have a detectable effect on the numbers, reproduction, or distribution of the population.

As a result, NMFS does not expect that the impacts of the death of up to one adult female leatherback in the DSLL fishery is sufficient to reduce appreciably both the likelihood of survival and recovery of the Western Pacific leatherback population. Because we expect no reductions in the likelihood of survival and recovery to the Western Pacific leatherback, we therefore also expect no impacts to the leatherback sea turtle species as globally listed.

6.3.4 Olive ridley turtles

As detailed above, we used information from the Hawaii-based DSLL fishery observer program to characterize the likely impacts to olive ridleys likely to be captured in the proposed action. It is likely that up to three olive ridleys will be incidentally captured and killed in the West Coast DSSL over the next three years and they are most likely to be an adult or sub-adult from the eastern Pacific nesting population and may be either female or male.

As described in the status section, olive ridleys face a number of threats, most notably direct harvest and bycatch in fisheries. The legal harvest of adults and eggs was largely eliminated in the late 1980's and early 1990's, which may account for the significant increases in some nesting populations, especially in the Eastern Pacific. Some harvest does still continue in Costa Rica and illegal harvest occur in Central America and India (NMFS and USFWS 2007d). Bycatch in fisheries can not be quantified, but is likely in the thousands annually particularly in areas of high nesting activity (e.g., the Indian Ocean and the Eastern Tropical Pacific) (NMFS and USFWS 2007d). In response to these high levels of bycatch, there are prohibitions on some commercial fisheries near large arribadas off the east coast of India and Central America. In addition, a number of community based initiatives are in place to protect nesting beaches and reduce illegal egg harvest.

It is likely that olive ridleys from the Eastern Pacific population will be affected by the proposed action. We make this assumption based upon genetic analysis of olive ridleys incidentally captured in the Hawaii-based longline fisheries as well as the abundance of olive ridleys nesting and foraging within the area identified as the primary fishing area. As noted in the status section above, this population has had a substantial increase in the number of annual nests. The estimated number of nests in Mexico alone is over one million. In-water surveys estimate the adult and sub-adult population at over 1.2 million olive ridleys in the Eastern Tropical Pacific. Given the status of the species and the abundance of animals, it is unlikely that the loss of three sub-adults or adults over the course of three years will have a detectable effect on the numbers, reproduction, or distribution of the population.

As a result, NMFS does not expect that the impacts of the death of up to three sub-adult or adult olive ridleys in the DSLL fishery over the next three years is sufficient to reduce appreciably both the likelihood of survival and recovery of the Eastern Pacific olive ridley population. Because we expect no reductions in the likelihood of survival and recovery to the Eastern Pacific olive ridley, we therefore also expect no impacts to the olive ridley sea turtle species as globally listed.

7. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this opinion (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 the high seas of the Eastern North Pacific no state or local activities are expected to occur in the area.

Global climate change is expected to continue and impacts on sea turtles and their habitats will also continue. As described above in the status and environmental baseline sections of this opinion, anticipated effects on sea turtles include changes in nesting habitat, hatchling success, hatchling sex ratio, nesting timing, distribution of prey, and migratory patterns. However, the available information does not allow us to reliably predict future climate change and current information does not allow us to clearly link large scale climate change to impacts on sea turtles considered in this opinion or to quantify the impact of climate change. The implication of climate change on sea turtles at the population level is an area of great uncertainty and active research (e.g. Jonzén et al. 2007). At this time, the impacts of climate change on sea turtles considered in this opinion cannot be reliably quantified in terms of actual mortalities over any time scale. Further, the impacts can not be qualitatively described or predicted in such a way as to be meaningfully evaluated in the context of this biological opinion. Within the temporal scale of the proposed action, any current or future impacts of climate change in the action area that might interact with the effects of the proposed action are not considered significant.

We reviewed the NEPA document for this action as well as the 2008 biological opinion on Implementation of Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region, as this is the most recent biological opinion that covers the North Pacific High Seas. We could find no information on future activities, beyond those already occurring, in the action area. NMFS is unaware of any human-related future activities within the action area that would substantially change the impacts of the proposed action on the sea turtles covered in this opinion.

8. CONCLUSION

After reviewing the available scientific and commercial data, current status of green turtles, loggerhead turtles, leatherback turtles, and olive ridley turtles, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is NMFS' biological opinion that the deep-set longline fishing that is being conducted, and as may be conducted with additional effort, under the Highly Migratory Species Fishery Management Plan, is not likely to jeopardize the continued existence of ESA listed green, loggerhead, leatherback and olive ridley sea turtles. As noted elsewhere in this opinion, loggerhead sea turtles are currently listed globally as one species. There is a proposed rule that would establish nine distinct population segments, including the North Pacific population, which is the DPS likely to be affected by this action. We considered the effects of this action on the proposed North Pacific DPS and determined that action is not likely to jeopardize the proposed North Pacific loggerhead DPS. This biological opinion serves as a conference opinion on the DPS.   No other ESA-listed species under NMFS's jurisdiction are considered likely to be adversely affected by the proposed action. Because the deep-set longline fishery is not likely to jeopardize the continued existence of any ESA listed species, continued issuance of the High Seas Fishing Compliance Act permit would not be inconsistent with the ESA.

The conclusion of this biological opinion is for the DSLL component of the HMS FMP only. This opinion augments NMFS's 2004 biological opinion on the HMS FMP and does not in any way change the conclusion of that biological opinion as a whole.

9. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS further defines "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not the purpose of the proposed action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by NFMS for the exemptions in section 7(o)(2) to apply. NMFS has a continuing duty to regulate the activity covered by this incidental take statement. 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 incidental take statement. (50 CFR §402.14(I)(3))

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Only incidental take resulting from the agency action and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

9.1 Amount or Extent of Take

Mortality and interaction rates of sea turtles have been calculated using the Hawaii-based DSLL as a proxy for likely interactions with a higher level of fishing effort than at present. Currently, only one fisherman participates in this fishery, although it is considered reasonably likely that additional fishermen will want to enter this fishery. Due to the rarity of takes of ESA listed species in DSLL fisheries in the Pacific, we used a larger data set, the Hawaii based DSLL data set, scaled to the anticipated maximum effort of 800,000 hooks per year and anticipates the following takes in the form of captures as shown in Table 18. We did consider using the observed sea turtles encounter rates in the West Coast based DSLL to develop a CPUE for the proposed action. Using the data from the West Coast based DSLL gives us estimates of zero green, leatherback and loggerhead sea turtles and four olive ridley sea turtles incidentally taken in the DSLL over the course of three years. We felt that these estimates likely under-estimated the interactions with green, leatherback, and loggerhead sea turtles and likely over-estimated the interactions with olive ridley. As described previously in this opinion, we believe that using a larger data set with more than one interaction with a sea turtle provides us with a better means of projecting future incidental takes in the DSLL.

As noted above, we used an extremely precautionary approach in estimating the number of entanglements and mortality in the proposed action. The West Coast based DSLL fishery has been observed at 100% since 2005 and there has only been one observed interaction, one mortality of an olive ridley sea turtle. Further, the action agency's proposed action effort, up to 800,000 hooks set annually, is likely an over-estimate of actual fishing effort in the West Coast based DSLL. This fishery has been active since 2005 and there has been only one fisherman participating. SFD provided what it considered the highest level of effort that this fishery could reasonably expand to in the next three years and used that as the proposed action.

As indicated in Table 17 above, the mortality rate for each of these species, based on ten years of observer coverage from the Hawaii-DSLL ranges from 34% to 96% (this includes immediate and post-interaction mortality). Because the mortality rate is not zero, we take a precautionary approach and assume that any turtle entangled or hooked in DSLL gear will be killed as a result of the interaction. This assumption likely overestimates the likely mortalities of sea turtles. For example, the mortality rate for leatherbacks observed incidentally captured in the Hawaii-based DSLL is 34%. Using this rate and applying it to the likely interactions, it is expected that one leatherback would be killed every nine years in the West Coast based DSLL.

Table 18: Number of turtle interactions and associated mortality from the proposed action during three consecutive years, beginning in 2011.

Species/Stock	Estimated entanglements (mortality) in three years
Green	1
Leatherback	1
Olive Ridley	3
Loggerhead	1

Because interactions with sea turtles and the DSLL may or may not result in immediate or post interaction mortality, the ITS is based on interactions, but to be precautionary in our analysis of the impacts, we assume that these interactions cause mortality and consider the impact of that mortality on the species. Therefore, if more than one green, one leatherback, or one loggerhead and three olive ridleys are hooked or entangled in DSLL gear over the course of three years, the ITS has been exceeded, regardless of if the animals were injured or killed. For example, if one loggerhead is hooked in DSLL gear, but is released alive during the 2012 fishing season, then the ITS has not been exceeded. However, if in the 2013 fishing season another loggerhead is hooked and released alive, then the ITS would have been exceeded. If this is the case, then re-initiation of consultation would be required.

9.2 Effect of the Take

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to green sea turtles, loggerhead sea turtles, leatherback sea turtles, or olive ridley sea turtles.

9.3 Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures, as implemented by the terms and conditions, are necessary and appropriate to minimize impacts to ESA-listed species considered in this opinion. These measures have been applied to the HMS FMP since its implementation in 2004. At that time there was no DSLL fishery and the effects of the DSLL were not analyzed in the 2004 biological opinion. Therefore, NMFS applies the reasonable and prudent measures required of HMS FMP to the DSLL in this biological opinion. The measures described below are non-discretionary, and must be undertaken by NMFS for the exemption in section 7(o)(2) to apply. If NMFS fails to adhere to the terms and conditions of the incidental take statement, the protective coverage of section 7(o)(2) may lapse. Thus, the following reasonable and prudent measures must be implemented to allow activities.

1. NMFS shall provide training to DSLL fishing vessel operators and observers on sea turtle biology and on methods that will reduce injury or mortality during fishing operations.

2. 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.

3. NMFS shall continue to collect data on capture, injury, and mortality of any ESA-listed species encountered during fishing operations authorized by the HMS FMP in addition to life history information.

4. NMFS shall require that, if practicable, comatose or lethargic sea turtles be retained on board, handled, resuscitated, and released according to the procedures outlined at 50 CFR 223.206 (d)(1).

5. NMFS shall require that dead sea turtles be disposed of at sea unless an observer requests retention of the carcass for sea turtle research.

9.4 Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, NMFS must comply or ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above, and apply to the proposed action. NMFS applies the reasonable and prudent measures required of HMS FMP to the DSLL in this biological opinion. These terms and conditions are non-discretionary.

1. The following terms and conditions implement reasonable and prudent measure No. 1.

   1A. NMFS will continue to provide skipper education workshops with a module on sea turtle resuscitation requirements, as outlined in 50 CFR §223.206(d)(1). These workshops shall be provided to skippers in the deepset longline fisheries.

   1B. NMFS will also include in skipper education workshops a module of information on sea turtle biology and ways to avoid and minimize sea turtle impacts
   .

   1C. NMFS will encourage HMS permit holders to suggest additional strategies or techniques that might minimize impacts of fishing gear or practices on sea turtles.

   1D. NMFS will include sea turtle resuscitation techniques and sea turtle biology information during observer training.

2. The following terms and conditions implement reasonable and prudent measure No. 2.

   2A. As soon as practicable upon capture, vessel operators or observers shall disengage any hooked or entangled sea turtles with the least harm possible to the sea turtles. If a hook cannot be removed, the line should be cut as close to the hook as possible.

   2B. Sea turtles must not be dropped on to the deck or run through a power block.

3. The following terms and conditions implement reasonable and prudent measure No. 3.

   3A. NMFS shall continue to maintain an observer program to collect data on the incidental take of marine mammals, sea turtles, and other protected species. Quarterly and annual reports summarizing protected species bycatch data collected for HMS fisheries shall be prepared and disseminated in a timely fashion to the Southwest Region, Protected Resources Division. Information collected shall include, at a minimum, the incidental capture, injury, and mortality of sea turtles by species, gear and set information in which each interaction occurred, and life history information.

   3B. NMFS shall continue to collect life history information on sea turtles, such as species identification, measurements, condition, skin biopsy samples, and the presence or absence of tags. NMFS observers shall directly measure or visually estimate tail length on all sea turtles captured by the HMS fisheries.

   3C. NMFS shall continue to place observers aboard any longline vessels subject to the HMS FMP which may make deep sets in order to monitor the effects to listed species.

3D. NMFS collected data and other available information shall be evaluated on an annual basis to determine whether estimated annual incidental injuries or mortalities of sea turtles has exceeded allowable removal levels.

4. The following terms and conditions implement reasonable and prudent measure No. 4.

4A. HMS vessel operators shall bring comatose sea turtles aboard, if feasible, and perform resuscitation techniques according to the procedures described at 50 CFR §223.206(d)(1).

4B. If an observer is aboard the vessel, the observer shall perform resuscitation techniques on comatose sea turtles brought aboard the vessel.

5. The following term and condition implements reasonable and prudent measure No. 5.

5A. Dead sea turtles may not be consumed, sold, landed, offloaded, transhipped or kept below deck, but must be returned to the ocean after identification unless the observer requests the turtle to be kept for further study.

10. CONSERVATION RECOMMENDATIONS

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

The following conservation recommendations are provided pursuant to section 7(a)(1) of the ESA for developing management policies and regulations, and to encourage multilateral research efforts which would help in reducing adverse impacts to listed species in the Pacific Ocean. Many of these recommendations are similar to recommendations made in recent biological opinions for fisheries managed under the Pelagic Fisheries of the Western Pacific Region.

1. NMFS should continue to research modifications to existing gear that: (1) reduce the likelihood of interactions between sea turtles and longline fishing gear; and (2) reduce the immediate or delayed mortality rates of captured turtles. In particular, NMFS should continue to develop and test circle hooks suitable for use in deep-set longline gear. Any research funded or implemented by NMFS, likely to increase the number of turtles captured or killed in the deep-set fishery beyond the levels considered in this Opinion, must be covered by a research and enhancement permit pursuant to section 10(a)(1)(a) of the ESA. The goal of any research should be to develop a technology or method, through robust experimental designs, that would achieve these goals while remaining economically and technically feasible for fishermen to implement.

2. NMFS should research development or modifications of existing technologies, to detect and alert fishers if sea turtles become entangled in their gear.

3. NMFS should research development or modifications of existing methods for setting DSLL gear to ensure that all hooks are set at depths of 100 meters or more to reduce the likelihood of interactions with some species of sea turtles.

4. NMFS should continue to promote the reduction of sea turtle bycatch in Pacific fisheries by supporting:
   a. The Inter-American Convention for the Protection and Conservation of Sea Turtles.
   b. Any binding Western and Central Pacific Fisheries Commission sea turtle conservation and management measures for commercial longline fisheries operating in the Western Pacific. Similarly, any sea turtle conservation and management recommendations of the Inter-American Tropical Tuna Commission.
   c. Technical assistance workshops to assist other longlining nations in fishing modifications and safe handling procedures designed to reduce sea turtle interactions and mortality.
   d. A trans-Pacific international agreement that would include relevant Pacific Rim nations for the conservation and management of sea turtle populations, specifically a Japan-USA-Mexico agreement for North Pacific loggerhead sea turtles.

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

6. NMFS should make available and disseminate information on sea turtle biology and ways to avoid and minimize sea turtle impacts for promoting sea turtle protection and conservation at appropriate fishery regional meetings.

7. NMFS should review the most recent post-hooking studies and update its guidelines on estimating sea turtle post-release mortality, if appropriate.

11. REINITIATION NOTICE

This concludes formal consultation on the action outlined above. 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 is exceeded, the Sustainable Fisheries Division must immediately request reinitiation of formal consultation.

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