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

May 2, 2013

MEMORANDUM FOR: Mark Helvey
Assistant Regional Administrator, Sustainable Fisheries Division

FROM: Rodney R. McInnis Rodney R McInnis
Regional Administrator

SUBJECT: Biological Opinion on the continued management of the drift gillnet fishery under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species 2012/03020:DDL

This document transmits NOAA's National Marine Fisheries Service's (NMFS) final biological opinion based on NMFS Protected Resources Division (PRD) review of the proposed action of the continued management of the drift gillnet fishery under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species, 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 focused on analyzing the effect of the drift gillnet fishery for swordfish and thresher shark on the following ESA listed species: fin whale (endangered); humpback whale (endangered); sperm whale (endangered); leatherback sea turtle (endangered); North Pacific distinct population segment (DPS) of loggerhead sea turtle (endangered); green sea turtles (endangered); and olive ridley sea turtle (endangered). The information used in the development of this Opinion came from a June 2012 transmittal letter and biological assessment prepared by NMFS Sustainable Fisheries Division (SFD), revised in September, 2012, supplemental analysis of observer coverage and compliance provided by SFD March 28, 2013, discussions and comments between NMFS PRD and SFD staff, discussions and comments between NMFS PRD, SFD, and SWFSC staff, and other relevant documents pertaining the drift gillnet fishery or any of the ESA-listed species considered in this Opinion. A complete administrative record of this consultation is on file at the NMFS PRD Southern California Area Office.

Based on the best available scientific and commercial information, NMFS' Opinion concludes that the continued management of the drift gillnet fishery under the U.S. West Coast Highly Migratory Species Fishery Management Plan , given the proposed action, including the protective measures to minimize the bycatch of protected species that have already previously been implemented, is not likely to jeopardize the continued existence of: fin whales; humpback whales; sperm whales; leatherback sea turtles; North Pacific DPS loggerhead sea turtles; green sea turtles, or olive ridley sea turtles, or adversely modify or destroy any critical habitat designated under the ESA.

NMFS PRD and SFD have had discussion on the preparation and scope of this Opinion as well as development of the Reasonable and Prudent Measures and Terms and Conditions 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. These recommendations include maximizing observer coverage resources, continued pursuant of ways to better understand when and where ESA-listed species may encounter drift gillnet fishing gear and strategies to avoid those encounters, and continued work on promoting marine mammal and sea turtle conservation and recovery efforts.

Attachment: Biological Opinion

cc: Administrative File: 151422SWR2012PR00321

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

ACTION:	Continued management of the drift gillnet fishery under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species.
ACTION AGENCY:	NOAA's National Marine Fisheries Service, Southwest Region, Sustainable Fisheries Division
CONSULTATION CONDUCTED BY:	NOAA's National Marine Fisheries Service, Southwest Region, Protected Resources Division
FILE NUMBER:	2012/03020
DATE ISSUED:	**May 2, 2013**

List of Acronyms

ESA – Endangered Species Act
MMPA – Marine Mammal Protection Act
PBR – Potential Biological Removal
NOAA - National Oceanic and Atmospheric Administration
NMFS – National Marine Fisheries Service
ITS – Incidental Take Statement
CPUE – Catch per Unit of Effort
MSA – Magnuson Stevens Fishery Conservation and Management Act
DGN – Drift Gillnet
HMS – Highly Migratory Species
FMP – Fishery Management Plan
EEZ – Exclusive Economic Zone
PFMC – Pacific Fisheries Management Council
NID – Negligible Impact Determination
PRD – Protected Resources Division
SFD – Sustainable Fisheries Division
PLCA – Pacific Leatherback Conservation Area
PCTRT – Pacific Cetacean Take Reduction Team
PCTRP - Pacific Cetacean Take Reduction Plan
CDFW – California Department of Fish and Wildlife
ESU – Evolutionarily Significant Unit
DPS – Distinct Population Segment
SAR – Stock Assessment Report
EA- Environmental Assessment
SAFE - Stock Assessment and Fishery Evaluation
IWC - International Whaling Commission
DDT - Dichloro-diphenyl-trichloroethane
PCB - Polychlorinated Biphenyl
IATTC - Inter-American Tropical Tuna Commission
OLE - Office of Law Enforcement
MMAP - Marine Mammal Authorization Program
SWFSC - Southwest Fisheries Science Center
ENP - Eastern North Pacific
WNP - Western North Pacific
SRKW - Southern Resident Killer Whales
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora
CV - Coefficient of Variation
DDE - Dichloro-diphenyl-dichloroethylene
PaH - Polycyclic Aromatic Hydrocarbons

TED - Turtle Excluder Device
IMO - International Maritime Organization
USCG - United States Coast Guard
NOI - Notice of Intent

Introduction

Fisheries in the Exclusive Economic Zone (EEZ) are managed by NOAA's National Marine Fisheries Service (NMFS) under authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or MSA). NMFS is also responsible for administering the Endangered Species Act (ESA) with respect to most marine species, including marine mammals and sea turtles in the marine environment. Section 7(a)(2) of the ESA requires federal agencies that propose an action which may affect listed species consult with NMFS to ensure that the action is not likely to jeopardize the continued existence[1] of any threatened or endangered species under NMFS's jurisdiction, or destroy or adversely modify any habitat designated by NMFS as critical for their survival. NMFS is responsible for authorizing commercial and recreational fisheries for Highly Migratory Species (HMS) in the U.S. EEZ and adjacent waters off the coasts of Washington, Oregon, and California (herein referred to as the "west coast EEZ") under the MSA. Specifically, these fisheries are managed under the HMS Fishery Management Plan (FMP) (PFMC 2011a).

In February 2004, NMFS issued a biological opinion on: (1) adoption and implementation of the HMS FMP; (2) continued operation of HMS vessel permits under the High Seas Fishing Compliance Act; and (3) implementation of ESA regulations prohibiting shallow set longline fishing east of 150°W longitude. That Opinion concluded that the proposed actions were not likely to jeopardize leatherback, loggerhead, green, and olive ridley sea turtles, or fin, humpback, and sperm whales. An Incidental Take Statement (ITS) for these species in HMS fisheries, more specifically for the large mesh drift gillnet fishery (DGN), was issued, along with implementing terms and conditions. Some very rare captures of sea turtles in the albacore surface hook and line fishery were expected, but due to the fishing techniques used (e.g., gear is immediately retrieved and not left to soak) it was not expected that any incidental takes would result in mortality. Subsequent to the completion of the HMS FMP biological opinion, a deep-set longline fishery developed. In 2011, NMFS issued a biological opinion on the deep-set longline fishery, which supplements the 2004 opinion on the HMS FMP.

Under the HMS FMP, NMFS, through its Sustainable Fisheries Division (SFD), proposes to continue management of the commercial drift gillnet (DGN) fishery targeting swordfish and thresher shark consistent with the management and conservation measures that have been in place since implementation of the HMS FMP in 2004, including measures implemented to

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[1] "'Jeopardize the continued existence of' means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." (50 CFR § 402.02).

prevent or reduce marine mammal and sea turtle bycatch, as well as continued placement of observers to document interactions with protected species. This biological opinion (Opinion), developed through consultation with the Protected Resources Division (PRD) of NMFS, will analyze the impact of continued operation of the DGN fishery on ESA-listed species, including: leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and olive ridley (*Lepidochelys olivacea*) sea turtles; as well as fin (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), and sperm (*Physeter macrocephalus*) whales.

I. CONSULTATION HISTORY

NMFS issued a biological opinion on September 30, 1997, to evaluate the effect of the final regulations to implement the Pacific Offshore Cetacean Take Reduction Plan (PCTRP) for the CA/OR DGN fishery on listed sea turtle and marine mammal populations (NMFS 1997). NMFS concluded in this opinion that establishing a minimum extender length requirement of 6 fathoms (36 feet), conducting skippers workshops, and using pingers on the nets would most likely reduce the incidental catch of listed marine mammals and sea turtles. Based on analyses of the final regulations, NMFS concluded that the continued operation of the DGN fishery under the PCTRP was not likely to jeopardize the continued existence of the humpback and sperm whales, or leatherback and loggerhead sea turtles.

On October 23, 2000, NMFS issued a new biological opinion based upon review of bycatch in the DGN fishery and authorization to take listed marine mammals incidental to commercial fishing operations under section 101(a)(5)(E) of the Marine Mammal Protection Act (MMPA). That biological opinion concluded the DGN was not likely to jeopardize the listed marine mammals affected, or green and olive ridley sea turtles. However, the biological opinion concluded that the issuance of the MMPA authorization for the DGN fishery was likely to jeopardize leatherback and loggerhead sea turtles.[2]

On February 4, 2004, NMFS issued the biological opinion on adoption of the HMS FMP, which included management of the DGN fishery. NMFS has observed and evaluated the DGN fishery to ensure that fishery interactions with ESA-listed species are consistent with the ITS of the 2004 biological opinion on the HMS FMP. On December 5, 2010, a NMFS observer recorded two sperm whales caught in the DGN fishery in U.S. federal waters near the U.S. border with Mexico. One whale was reported as released injured; the other was reported as released dead. NMFS SFD verbally notified PRD of this incident on December 7, 2010, and then sent a written incident summary memo on December 20, 2010[3], (Appendix A *in* NMFS 2012a). On January 5, 2011, staff from the two Divisions met to discuss these sperm whale takes and other takes of threatened and endangered species observed in the DGN fishery in recent years. On February 8,

[2] The biological opinion concluded that loggerhead sea turtle would be jeopardized if an El Niño event occurred, as that oceanographic event was linked to loggerhead bycatch in that biological opinion.
[3] An amended version was provided to PRD on June 23, 2011, correcting some of the dates in the original memo.

2011, the SFD sent a memo to PRD providing more information on these takes and requesting a meeting to discuss recommended next steps (Appendix B *in* NMFS 2012a). At that time the DGN fishery was closed, as it is annually after January 31st.

On June 3, 2011, staff from the two Divisions met to discuss the observed entanglements and implications under ESA section 7. In preparation for the meeting, PRD had sent an email to SFD explaining that the observed takes likely exceeded the incidental take statement (ITS) for sperm whales (Appendix C *in* NMFS 2012a). It was recommended that SFD reinitiate ESA consultation on the DGN fishery because the December, 5, 2010, takes of two sperm whales likely exceeded the (ITS) for the DGN fishery.

However, it was not possible at the time to say with certainty that the ITS for sperm whales had been exceeded due to the two entanglements because the ITS for sperm whales in the 2004 biological opinion provides an estimate of four entanglements in three years. Of these, it was estimated that two would result in mortality (i.e., two mortalities in three years). In the 2004 biological opinion, NMFS acknowledged that observer coverage in the DGN is usually around 20 percent and so it is not possible to state with certainty the actual number of entanglements based on observer records. Therefore, the biological opinion specified that if more than one entanglement of a marine mammal species was observed over the course of three years, then NMFS would likely determine that the incidental take for that species has been exceeded.

Also at the June 3, 2011, meeting, it was noted that there had been an entanglement of a humpback whale in 2009 reported by a fisherman via a Marine Mammal Authorization Permit (MMAP) reporting form. Based on the nature of the entanglement, it was determined that the animal was likely seriously injured. The ITS in the 2004 HMS FMP biological opinion specified that any take of humpback whales would not result in serious injury or mortality, so the MMAP reported take that resulted in a serious injury was inconsistent with the ITS, although the ITS was primarily considering the prospect of observer reports and not fishermen self-reports under the MMAP. At this meeting, PRD staff provided an overview of the consultation process, guidance for writing the biological assessment to initiate consultation, and offered assistance throughout this process. On July 6, 2011, PRD and SFD met to discuss the scope of the consultation and review draft material for the BA that had been prepared by SFD.

SFD increased observer coverage in the DGN fishery from 12.0 percent in 2010 to 19.5 percent in 2011. There were no observed interactions between the DGN fishery and any ESA-listed species in 2011.

In October and November 2011, staff from the two Divisions and the NMFS Southwest Fisheries Science Center (SWFSC) met to discuss the approach to calculating bycatch rates for the biological assessment. In February and March 2012, SFD staff worked with SWFSC staff to further refine and finalize the data used for calculating bycatch rates. Staff from the SFD and PRD met again in May and June 2012, to discuss finalizing the biological assessment.

On July 20, 2012, SFD requested formal consultation on the effects of the DGN fishery on ESA-listed species under Section 7 of the ESA and transmitted a biological assessment to PRD in which they concluded that the following species are likely to be adversely affected by the DGN fishery: leatherback, loggerhead, olive ridley and green sea turtles; and fin, humpback and sperm whales.

On August 16, 2012, staff from SFD and PRD met to discuss several issues related to the consultation. The discussion focused on the observer program including current and planned levels of coverage, whether the observer effort was representative of the entire fishery and could be used to characterize bycatch and what proportion of the fishery is unobservable. On September 7, 2012, a revised biological assessment was transmitted to PRD in response to several issues brought up during formal consultation (NMFS 2012a). This revised biological assessment was considered by both Divisions to replace the original July 20, 2012, biological assessment.

On October 17, 2012, SFD notified PRD that a leatherback had been taken on October 12, 2012. The ITS of the 2004 biological opinion anticipated that 3 leatherbacks may be entangled each year. Given that only 2 leatherback turtles had been observed taken in the DGN fishery (both released alive) since issuance of the 2004 biological opinion, NMFS determined that the 2012 observed take of a leatherback did not exceed the ITS.

On September 6, 2012, NMFS received a 60-day notice of intent (NOI) to sue over violations of the ESA and MMPA related to the California DGN from three environmental non-governmental organizations: Center for Biological Diversity, Oceana, and Turtle Island Restoration Network. NMFS sent a response letter on November 19, 2012. NMFS staff subsequently met with representatives of the three organizations by phone on December 3, 2012 to discuss the allegations in the NOI and NMFS' plan to address these. On December 19, 2012, and December 20, 2012, NMFS staff met to discuss ways to address issues related to the use of observer data in the consultation. Staff from SFD committed to conducting additional research and analyses to address the issues related to observer information. It was agreed that based upon the need for additional information from the action agency, SFD, the consultation would require more than 135 days to complete although the Divisions did not set a specific date for completion of the biological opinion. On January 5, 2013, SFD requested and was confirmed support from SWFSC to complete the "observer effect" work described in the December meetings. On March 28, 2013, SFD submitted to PRD a summary of analyses and conclusions based on the analyses, and that material augments the package of information that SFD has provided and is included in this Biological Opinion.

II. DESCRIPTION OF THE PROPOSED ACTION

HMS fisheries in the U.S. EEZ and adjacent waters off the coasts of Washington, Oregon, and California are authorized by NMFS under the MSA and other applicable federal statutes.

Consistent with the HMS FMP, any necessary conservation and management measures are adopted on a bi-annual basis through the Pacific Fisheries Management Council (PFMC or Council). These measures are implemented through the Federal rulemaking process and sent to the U.S. Secretary of Commerce, through NMFS, for review and approval. Additional measures can be adopted on an emergency basis outside of the Council's bi-annual process.

Information on distribution, life history, stock structure, stock status, and catch of FMP management unit species is summarized in several existing documents including the environmental assessment (EA) for Amendment 2 to the HMS FMP, the Council's HMS Stock Assessment and Fisheries Evaluation (SAFE) documents[4], and the EA and ESA biological opinion produced for the adoption of the original HMS FMP in 2004 and for HMS FMP Amendment 1. There were 13 management unit species codified in federal regulations under the 2004 HMS FMP. NMFS published a final rule implementing Amendment 2 to the HMS FMP on September 13, 2011 (76 FR 56327), reducing the number of management unit species to 11, as follows:

1. Albacore tuna, *Thunnus alalunga*
2. Bigeye tuna, *T. obesus*
3. Skipjack tuna, *Katsuwonus pelamis*
4. Bluefin tuna, *T. orientalis*
5. Yellowfin tuna, *T. albacares*
6. Striped marlin, *Tetrapturus audax*
7. Swordfish, *Xiphias gladius*
8. Blue shark, *Prionace glauca*
9. Common thresher shark, *Alopias vulpinus*
10. Shortfin mako shark, *Isurus oxyrinchus*
11. Dolphinfish, *Coryphaena hippurus*

The DGN fishery for swordfish and thresher shark is one of six authorized gear types/fisheries under the HMS FMP. The other fisheries include: the albacore fishery using surface hook-and-line gear by trolling and pole-and-line -fishing techniques; the deep-set longline fishery based in California targeting tuna in waters beyond the EEZ; the tropical tuna fisheries using purse seine, including the coastal purse seine fishery (small vessels) that concentrates on small pelagic species but which also harvests northern bluefin and yellowfin tuna when they migrate into the Pacific EEZ; the swordfish harpoon fishery; and the charter boat HMS sport fisheries. The 2004 HMS biological opinion and supplemental 2011 biological opinion on the deep-set longline fishery remain intact and in force relative to all of these other HMS fisheries besides the DGN fishery, which is the subject of this consultation and biological opinion.

[4] http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents/

Management of the California Drift Gillnet Fishery for Highly Migratory Swordfish and Sharks

A. Vessels and Gear of the DGN Fishery

California's swordfish fishery began using harpoon gear to target swordfish basking at the surface, but in the early 1980s, some fishermen began using drift gillnet gear. Shortly after this time period, landings reached a historical annual high of 3,000 metric tons (mt) of swordfish in 1985 (PFMC 2011b). Fishing activity is highly dependent on seasonal oceanographic conditions that create temperature fronts which concentrate prey species for swordfish. Historically, the California DGN fleet operated within EEZ waters adjacent to the state and as far north as the Columbia River, Oregon, during El Niño years. Starting in 2001 for leatherback turtles, and 2003 for loggerhead turtles, NMFS created areas off the West Coast that are closed to DGN fishing seasonally or conditionally to protect endangered sea turtles, referred to as Pacific Sea Turtle Conservation Areas.

Drift Gillnet Gear

A drift gillnet is a panel of netting suspended vertically in the water by floats, with weights along the bottom. It is usually used to target swordfish and common thresher shark along the West Coast EEZ. Fish are entangled in the net, which uses relatively large mesh (typically around 18-20 inches) to target relatively large species of pelagic fish in an effort to minimize the bycatch of smaller unwanted or prohibited species. The number of meshes hanging between the floatline and leadline (bottom of the net) ranges from 100 to 150. The lines that attach the buoys to the floatline, and dictate the depth the net is fished, are referred to as buoy lines or extenders. Drift gillnet gear is anchored to a vessel at one end, and drifts along with the current. Nets are often set perpendicular to currents, or across temperature, salinity or turbidity fronts. Nets are typically set in the evening, allowed to soak overnight, and then retrieved in the morning. The average soak time is around 10 hours. See DGN Fishery Regulations section below for more specific gear requirements in this fishery.

Fishing Season

The DGN fishing season runs from August 15 to August 14 of the following year. However, nearly all of the fishing effort occurs from August 15 to January 31 of the following year due to the seasonal migratory pattern of swordfish and current seasonal fishing restrictions.

Participation and Permits

The HMS FMP requires a federal permit[5] for all U.S. commercial fishing vessels (including recreational charter vessels) that fish for HMS management unit species within the West Coast

[5] Federal permits must be renewed every 2 years, but permits are not currently limited and permit applications may be submitted at any time.

EEZ and to U.S. vessels that pursue HMS management unit species on the high seas (seaward of the EEZ). In order to participate in the DGN fishery specifically, a California-issued DGN permit is also required[6]. This permit is linked to an individual fisherman, not a vessel, and is only transferable under very restrictive conditions. To keep a California-issued DGN permit active, current permit holders are required to purchase a permit each year. However, permit holders are not required to make landings using DGN gear. In addition, a general California resident or non-resident commercial fishing license and a current vessel registration are required to catch and land fish in California caught with DGN gear. Completion and submission of California state logbook records is also required. About 150 DGN permits were initially issued when the limited entry program was established by the state of California in 1980. The number of permits has declined from a high of 251 in 1986 to a low of 73 in 2010, with only 16 vessels actively participating in the swordfish fishery in 2012 (Table 1). Annual fishing effort (number of sets as reported by NMFS) has also decreased from a high of 11,243 sets in the 1986 fishing season to a low of 435 sets in 2011 (Table 2).

Table 1. Annual drift gillnet permits issued and number of active vessels, 1980–2012.

Year	Active[1] Vessels	Permits Issued	Year	Active[1] Vessels	Permits Issued
1980	100	*	1997	108	120
1981	118	*	1998	98	148
1982	166	*	1999	84	136
1983	193	*	2000	78	127
1984	214	226	2001[2]	69	114
1985	228	229	2002	50	106
1986	204	251	2003	43	100
1987	185	218	2004	40	96
1988	154	207	2005	42	90
1989	144	189	2006	45	88
1990	134	183	2007	46	86
1991	114	165	2008	46	85
1992	119	149	2009	46	84
1993	123	117	2010	27	73
1994	138	162	2011	19	76
1995	117	185	2012	16	n.a
1996	111	167			

Source: CDFW License and Revenue Branch (LRB), extracted July 14, 2011. Additional processing information:
[1] some vessels only land thresher and/or swordfish from year to year so the highest number of active vessels for both components of the fishery were reported for this gear.
* actual number of permits issued by LRB not available but the California State Legislature set a cap of 150 in 1982.
[2] implementation of Pacific Leatherback Closure Area regulations.

Based on fishing effort patterns since 2001 and the number of permits currently issued, NMFS SFD expects the maximum annual DGN fishing effort to be 1,500 sets for the foreseeable future

[6] States of Oregon and Washington do not permit landing of fish caught with DGN gear.

(NMFS 2012a). DGN effort during 2002 was 1,630 sets, the first full year after the Pacific Leatherback Conservation Area (PLCA; see Pacific Sea Turtle Conservation Areas section below) area went into effect (Table 2). Effort declined to 1,075 sets in 2005. Fishing effort increased in 2006 to 1,433 sets. Since then, effort has progressively decreased annually, to a level of 492 sets in 2010. NMFS SFD believes that fishing effort could again reach 1,500 sets per year if currently inactive DGN permit holders re-enter the fishery.

Table 2. Annual drift gillnet fishing effort and catch of swordfish and thresher shark (combined species), 1990–2011.

Year	Number of Sets	Swordfish (mt)	Thresher Shark (mt)
1990	4,078	1,126	297
1991	4,778	936	573
1992	4,379	1,350	274
1993	5,442	1,409	285
1994	4,248	801	324
1995	3,673	772	264
1996	3,392	762	315
1997	3,093	708	353
1998	3,353	931	346
1999	2,634	605	236
2000	1,936	650	214
2001	1,665	371	322
2002	1,630	301	273
2003	1,467	217	290
2004	1,084	182	101
2005	1,075	220	177
2006	1,433	443	136
2007	1,241	490	191
2008	1,103	405	134
2009	761	251	88
2010	492	59	69
2011	435	118	64

Source: PFMC 2011b and PFMC 2012.

B. Action Area for DGN Fishery

The Action Area for this proposed action is the U.S. EEZ and adjacent high seas waters off the coast of California, Oregon, and Washington.[7] To a large degree, the action area for the

[7] 50 CFR § 660.701 defines the action area for the HMS FMP, but does not define "adjacent high seas waters." For the purposes of the DGN fishery, adjacent high seas waters could include a small amount DGN fishing effort

proposed action is further reduced by the combination of state and federal regulations that have influenced where this fishery has occurred in the past, and would be expected to occur in the foreseeable future. For the purposes of this proposed action, the range and extent of the DGN fishery that has occurred in this area since 2001 represent the current state and expected extent of the DGN fishery in the foreseeable future (Figure 1). The descriptions of regulations that govern the DGN are provided below to help define the actual action area for the fishery based on when and where the fishery is expected to occur.

DGN Fishery Regulations

In 2001, the PLCA went into effect, which significantly altered the availability of fishing grounds for the DGN fleet and ultimately the distribution of DGN fishing effort off the coast of California. While Oregon and Washington state laws do not currently allow landings caught with drift gillnet gear, vessels may fish in federal waters offshore of these states and land their catch in California.

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occurring in the high seas waters outside the EEZ in relatively close proximity to the EEZ, although fishing effort has not been observed in high seas waters since 2001 (Figure 4).

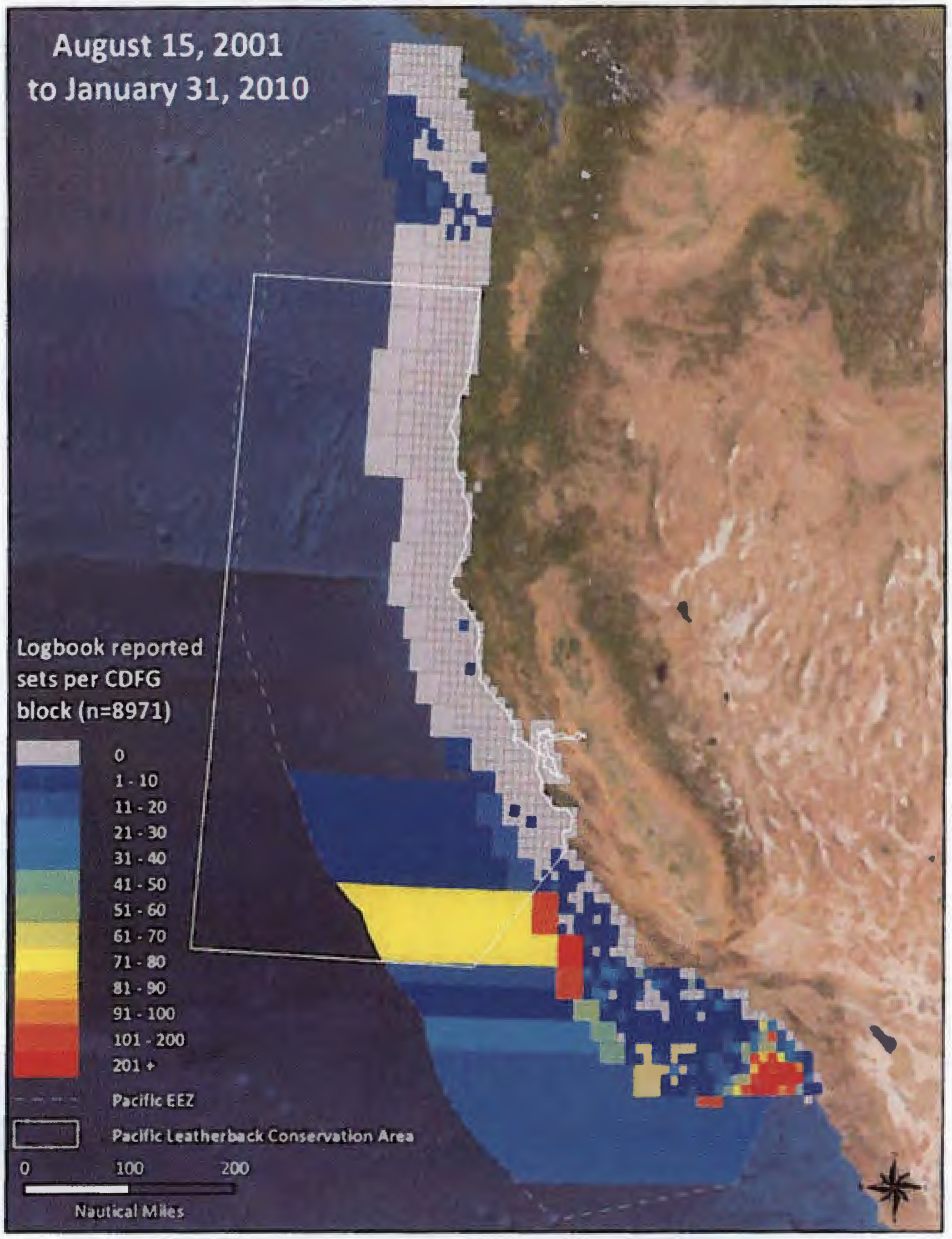

Figure 1. DGN logbook-reported fishing effort from August 15, 2001, to January 31, 2010. Although, the fishing season runs a full year (August 15-August 14), no reported effort occurred during this time period outside of the August 15-January 31 timeframe.

The DGN fishery for swordfish and shark (14" minimum mesh size) is managed through both federal and state regulations to conserve target and non-target stocks including protected species that are incidentally captured. These regulations are described in Appendices B and C to the original HMS FMP Final Environmental Impact Statement (PFMC 2003), the latter being the California code for fishing swordfish and shark with minimum stretched mesh of 14 inches required. The regulations for ≥14" stretched mesh only drift gillnets summarized as follows:

Federal Regulations

Pacific Cetacean Take Reduction Team (PCTRT) measures to protect marine mammals (50 CFR 229.31[8]):

• Acoustic deterrent devices (pingers) are required on drift gillnets to deter entanglement of marine mammals. Pingers, when immersed in water, must broadcast a 10 kHz (± 2kHz) sound at 132 dB (±4 dB) re 1 micropascal at 1 meter lasting 300 milliseconds (± 15 milliseconds) and repeating every 4 seconds (±0.2 seconds). They must also remain operational to a water depth of at least 100 fathoms). Pingers must be attached in a staggered configuration no more than 300 ft (91.44m) apart along the floatline and leadline (Figure 2).
• All drift gillnets must be fished at minimum depth below the surface of 6 fathoms (fm) (10.9 m).
• Attendance at skipper workshops is required after notification from NMFS.
• Vessels must provide accommodations for observers when assigned.[9]

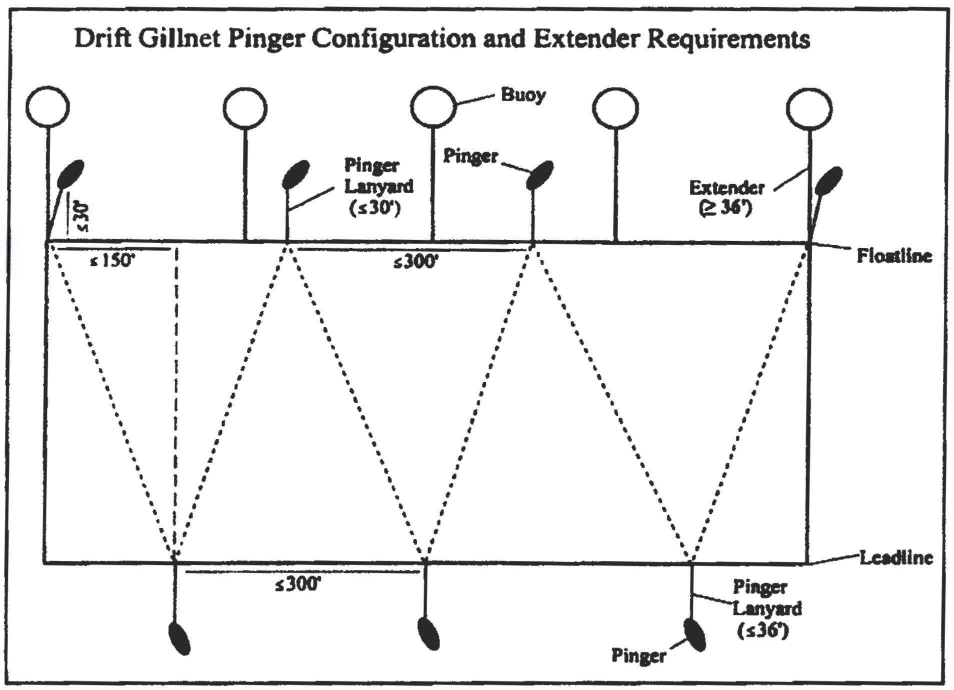

Figure 2. Diagram of required pinger placement on a drift gillnet (50 CFR Sec. 229.31).

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[8] Initially implemented in 1997 (62 FR 51805; October 3, 1997); amended in 1998 (63 FR 27860; May 21, 1998); amended again in 1999 (64 FR 3431; January 22, 1999).
[9] This is a regulatory requirement under 50 CFR 660.719.

Pacific Sea Turtle Conservation Areas (50 CFR 660.713)

- Drift gillnet fishing may not be conducted:
  - From August 15 to November 15 in the portion of the EEZ bounded by the coordinates 36° 18.5' N latitude (Point Sur), to 34°27' N latitude, 123° 35' W longitude; then to 129°W longitude; then north to 45° N latitude; then east to the point where 45° N latitude meets land - Pacific Leatherback Conservation Area.
  - From the months of June, July, and/or August during a forecast or declared El Niño, as announced by NMFS in the Federal Register, in the portion of the EEZ south of Point Conception, California (34°27' N latitude) and west to 120° W longitude - Pacific Loggerhead Conservation Area.

The Pacific Sea Turtle Conservation Areas are based on a NMFS October 23, 2000, biological opinion on the DGN fishery and subsequent recommendations made by the PCTRT in 2001 (PCTRT 2001). In an effort to minimize the economic impact of the time and area closures, NMFS modified the PCTRT recommendations in the 2001 final rule creating the PLCA (66 FR 44549; August 24, 2001). The PCTRT recommended a line heading due west from shore at 36°15' N latitude as the southern boundary of the PLCA. NMFS moved the southern boundary's intersection with shore to Point Sur because it is a more recognizable landmark and only three miles north of 36° 15' N latitude. NMFS also modified the PCTRT recommendation (a line heading due west) to a diagonal line from Point Sur to 34° 27' N latitude, 123° 35' W longitude based on satellite tracking data of two leatherback turtles tagged in Monterey Bay in September 2000. The reason for this precaution was to protect a potential migratory corridor of leatherbacks departing Monterey Bay for western Pacific nesting beaches. The original trigger language identified by the PCTRT to extend the area closure in a southerly direction to Point Conception if a leatherback was observed taken was also removed because NMFS did not consider this extra precaution to be necessary based on the distribution of the turtles that had historically been taken incidentally in the fishery. In addition, the final PLCA did not include lowering the top of drift gillnets to at least 60 feet deep as recommended by the PCTRT, because observer data (1990-2000) did not suggest that this would result in a definite decrease in leatherback interactions. Modifications provided access to the productive fishing grounds north of Point Conception, which is consistent with the intent of the PCTRT proposal, while still providing at least an equal, if not greater, level of protection for leatherback and loggerhead sea turtles.

The Pacific Sea Turtle Conservation Areas, as well as other seasonal time/area closures for the DGN fishery and designated leatherback critical habitat, are shown below in Figure 3.

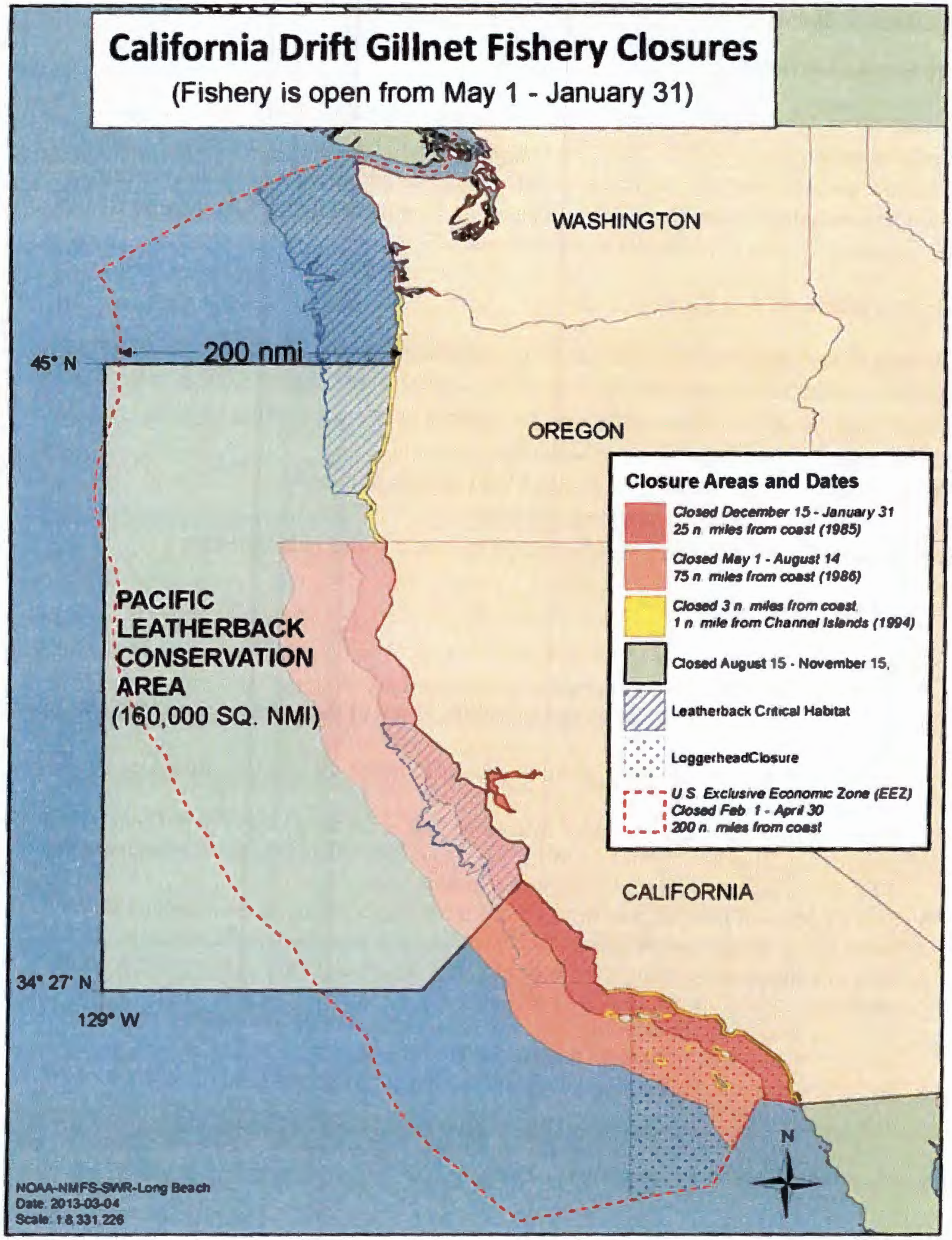

Figure 3. Pacific Sea Turtle Conservation Areas and other time/area closures for the DGN, and designated leatherback critical habitat.

State Restrictions (applicable to vessels operating from the state's ports)

Participation restrictions:

• California has a limited entry program, which was adopted into the HMS FMP, for the swordfish/thresher shark DGN fishery. No new permits will be issued and current permits (issued to vessel operator) can only be transferred under certain conditions (health concern or death of permit holder) to another fishermen currently holding or eligible for a general gillnet/trammel net permit by the State of California.

Gear restrictions (California):

• The maximum cumulative length of a shark or swordfish gill net(s) on the net reel of a vessel, on the dock of the vessel, and/or in the water at any time shall not exceed 6,000 ft in float line length, except that up to 250 fm of spare net (in separate panels not to exceed 100 fm) may be on board the vessel stowed in lockers, wells, or other storage.
• The use of quick disconnect devices to attach net panels is prohibited.
• DGN gear must be at least 14 inch stretched mesh.
• The unattached portion of a net must be marked by a pole with a radar reflector.

Mainland area restrictions/closures:

• DGN gear cannot be used:
  - In the EEZ off California from February 1 to April 30.
  - In the portion of the EEZ off California within 75 nm of the coastline from May 1 to August 14.
  - In the portion of the EEZ off California within 25 nm of the coastline from Dec. 15 through Jan. 31.
  - In the portion of the EEZ bounded by a direct line connecting Dana Point; Church Rock on Catalina Island; and Point La Jolla, San Diego County; and the inner boundary of the EEZ from August 15 through September 30 each year.
  - In the portion of the EEZ within 12 nm from the nearest point on the mainland shore north to the Oregon border from a line extending due west from Point Arguello.
  - East of a line running from Point Reyes to Noonday Rock to the westernmost point of southeast Farallon Island to Pillar Point.
  - In the portion of the EEZ within 75 nm of the Oregon shoreline from May 1 through August 14, and within 1000 fm the remainder of the year.
  - In State waters off the Washington coast (Washington does not authorize the use of this HMS gear).

Channel Islands (California) closures:

• DGN gear cannot be used:
  - In the portion of the EEZ within six nm westerly, northerly, and easterly of the shoreline of San Miguel Island between a line extending six nm west magnetically from Point

Bennett and a line extending six nm east magnetically from Cardwell Point and within six nm westerly, northerly, and easterly of the shoreline of Santa Rosa Island between a line extending six nm west magnetically from Sandy Point and a line extending six nm east magnetically from Skunk Point, from May 1 through July 31 each year.

- In the portion of the EEZ within 10 nm westerly, southerly, and easterly of the shoreline of San Miguel Island between a line extending 10 nm west magnetically from Point Bennett and a line extending 10 nm east magnetically from Cardwell Point and within 10 nm westerly, southerly, and easterly of the shoreline of Santa Rosa Island between a line extending 10 nm west magnetically from Sandy Point and a line extending 10 nm east magnetically from Skunk Point from May 1 through July 31 each year.
- In the portion of the EEZ within a radius of 10 nm of the west end of San Nicolas Island from May 1 through July 31 each year.
- In the portion of the EEZ within six of the coastline on the northerly and easterly side of San Clemente Island, lying between a line extending six nm west magnetically from the extreme northerly end of San Clemente Island to a line extending six nm east magnetically from Pyramid Head from August 15 through September 30 each year.

C. DGN Fishery Observer Program

NMFS Southwest Region has operated an at-sea observer program in the DGN fishery since July 1990 to the present, while California Department of Fish and Wildlife (CDFW) had operated a DGN observer program from 1980–90. The objectives of the NMFS Observer Program are to record, among other things, information on non-target fish species and protected species interactions that may not be typically nor accurately reported in the fishing logbooks, due to focus on target species by fishermen or incentives not to report certain species to avoid increased regulation. These observer data are relied upon to produce estimates of protected species bycatch and forecast potential impacts of future fishing effort on these species. Since 1990, NMFS has sought to obtain 20 percent observer coverage of the DGN fishery each year, per recommendations from the SWFSC (NMFS 1989). Table 3 provides the recent history of observer coverage based on the calendar year fishing effort (although the fishing season typically runs August - January), which has been less than 20 percent in some years. NMFS SFD relies upon the contracted observer provider to take the actions necessary to maintain coverage rates, and challenges in observer deployment such as monitoring the activity of the fleet and accounting for effort from vessels that cannot take an observer were not well met. NMFS SFD has consulted with the contractor over the deployment record and has indicated that steps have been taken to improve compliance with observer requirements (NMFS 2012b). Overall, the annual average of observer coverage that occurred from 2000-2012 was 18.4 percent and total observer coverage of all effort during this time was 19.2 percent, which in total is not far off the 20 percent coverage goal.

Table 3. Summary of CA thresher shark/swordfish DGN Observer Program from 2000-2012 (calendar fishing year January to December).

Calendar Year	Estimated Total Fishing Effort (Sets)	Total Number of Observed Sets	% Observer Coverage
2000	1936	444	22.9%
2001	1665	339	20.4%
2002	1630	360	22.1%
2003	1467	298	20.3%
2004	1084	223	20.6%
2005	1075	225	20.9%
2006	1433	266	18.6%
2007	1241	204	16.4%
2008	1103	149	13.5%
2009	761	101	13.3%
2010	492	59	12.0%
2011	435	85	19.5%
2012	445	83	18.7%

Observer coverage relative to the overall distribution of the DGN fishery is illustrated in Figure 4. Logbook records report set location by statistical reporting areas, which represent gradually larger fishing areas as those areas, known also as reporting blocks, are located further offshore (e.g., large yellow reporting block located offshore between Point Conception and Morro Bay). In reality, effort could have occurred anywhere within these blocks, and may likely be concentrated or confined to relatively small portions of those blocks.

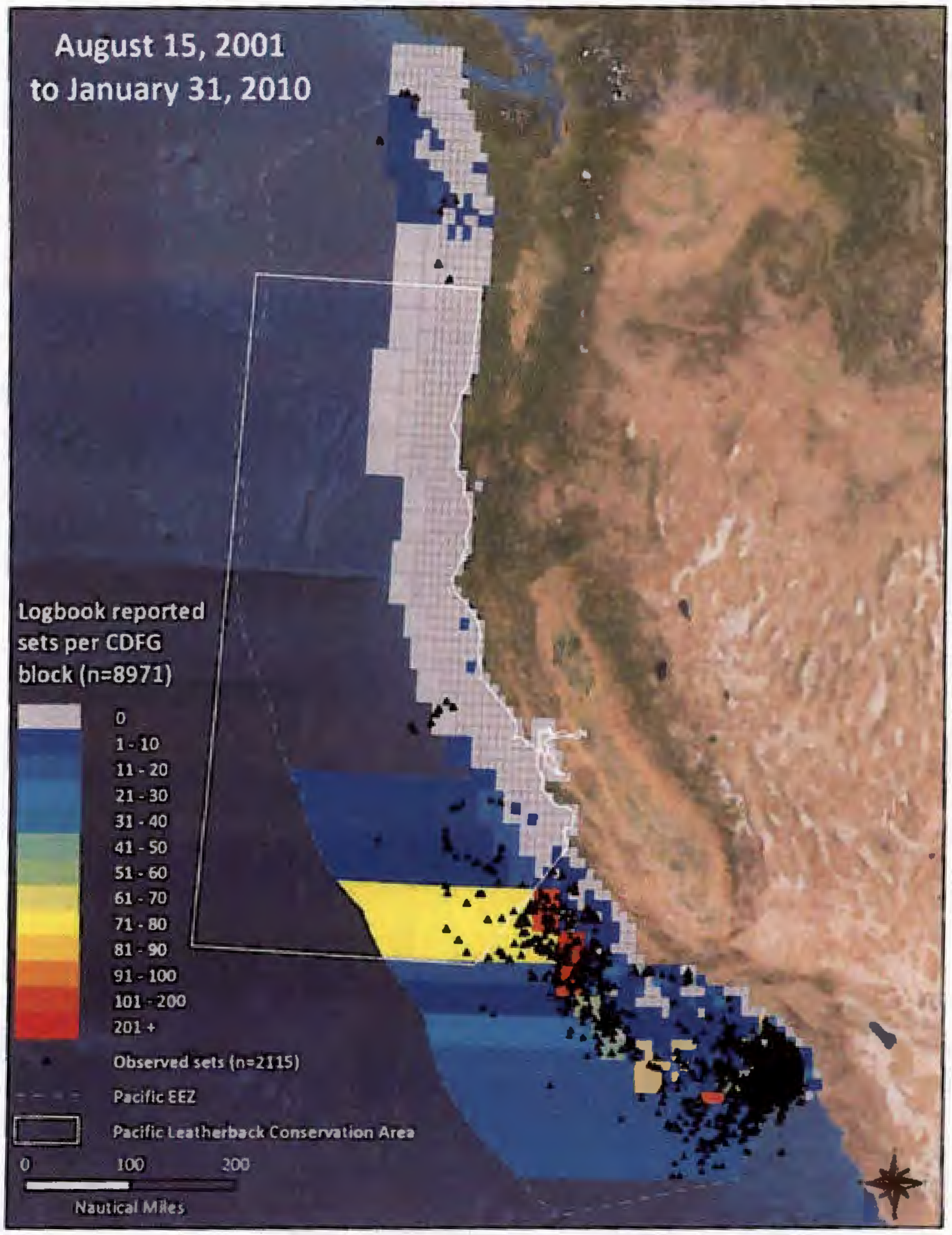

Figure 4. DGN logbook-reported fishing effort and observed sets from Aug 15, 2001, to January 31, 2010. Although, the fishing season runs a full year (August 15-August 14), no reported effort occurred during this time period outside of the August 15-January 31 timeframe.

The 2011 U.S. National Bycatch Report (NMFS 2011) recommended that observer coverage in the DGN fishery should be increased to 30 percent to better document bycatch of rare and sensitive species, especially ESA-listed species. At this time, NMFS SFD is proposing to maintain a target coverage level of 20 percent, primarily due to limitations in Observer Program funding.

NMFS also considers the effects of any other actions are interrelated or interdependent to the proposed action as described above. "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). At this time, NMFS is unable to identify any other actions that may be interrelated to on interdependent on the management of the DGN fishery.

III. STATUS OF THE SPECIES

The following ESA-listed species under NMFS jurisdiction may occur in the action area:

Marine Mammals	**Status**
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
North Pacific right whale (*Eubalaena japonica*)	Endangered
Guadalupe fur seal (*Arctocephalus townsendi)*	Threatened
Gray whale - western North Pacific population (*Eschrichtius robustus*)	Endangered
Sea Turtles	
Leatherback turtle (*Dermochelys coriacea*)*	Endangered
Loggerhead turtle – North Pacific DPS (*Caretta caretta*)	Endangered
Olive ridley (*Lepidochelys olivacea*)	Endangered/Threatened
Green turtle (*Chelonia mydas*)	Endangered/Threatened
Marine Fish	
Green Sturgeon, southern DPS (*Acipenser medirostris*)*	Threatened
Pacific eulachon, southern DPS (*Thaleichthys pacificus*)	Threatened
Scalloped hammerhead shark - eastern Pacific DPS (*Sphyrna lewini*)	Proposed as Endangered[1]
Marine Invertebrates	
White abalone (*Haliotis sorenseni*)	Endangered
Black abalone (*Haliotis cracherodii*)*	Endangered
Salmonids	

Chinook (*Oncorhynchus tshawytscha*)	Sacramento River winter-run, evolutionarily significant unit (ESU)	Endangered
	Central Valley spring-run ESU	Threatened
	California Coastal ESU	Threatened
	Snake River fall-run ESU	Threatened
	Snake River spring/summer-run ESU	Threatened
	Lower Columbia River ESU	Threatened
	Upper Willamette River ESU	Threatened
	Upper Columbia River spring-run ESU	Endangered
	Puget Sound ESU	Threatened
Chum (*Oncorhynchus keta*)	Hood Canal summer-run ESU	Threatened
	Columbia River ESU	Threatened
Coho (*Oncorhynchus kistuch*)	Central California Coast ESU	Endangered
	S. Oregon/N. CA Coast ESU	Threatened
	Lower Columbia River ESU	Threatened
Sockeye (*Oncorhynchus nerka*)	Snake River ESU	Endangered
	Ozette Lake ESU	Threatened
Steelhead (*Oncorhynchus mykiss*)	Southern California DPS	Endangered
	South-Central California Coast DPS	Threatened
	Central California Coast DPS	Threatened
	California Central Valley DPS	Threatened
	Northern California DPS	Threatened
	Upper Columbia River DPS	Threatened
	Snake River Basin DPS	Threatened
	Lower Columbia River DPS	Threatened
	Upper Willamette River DPS	Threatened
	Middle Columbia River DPS	Threatened

*Species with designated critical habitat within marine waters.
[1]Proposed listing as endangered DPS on April 5, 2013 (78 FR 20718).

In order to determine which ESA-listed species may be affected, NMFS relied largely upon records of bycatch gathered by the observer program. The placement of federal fisheries observers on fishing vessels became mandatory in the DGN fishery starting in 1990. Observers are placed on all DGN vessels when requested by NMFS, except when the presence of an observer would jeopardize the safety of the observer, crew, or vessel. Based on observer records, the incidental take of ESA-listed species are rare events in the DGN fishery.

A. ESA-listed species likely to be adversely affected by the proposed action

Leatherback, loggerhead, olive ridley, and green sea turtles and fin, humpback, and sperm whales, have been observed entangled in DGN gear within the action area (see Environmental Baseline and Effects section for more details). NMFS anticipates that these seven ESA-listed species may be exposed to fishing gear under the proposed action and are likely to be taken by the fishery in the future. Therefore, these seven species are likely to be adversely affected by the proposed action, and will be considered in this Opinion.

Table 4. Total observed and reported sea turtle and marine mammal takes in the DGN fishery (7,807 observed sets) from 1990 to 2013 (NMFS 2012a[10]).

Species	Observed takes	Number of mortalities*
Green sea turtle	1	1
Olive ridley sea turtle	1	0
Loggerhead sea turtle	19	4
Leatherback sea turtle	25	13
Fin whale	1	1
Humpback whale	3	0
Sperm whale	10	5

*This number includes only animals that were recorded as dead by the observer and does not include injured animals which were determined to likely have died later as a result of the interaction.

B. ESA-listed species not likely to be adversely affected by the proposed action

Other ESA-listed species are not considered likely to be adversely affected by the proposed action. Some have been observed taken in the DGN in the past, others have not. The rationale for why NMFS has determined which species are not likely to be adversely affected is provided in this section.

The 2012 Biological Assessment identified three species that have been observed taken by the DGN fishery in the past but, as is explained below, the following ESA-listed species are not likely to be adversely affected by the proposed action:

Steller Sea Lion – Eastern DPS

Over the past 21 years, only two Steller sea lions have been observed taken by the DGN fishery. One occurred off southern California in 1992, and one occurred off the California/Oregon border in 1994; both were mortalities. No Steller sea lions have been observed taken or reported entangled in DGN gear since the implementation of the PCTRP in 1997, which appears to have reduced the likelihood of an incidental take of Steller sea lions. To a large degree, the DGN fishery has shifted south of areas likely to be frequented by Steller sea lions. In addition, it has been suggested that the range of Steller sea lions may have shifted northward in response to

[10] Updated March, 2013.

warming ocean conditions, (NMFS 2012c) further reducing the likelihood of interactions between the fishery and Steller sea lions. Therefore, NMFS concludes that the risk of Steller sea lion entanglement or adverse effects is discountable. Thus, NMFS concludes the proposed action is not likely to adversely affect the Eastern DPS of Steller sea lions, and this species will not be considered further in this Opinion.

Southern Resident Killer Whale

One killer whale was observed taken in the DGN fishery in early November 1995 south of Monterey Bay and prior to the implementation of the PCTRP and the PLCA. The animal was identified as an Eastern North Pacific transient killer whale, which is not listed under the ESA (2012 SARs). It is reasonable to assume that any killer whales that interact with the DGN fishery would be either a transient or offshore killer whale, and not an endangered Southern Resident killer whale (SRKW) based on the number, distribution and behaviors of these three sub-species.

There are three ecotypes of killer whales; transients, offshores, and residents - and each can be distinguished genetically, morphologically and behaviorally. Transients are most common worldwide and generally prey on marine mammals. Less is known about offshores, although they appear to be opportunistic feeders. Residents are generally piscavores and maintain stable family units and are often "resident" to a specific area. Along the U.S. West Coast, it has been estimated that there are approximately 340 transients (Allen and Angliss 2012) and 240 offshore (Carretta *et al.* 2013) killer whales, compared to 86 SRKWs (Carretta *et al.* 2013). Based on the relative population sizes, it is likely that any killer whale interaction with DGN gear would be a transient or offshore killer whale.

As noted previously, the majority of effort in the DGN occurs within southern California and this is beyond the observed range of SRKWs. Offshore and transient killer whales have been observed along the entire U.S. West Coast, including southern California, the area of greatest effort in the DGN fishery. SRKW spend a substantial amount of time within the inland water of waters of Washington state and Vancouver Island, Canada. There are a number of whale watch vessels along the U.S. West Coast and there have been reports of SRKWs off the coast of Northern and Central California in the winter and spring and no whale watch company has reported seeing SRKWs south of Monterey Bay. This general trend in distribution is supported by recent tagging work. In order to better understand the winter distribution of the SRKWs, in early 2012, the NWFSC began satellite tagging individual whales from the SRKW. There have been limited tracks, but so far whales tracked into California waters have not traveled south of Monterey Bay. Based on the relative number of SRKWs and their distribution, it is extremely unlikely that any killer whales that interact with the DGN off of California would be a SRKW.

There is a potential for overlap of DGN fishing effort off of Washington and Oregon with killer whale distribution, but given the very low fishing effort in the area and the fact that offshore and transients significantly outnumber SRKWs, it is considered extremely unlikely that any interactions between the DGN fishery and killer whales would be with SRKWs. As a result, NMFS concludes the proposed action is not likely to adversely affect SRKWs, thus, SRKWs will not be considered further in this Opinion.

Western North Pacific Gray Whales

Gray whales are presently recognized as 2 populations in the North Pacific Ocean and recent genetic studies using both mitochondrial (mtDNA) and nuclear markers have demonstrated significant differentiation between the western North Pacific (WNP) and eastern North Pacific (ENP) populations (Lang *et al.* 2004; Weller *et al.* 2004; Lang *et al.* 2005; Swartz *et al.* 2006; Weller *et al.* 2006; Weller *et al.* 2007; Brownell *et al.* 2009; LeDuc *et al.* 2002, Lang 2010a; Lang *et al.* 2010b; Lang *et al.* 2011). The WNP gray whales are listed as endangered under the ESA. ENP and WNP gray whales were once considered geographically separated along either side of the ocean basin, but recent photo-identification, genetic, and satellite tracking data indicate WNP gray whales may be accompanying ENP gray whales along their U.S. west coast migrations.

In the fall, gray whales migrate from their summer feeding grounds, heading south along the coast of North America to spend the winter in their breeding and calving areas off the coast of Baja California, Mexico. Calves are born in shallow lagoons and bays from early January to mid-February. From mid-February to June, gray whales can be seen migrating northward with newborn calves along the West Coast of the U.S. Two WNP gray whales have been satellite tracked from Russian foraging areas east along the Aleutian Islands, through the Gulf of Alaska, and south to the Washington State and Oregon coasts in one case (Mate *et al.* 2011) and to the southern tip of Baja California and back to Sakhalin Island in another (IWC 2012). Comparisons of ENP and WNP gray whale photo-identification catalogs have thus far identified 21-23 western gray whales occurring on the eastern side of the basin (IWC 2012; Weller *et al.* 2011) and Burdin *et al.* (2011) found an additional individual. During one field season off Vancouver Island, western gray whales were found to constitute 6 of 74 (8.1%) of photo-identifications (Weller *et al.* 2012). In addition, two genetic matches of western gray whales off Santa Barbara, California have been made (Lang *et al.* 2011). It is assumed that part of the WNP gray whale population has migrated, at least in some years, to the eastern North Pacific during the winter breeding season (Burdin *et al.* 2012; Urban *et al.* 2012).

The timing of the majority of effort in the DGN fishery overlaps with the gray whale southbound migration along the U.S. west coast (November to February), but there are a number of fishing restrictions during this time that may limit the overlap between migrating gray whales and DGN fishing. From August to November 15, fishing may occur outside of the PLCA, typically south of Point Conception; from December 15 to January 31, the fishery is restricted to areas outside of 25 nm from the coastline; fishing is closed in the California EEZ from Feb 1-April 30; and from May 1-August 14, the fishery is restricted to outside of 75 nm from the coastline. Northbound gray whales, which include all age classes, migrate from February to June and therefore are not expected to overlap with any DGN fishing. Since 2001, from November 1 to January 31, approximately half of the total DGN fishing effort occurs and is concentrated south of Point Conception, with the exception of some limited effort that occurs just north of Pt. Conception or inside the PLCA that opens in mid-November. Southbound gray whales typically migrate within 10 kilometers from shore during the southbound migration, but some individuals have been observed farther offshore, usually less than 50 kilometers from the coastline. In the southern California Bight, gray whales do travel around and through the Channel Islands, in addition to a migratory route in between the mainland and the Channel Islands.

From 1998 to 2012, a total of 3 gray whales have been observed by the NMFS fishery observer program interacting with the DGN fishery (Enriquez pers. comm. 2013). Historically, the assumption has been that these whales were ENP gray whales. All 3 occurred in the month of January in an area west of San Diego and south of San Clemente: one in 1998 (alive); one in 1999 (dead); and one in 2005 (alive). Although the total documented interactions with DGN gear may be a minimum, as some interactions may have been unobserved, the likelihood that a gray whale would interact with the DGN fishery is low. Historically, records suggest that gray whale strandings have been commonly associated with gillnet gear, although no positive identification of DGN gear can be made from those records outside the observer program (Saez *et al.* 2013, *in prep*). With the exception of the Southern California Bight, the area where the DGN fishery occurs is outside of the majority of the traditional gray whale southbound migratory route. All of the documented interactions between gray whales and the DGN fishery have occurred in the Southern California Bight in January which does coincide with a large proportion of the ENP population migrating through the area at that time. Based on tagging data, it is assumed that when WNP gray whales migrate along the coast of North America to Baja California, they are likely slightly delayed from the ENP's "start date" by at least a couple of weeks based on distance and average swim speed (i.e., they have to swim from Sakhalin Island, Russia before joining the ENP route). The first migratory ENP gray whales can be observed in California as early as October, depending on the year, but mid-to late November is typical and approximately 10 percent of the population is expected to have made the migration by the end of December. Thus, it is possible that a WNP gray whale's migratory route could overlap with the DGN fishing area, particularly from November to January during the southbound migration and most likely in the Southern California Bight region, based on the distribution of DGN fishing effort in that area. However, there is no evidence indicating that WNP gray whales behave differently than an ENP whale and are more susceptible to interaction with the DGN fishery. Therefore, similar to ENP gray whales, the likelihood that a WNP gray whale would interact with the DGN fishery is low.

The current minimum population estimate for ENP gray whales is 19,126 (Carretta *et al.* 2013). The most recent estimate of WNP gray whale abundance is 137 individuals (IWC 2012). Given that only some small portion of these WNP gray whales could be expected to be part of the approximately 20,000 gray whales migrating through the Southern California Bight during any given year that might be exposed to the DGN fishery, and the already low probability of a gray whale entanglement occurring, the likelihood that a WNP gray would be entangled in DGN gear is insignificant and discountable. As a result, NMFS concludes this species is not likely to be adversely affected by the proposed action, thus, this species will not be considered further in this Opinion.

Other ESA-listed Species

The following marine mammal species may be in the action area, but have never been observed interacting or entangled with DGN gear: blue whale, sei whale, North Pacific right whale, and Guadalupe fur seal. It is possible that some species, such as blue and sei whales, may occasionally encounter DGN gear. Due to their large size, however, these species are capable of bursting through nets making it unlikely that they would be observed entangled. North Pacific right whales are rarely found off the U.S. west coast and have primarily been documented foraging in the Bering Sea and the Gulf of Alaska, where critical habitat was designated in 2006. Guadalupe fur seals occur primarily near Guadalupe Island, Mexico, their primary breeding area. As a non-migratory species, they are occasionally found north of the U.S.-Mexican border and therefore, the encounter rate with DGN vessels can be considered discountable. Without documented records of DGN bycatch of these marine mammals, NMFS concludes that these ESA-listed species are not likely to be adversely affected by the proposed action.

There are a number of ESA-listed fish species in the proposed action area, including: some salmon stocks, steelhead, eulachon, and green sturgeon. None of these species are likely to be caught in DGN gear, due to the relatively large size of mesh used (typically 18 inches). Also, the distribution of the DGN fishery is more offshore and southerly focused than the distribution of most of these species, including salmonids, eulachon, and green sturgeon. The eastern Pacific DPS of scalloped hammerhead sharks was recently proposed for listing as endangered on April 5, 2013. The range of this DPS does extend up into southern California, although the primary habitat for scalloped hammerhead sharks is found in waters warmer than 22°C south and west of the U.S. EEZ and throughout the Eastern Tropical Pacific region (78 FR 20718). The bycatch of scalloped hammerhead sharks has never been documented in the DGN fishery by fisheries observers. From 1990-2012, a total of 50 hammerhead sharks have been observed caught in the DGN fishery, but none have been identified as a scalloped hammerhead (78 FR 20718). As a result, NMFS concludes the proposed action is not likely to adversely affect any of these species.

White and black abalone are species confined to the sea floor bottom and would not be encountered by DGN gear. As a result, NMFS concludes the proposed action is not likely to adversely affect these species.

C. Critical habitat

Critical habitat has not been designated or proposed within the action area for most ESA-listed marine mammals, sea turtles, fish or invertebrates. Designated critical habitat for Steller sea lions (eastern DPS) is within the action area, including waters surrounding Año Nuevo Island, Sugarloaf Island, and the southeast Farallon Islands in California; and Pyramid Rock at Rogue Reef, and Long Brown Rock and Seal Rock at Orford Reef in Oregon (50 CFR 226, Table 1). Critical habitat includes associated aquatic zones 3,000 feet seaward in State and Federally managed waters from the baseline of each rookery (50 CFR 226.202(b)). The DGN fishery does not operate within 3,000 feet of any shoreline and, therefore, will not affect Steller sea lion critical habitat. As noted above, most of the DGN effort occurs well south of the islands that are designated as critical habitat. NMFS concludes that the risk of adverse effects to Steller sea lion critical habitat is discountable. As a result, NMFS concludes the proposed action is not likely to adversely affect Steller sea lion critical habitat, and it will not be considered further in this Opinion.

Critical habitat was recently designated off the U.S. west coast for leatherback sea turtles (77 FR 4170, January 26, 2012), which does include areas that are seasonally open to the DGN fishery off the central coast of California. In the final rule, NMFS identified one primary constituent element essential for the conservation of leatherbacks in marine waters off the U.S. West Coast: the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (e.g., *Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. However, the critical habitat designation does not specifically define or develop standards or measurable criteria for any of these particular aspects of prey occurrence. Observers in the DGN fishery do occasionally report the bycatch of invertebrate species (Table 3 *in* Larese and Coan 2008). This bycatch includes pelagic tunicates (likely salps) and other unidentified invertebrate species, presumed to be passively snagged by these nets as the gear drifts in the water or is being hauled through the water and onboard the net reel of fishing vessels. The fate of these species upon release is very difficult to judge. The critical habitat designation emphasizes that the preferred prey of leatherbacks off the California coast is jellyfish, with other gelatinous prey, such as salps (a pelagic tunicate), considered of lesser importance (77 FR 4170). While jellyfish bycatch may occur in the DGN fishery, the extent is believed to be rare and cannot be quantified (NMFS 2012a). In addition, significant portions of the designated critical habitat are not open to DGN during the PLCA restriction when leatherbacks would be expected to be foraging on prey (i.e., summer and early fall). As a result, NMFS concludes that any effects of the proposed action to designated critical habitat for leatherback sea turtles are insignificant and discountable. Therefore, NMFS concludes designated critical habitat for leatherback sea turtles is not likely to be adversely affected by the proposed action, and will not be considered further in this Opinion.

Critical habitat for the North Pacific loggerhead DPS is currently being considered off the U.S. west coast, as required under the ESA for a new designation.

D. Marine Mammals

i. Fin Whales

Global status

Fin whales, like most large baleen whales, are listed as endangered under the ESA. They were originally listed in 1970 under the Conservation of Endangered Species and Other Fish or Wildlife Act and were listed in 1973 when the ESA was passed by Congress. There is no designated critical habitat for fin whales. The MMPA identifies geographic stocks of marine mammals and requires the monitoring and management of marine mammals on a stock by stock basis rather than entire species, populations, or distinct population segments. The fin whale stock most likely to interact with the DGN gear within the proposed action area is identified as the California/Oregon/Washington stock.

The International Whaling Commission (IWC) first protected fin whales in the North Pacific in 1966. They are also protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and the MMPA. Fin whales in the entire North Pacific were estimated to be less than 38 percent of historic carrying capacity (Mizroch *et al.* 1984). The initial abundance estimate has never been estimated separately for the "west coast" stock of fin whales, but it is likely that it was depleted by whaling, particularly in the 20th century.

Species description and distribution

Fin whales are widely distributed throughout the world's oceans and are second only to blue whales in size, reaching lengths between 20 to 29 meters at adulthood. They are typically dark gray above and white or cream-colored below with a long slender body and variably-shaped dorsal fin that is often pointed and falcate, located about two-thirds of the way back on their body, and the flukes are bordered with gray. Like other baleen whales, fin whales have fringed baleen plates and ventral grooves, which expand during feeding. The lower jaw is gray or black on the left side and creamy white on the right side. This asymmetrical coloration extends to the baleen plates as well, and is reversed on the tongue. The rostrum is narrower and more V-shaped than the blue whale, and it has a more prominent median ridge. Along the back of many individuals, just behind the right side of the head, is a grayish white chevron, sometime referred to as a "blaze."

The fin whale is a cosmopolitan species with a generally anti-tropical distribution centered in the temperate zones. They are known to associate with steep contours, perhaps due to abundance of prey. Fin whale populations exhibit differing degrees of mobility, presumably depending on the stability of access to sufficient prey resources throughout the year. Most groups are thought to migrate seasonally, in some cases over distances of thousands of kilometers. They feed intensively at high latitudes in summer and fast, or at least greatly reduce their food intake, at lower latitudes in winter. Some groups apparently move over shorter distances and can be considered resident to areas with a year-round supply of adequate prey. Year round residence has been observed in the Gulf of California, although higher abundances are observed in the winter and spring. Fin whales have also been observed in the waters around Hawaii. In the Atlantic Ocean, fin whales have an extensive distribution from the Gulf of Mexico and Mediterranean Sea northward to the arctic. In general, the fin whale feeds on krill and various amounts of schooling fish, notably herring, capelin, walleye pollock, and sandlance (Reeves *et al.* 2002). In the Pacific Ocean, they are found year-round off southern and central California, in the summer off Oregon and in the summer and fall months in the Shelikof Strait and Gulf of Alaska. In the Pacific fin whales prey mainly on euphausiids, copepods, herring, capelin, and walleye pollock.

Population status and trends

Although reliable and recent estimates of fin whale abundance are available for large portions of the North Atlantic Ocean, this is not the case for most of the North Pacific Ocean and Southern Hemisphere. Status of populations in both of these ocean basins, stated in terms of present population size relative to "initial" (pre-whaling, or carrying capacity) level, is uncertain. Fin whales in the entire North Pacific are estimated to be less than 38 percent of historic carrying capacity of the region (Mizroch *et al.* 1984). Commercial whaling for this species ended in the North Pacific in 1976, in the North Atlantic in 1987, and in the Southern oceans in 1976-77. Fin whales are still hunted in Greenland and Japan and are subject to catch limits under the IWC's "aboriginal subsistence whaling" scheme. The recent fin whale recovery plan (2010) provides the following minimum population estimates of fin whale populations outside the Pacific for North Atlantic fin whales, 2,362; for the West Greenland waters fin whales, a range from 500 to 2,000; and recent estimates for the British Isles-Spain-Portugal stock have ranged from 7,500 to 17,000. Minimum population estimates for other fin whale stocks within U.S. waters are provided below (Table 5).

Table 5. Minimum population estimates of fin whale populations in U.S. waters.

Stock	Minimum population estimate	Trend
Hawaiian[1]	101	No trend information
CA/OR/WA[2]	2,624	No trend information
Western North Atlantic[3]	3,269	No trend information
Northeast Pacific[4]	5,700	No trend information

[1] Carretta *et al.* 2013
[2] Carretta *et al.* 2013
[3] Waring *et al.* 2012
[4] Allen and Angliss 2012

Historically, the main direct threat to fin whales was whaling. Commercial whaling for this species ended in 1988. Removal of this significant threat has allowed increased recruitment in the population, and therefore, fin whale populations are expected to have grown.

NMFS has not established DPS's of fin whales, but does define stocks of marine mammals consistent with the MMPA. These stocks are useful for considering population level impacts on a species that is listed globally. The whales that are likely to be affected by the proposed action are from the California/Oregon/Washington stock of fin whales. The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nmi is the geometric mean of line transect estimates from summer/autumn ship surveys conducted in 2005 (3,281, CV=0.25) and 2008 (2,825, CV = 0.26) (Forney 2007; Barlow 2010), or 3,044 (CV=0.18) whales. This is probably an underestimate because it almost certainly excludes some fin whales which could not be identified in the field and which were recorded as "unidentified rorqual" or "unidentified large whale".

There is some indication that fin whales have increased in abundance in California coastal waters between 1979/80 and 1991 (Barlow 1994) and between 1991 and 1996 (Barlow 1997), but these trends are not statistically significant. Although the population in the North Pacific is expected to have grown since receiving protected status in 1976 from the International Whaling Commission, the possible effects of continued unauthorized take (Yablokov 1994; Clapham and Ivashchenko 2009) and incidental ship strikes and fishery mortality make this uncertain. There is no clear definitive population trend from recent line-transect abundance surveys conducted in 1996, 2001, 2005, and 2008 in California, Oregon, and Washington waters.

The potential biological removal (PBR) level for this stock and all marine mammals is based upon a standard equation that includes the most recent minimum population size multiplied by a growth rate of the population multiplied by a recovery factor (which is based upon the status of the stock). The PBR for a stock can change annually or as new information becomes available. Because PBR is calculated using variables that can change over time (e.g., the minimum populations size for a stock may change based upon recent surveys) the PBR is a value that also fluctuates over time, and can vary year to year. The most recent PBR for fin whales is calculated as the minimum population size (2,624) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.3, resulting in a PBR of 16 per year.

Threats

Threats to fin whales occur within the action area. A list of general threats to the species is detailed in the Recovery plan. The following section is a summary of some of the major threats to fin whale recovery in the proposed action area.

Fin whales have been legally protected from commercial whaling for the last twenty or more years, and this protection continues. The main direct threat to fin whale populations is the possibility that illegal whaling or resumed legal whaling will cause removals at biologically unsustainable rates. Additionally, reduced prey abundance due to overfishing or other factors (including climate change), habitat degradation, and disturbance from low-frequency noise, constitute the most obvious threats to fin whales besides vessel interactions and fishery entanglements.

Because little evidence of entanglement in fishing gear exists, and large whales such as the fin whale may often die later and drift far enough not to strand on land after such incidents, it is difficult to estimate the numbers of fin whales killed and injured by gear entanglements. In addition, the injury or mortality of large whales due to interactions or entanglements in fisheries may go unobserved because large whales swim away with a portion of the net or gear. Fishers have reported that large whales tend to swim through their nets without entangling and causing little damage to nets (Barlow *et al.* 1997). Ship strikes are also a threat to large whales, including fin whales, although, as mentioned above, without necropsying or observing stranded or floating whales, the estimates of ship struck whales is likely a minimum.

Marine pollution is a concern for all marine mammals, but there is no evidence that levels of organochlorines, organotoxins or heavy metals in baleen whales generally (including the fin whale) are high enough to cause toxic or other damaging effects (O'Shea and Brownell 1995, *in* Reeves *et al.* 2002). The threat to fin whales due to military activities, underwater noise, pollutants, marine debris, and habitat degradation, are difficult to quantify. However, there is a growing concern that the increasing levels of anthropogenic noise in the ocean may be a habitat concern for whales, particularly for whales that use low frequency sound to communicate, such as baleen whales.

Fin whales have been the subject of field studies for decades. The primary objective of many of these studies has generally been monitoring populations to gather data for behavioral and ecological studies. Existing permits authorize investigators to make close approaches of endangered whales for photographic identification, behavioral observations, passive acoustic recording, aerial photogrammetry, and underwater observations. Research activities could result in disturbance to fin whales, but are closely monitored and evaluated in an attempt to minimize any impacts of research necessary for the recovery of fin whales. Specifically, the National Environmental Policy Act requires the development of environmental analyses to assess the potential impact of a project on protected species, and ESA and MMPA permits are required for any incidental take of fin whales.

The potential impacts of climate and oceanographic change on fin whales will likely affect habitat availability and food availability. Site selection for whale migration, feeding, and breeding for fin whales, may be influenced by factors such as ocean currents and water temperature. Any changes in these factors could render currently used habitat areas unsuitable. Changes to climate and oceanographic processes may also lead to decreased productivity in different patterns of prey distribution and availability. Such changes could affect fin whales that are dependent on those affected prey. Recent work has found that copepod distribution has showed signs of shifting in the North Atlantic due to climate changes (Hays *et al.* 2005). The feeding range of fin whales is larger than that of other species and consequently, it is likely that the fin whale may be more resilient to climate change, should it affect prey, than a species with a narrower range.

ii. Humpback Whales

Global status

The IWC first protected humpback whales in the North Pacific in 1966. They are also protected under CITES. In the U.S. humpback whales were listed as endangered under the ESA of 1973 and are therefore classified as a depleted and strategic stock under the MMPA. Critical habitat has not been designated for this species anywhere in their range.

Species description and distribution

The humpback whale is distributed worldwide in all ocean basins. They typically migrate between tropical/sub-tropical and temperate/polar latitudes, occupying tropical areas during winter months when they are breeding and calving, and polar areas during the spring, summer, and fall, when they are feeding. The humpback whale is of medium size relative to other large whales, with females and males reaching an average length of around 18 meters and 13 meters, respectively (Nitta and Naughton 1989) and a weight of approximately 40 tons at maturity (Johnson and Wolman 1984). Their body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins and belly. The variation is so distinct that the pigmentation pattern on the undersides of their flukes is used to identify individual whales. They are characterized by wing-like pectoral flippers that are from one-fourth to one-third of their total body length. Additionally, their heads are covered in tubercles, and their tail flukes have individually identifiable trailing-edge patterns. Like other balaenopterids, they have fringed baleen plates, which allow for the filtering of small crustaceans and fish.

Humpbacks primarily feed on small schooling fish, plankton, and krill (Caldwell and Caldwell 1983). It is believed that minimal feeding occurs in wintering grounds, such as the Hawaiian Islands (Balcomb 1987; Salden 1989). Humpback whales in the North Pacific feed in coastal waters from California to Russia and in the Bering Sea. They migrate south to wintering destinations off Mexico, Central America, Hawaii, southern Japan, and the Philippines. Humpback whales summer throughout the central and western portions of the Gulf of Alaska, including Prince William Sound, around Kodiak Island (including Shelikof Strait and the Barren Islands), and along the southern coastline of the Alaska Peninsula. The few sightings of humpback whales in offshore waters of the central Gulf of Alaska are usually attributed to animals migrating into coastal waters (Morris *et al.* 1983), although it has been suggested that they may use offshore banks for feeding. The continental shelf of the Aleutian Islands and Alaska Peninsula was once considered the center of the North Pacific humpback whale population (Berzin and Rovnin 1966; Nishiwaki 1966). The northern Bering Sea, Bering Strait, and the southern Chukchi Sea along the Chukchi Peninsula appear to form the northern extreme of the humpback whale's range (Nikulin 1946; Berzin and Rovnin 1966).

In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. During the winter, humpbacks mate and calve primarily in the West Indies, where spatial and genetic mixing among subpopulations occurs (Katona and Beard 1990; Clapham *et al.* 1993; Palsboll *et al.* 1995; Stevick *et al.* 1998). A few whales of unknown origin migrate to the Cape Verde Islands (Reiner *et al.* 1996). In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank, on Navidad Bank, and in Samana Bay (Balcomb and Nichols 1982; Mattila *et al.* 1989, 1994). Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc, from Puerto Rico to the coast of Venezuela (Winn *et al.* 1975; Levenson and Leapley 1978; Price 1985; Mattila and Clapham 1989).

Feeding is the principle activity of humpbacks in New England waters, and their distribution in this region has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al.* 1986, 1990). Humpback whales also use the Mid-Atlantic as a migratory pathway and apparently as a feeding area, at least for juveniles. Since 1989, observations of juvenile humpbacks in that area have been increasing during the winter months, peaking January through March (Swingle *et al.* 1993). Biologists theorize that non-reproductive animals may be establishing a winter feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean.

In their wintering grounds, humpback whales congregate and engage in mating activities. Humpback whales are generally polygynous with males exhibiting competitive behavior on wintering grounds. Gestation lasts for about 11 months. Newborns are 4 to 5 meters long and weaning occurs between 6 and 10 months after birth. Breeding usually occurs once every two years, but sometimes occurs twice in three years.

Population status and trends

Mitochondrial and nuclear genetic markers show that considerable structure exists in humpback whale populations in the North Pacific (Baker *et al.* 1998). Until recently, the North Pacific was considered to be one population but based on complexities observed through the Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific (SPLASH) study, which analyzed genetics and photographs, it appears that there is likely more than one (Calambokidis *et al.* 2008). For humpback whales, maternally directed fidelity to specific feeding areas within an ocean basin appears to be so strong that genetic differences have evolved in both the Atlantic, where there is a single breeding area, and in the Pacific, where there are multiple breeding areas. Because fidelity appears to be greater in feeding areas than in breeding areas, the stock structure of humpback whales is defined based on feeding areas.

Within the north Pacific Ocean, at least four stocks make up the north Pacific population(s): 1) the California/Oregon/Washington stock, which winters in coastal Central America and Mexico and migrates to California and southern British Columbia in summer/fall; 2) the central north pacific (CNP) stock, which winters in the Hawaiian Islands and migrates to northern British Columbia/Southeast Alaska and Prince William Sound west to Kodiak; 3) the Western North Pacific stock, which winters near Japan and migrates to waters west of the Kodiak Archipelago in summer/fall; and 4) the American Samoa stock which winters off American Samoa and largely undocumented feeding areas as far south as the Antarctic Peninsula (Carretta *et al.* 2013; Allen and Angliss 2012).

Based on whaling statistics, before 1905 the north Pacific population(s) was estimated to be 15,000 and was reduced by whaling to approximately 1,200 before it was placed under international protection in 1966 (Johnson and Wolman 1984). Since receiving protection from whaling, the north Pacific population has rebounded to approximately 21,000 individuals by 2010 (Carretta *et al.* 2013). The annual growth rate for the north Pacific population over the last several decades is estimated at 4.9 to 6.8 percent, depending on which area and time frame are considered (Calambokidis *et al.* 2008). Mark-recapture estimates of humpback whale abundance in California and Oregon have shown a long-term increase of approximately 7.5 percent per year (Calambokidis *et al.* 2009), although there have been short-term declines during this period, likely due to oceanographic variability.

In the North Atlantic, there are six populations of humpbacks that use specific areas for foraging, and these populations are genetically discrete. The total estimated North Atlantic population is estimated at around 10,000 individuals. The Gulf of Maine humpback whale stock is estimated to be 847 with a minimum population estimate of 549. This population is steadily increasing.

Aerial, vessel, and photo-identification surveys, and genetic analyses indicate that within the U.S. EEZ in the Pacific, there are at least three relatively separate populations that migrate between their respective summer/fall feeding areas and winter/spring calving and mating areas (Calambokidis *et al.* 1997; Baker *et al.* 1998). Significant levels of mitochondrial and nuclear genetic differences were found between central California and Southeast Alaska feeding areas (Baker *et al.* 1998). The genetic exchange rate between California and Alaska is estimated to be less than 1 female per generation (Baker 1992). Two breeding areas (Hawaii and coastal Mexico) showed fewer genetic differences than did the two feeding areas (Baker 1992). Individually identified whales have been found to move between winter breeding areas in Hawaii and Mexico (Baker *et al.* 1990). There have been no individual matches between 597 humpbacks photographed in California and 617 humpbacks photographed in Alaska (Calambokidis *et al.* 1997. Only two of the 81 whales photographed in British Columbia have matched with a California catalog (Calambokidis *et al.* 1996), indicating that the U.S./Canada border is an approximate geographic boundary between feeding populations. Waters off northern Washington may be an area of mixing between the California/Oregon/Washington stock and a southern British Columbia stock. Alternatively, humpback whales in northern

Washington and southern British Columbia may be a distinct feeding population (Calambokidis *et al.* 2008) and a separate stock.

A photo-identification study conducted in 2004-2006 estimated the abundance of humpback whales in the entire Pacific Basin to be approximately 18,000-20,000 (Calambokidis *et al.* 2008). Estimates of regional abundance in the California/Oregon stratum from that study (1,702) are less precise than estimates from dedicated west-coast studies. Barlow and Forney (2007) estimated 1,096 (CV=0.22) humpbacks in California, Oregon, and Washington waters based on summer/fall ship line-transect surveys in 2001. Forney (2007) estimated 1,769 (CV=0.16) humpbacks in the same region based on a 2005 summer/fall ship line-transect survey, which included additional fine-scale coastal strata not included in the 2001 survey. Barlow (2010) recently estimated 1,090 (CV=0.41) humpback whales from a 2008 summer/fall ship line-transect survey of the same region. The combined 2005 and 2008 line-transect estimate of abundance is the geometric mean of the two annual estimates, or 1,389 (CV=0.21). Calambokidis *et al.* (2009) estimated humpback whale abundance in these feeding areas from 1991 to 2008 using Petersen mark-recapture estimates based on photo-identification collections in adjacent pairs of years (Figure 2). The 2007/2008 mark-recapture population estimate for California and Oregon (2,043, CV=0.10) is higher than any previous mark-recapture estimates (Calambokidis *et al.* 2009). In general, mark-recapture estimates are negatively biased due to heterogeneity in sighting probabilities (Hammond 1986); however, this bias is likely to be minimal because the above mark-recapture estimate is based on data from nearly a third of the entire population (the 2007/2008 data contained 672 known individuals). The estimate of 2,043 humpback whales in 2007/2008 is also a negatively biased estimate of this stock because it excludes some whales in Washington. The best estimate of abundance for this stock is the mark-recapture estimate of 2,043 (CV=0.10) (Carretta *et al.* 2013), which is also the most precise estimate.

As for trends in the CA/OR/WA stock of humpbacks, ship surveys provide some indication that humpback whales increased in abundance in California coastal waters between 1979/80 and 1991 (Barlow 1994) and between 1991 and 2005 (Barlow and Forney 2007; Forney 2007), but this increase was not steady, and estimates showed a slight dip in 2001. Mark-recapture population estimates have shown a long-term increase of approximately 7.5 percent per year (Calambokidis 2009), although there have been short-term declines during this period, probably due to oceanographic variability. Population estimates for the entire North Pacific have also increased substantially from 1,200 in 1966 to approximately 18,000 to 20,000 whales in 2004 to 2006 (Calambokidis *et al.* 2008). Although these estimates are based on different methods and the earlier estimate is extremely uncertain, the growth rate implied by these estimates (6-7 percent) is consistent with the recently observed growth rate of the California/Oregon/Washington stock.

The PBR level for this stock is calculated as the minimum population size (1,878) times one half the estimated population growth rate for this stock of humpback whales (½ of 8%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 22.5. Because this stock spends approximately half of its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11.3 whales per year (Carretta *et al.* 2013).

Threats

The threat of underwater noise and other activities that occur throughout the range of humpback whales, including off U.S. west coast, apply generically across all large whale species including humpback whales. Entanglement in fishing gear poses a threat to individual humpback whales throughout the Pacific. Reports of entangled humpbacks whales found swimming, floating, or stranded with fishing gear attached have been documented in the North Pacific. The estimated impact of fisheries on this humpback whale stock is likely underestimated, since the serious injury or mortality of large whales due to entanglement in gear may go unobserved because whales swim away with a portion of the net, line, buoys, or pots.

Humpback whales, especially calves and juveniles, are highly vulnerable to ship strikes (Stevick 1999) and other interactions with non-fishing vessels. Younger whales spend more time at the surface, are less visible, and closer to shore (Herman *et al.* 1980; Mobley, Jr. *et al.* 1999), thereby making them more susceptible to collisions. Off the U.S. west coast, humpback whale distribution overlaps significantly with the transit routes of large commercial vessels, including cruise ships, large tug and barge transport vessels, and oil tankers in the proposed action area. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not have obvious signs of trauma. Several humpback whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (J. Calambokidis pers. comm., *in* Carretta *et al.* 2013).

Whale watching boats and boats from which scientific research is being conducted, specifically direct their activities toward whales and may have direct or indirect impacts on humpback whales. There is concern regarding the impacts of close vessel approaches to large whales, since harassment may occur, preferred habitats may be abandoned, and fitness and survivability may be compromised if disturbance levels are too high. While a 1996 study in Hawaii measured the acoustic noise of different whale-watching boats (Au and Green 2000) and determined that the sound levels were unlikely to produce grave effects on the humpback whale auditory system, the potential direct and indirect effects of harassment due to vessels cannot be discounted.

Similar to fin whales, humpbacks globally are potentially affected by a resumption of commercial whaling, loss of habitat, loss of prey (for a variety of reasons including climate variability), underwater noise, and pollutants. Humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989; Clapham *et al.* 1993; Atkins and Swartz 1989). Their responses to noise are variable and have been correlated with the size, composition, and behavior of the whales when the noises occurred (Herman *et al.* 1980; Watkins 1981; Krieger and Wing

1986). Several investigators have suggested that noise may have caused humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979; Dean *et al.* 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.* 1993; Wiley *et al.* 1995). In Hawaii, regulations prohibit boats from approaching within 91 m of adult whales and within 274 m in areas protected for mothers with a calf. Likewise, in Alaska, the number of cruise ships entering Glacier Bay has been limited to reduce possible disturbance.

The overall impact of pollution on habitats used by humpbacks is unknown. Concentrations of organochlorine pesticides, heavy metals, and polychlorobiphenyls (PCB's) have been reported in humpback whale tissues from the waters of Canada, United States, and Caribbean (Taruski *et al.* 1975). There is no evidence that levels of organochlorines, organotins, or heavy metals in baleen whales generally are high enough to cause toxic or other damaging effects (O'Shea and Brownell 1995). Indirect impacts from pollution could cause local depletion of prey that may occur as a result of displacement and mortality of food species. It should be emphasized, however, that very little is known about the possible long-term and trans-generational effects of exposure to pollutants.

Worldwide, commercial whale hunting was the single most significant impact on humpback whale populations, ceasing in the North Atlantic in 1955 and in other oceans in 1966. In the North Pacific, humpbacks were estimated to have been reduced by 13 percent of carrying capacity by commercial whaling (Braham 1991). In 1987, the IWC set a quota of 3 humpback whales per year for each of the years 1987 through 1989 for the Island of Bequia, St. Vincent and the Grenadines and Lesser Antilles. Humpback whales have been legally protected from commercial whaling for the last twenty or more years, and this protection continues. One of the main direct threats to humpback whale populations is the possibility that illegal whaling or resumed legal whaling will cause removals at biologically unsustainable rates.

iii. Sperm Whales

Global status

Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). They are also protected by CITES. In the U.S., sperm whales were listed as endangered when the ESA was passed in 1973. Because of this, they are listed as depleted and a strategic stock under the MMPA. Critical habitat has not been designated for sperm whales in waters off California, Oregon, and Washington, or anywhere in the U.S.

Species description and distribution

Reaching 60 feet in length and weighing up to 45 tons, the sperm whale is the largest of the toothed whales, and is one of the most widely distributed of marine mammals worldwide, between 60°N and 70°S (Leatherwood and Reeves 1983). Sperm whales have a blunt head, which is squared off and can take up to 40 percent of its body length. It has a small under slung jaw, and its eyes are relatively small. Their bodies are a dark brownish gray with a rounded or triangular hump followed by knuckles along its spine. It has the largest brain of any animal on Earth, and its blunt snout houses a large reservoir of spermaceti; a high-quality oil. Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea as far north as Cape Navarin, Russia. Mature female and immature sperm whales of both sexes are found in more temperate and tropical waters from the equator to around 45°N throughout the year. These groups of adult females and immature sperm whales are rarely found at latitudes higher than 50°N and 50°S (Rice 1989; Reeves and Whitehead 1997). Sexually mature males join these groups throughout the winter. During the summer, mature male sperm whales are thought to move north into the Aleutian Islands, Gulf of Alaska, and the Bering Sea. They are often concentrated around oceanic islands in areas of upwelling, and along the outer continental shelf and mid-ocean waters.

Population status and trends

Whitehead (2002) estimated current sperm whale abundance to be approximately 300,000–450,000 worldwide, growing at about 1 percent per year. Abundance in the Pacific is approximately 152,000–226,000 using Whitehead's 2002 methods. There are large populations of sperm whales in waters that are within several thousand miles west and south of California, Oregon, and Washington, although there is no evidence of sperm whale movements into this region from either the west or south. Analyses of genetic relationships of animals in the eastern Pacific found that mtDNA and microsatellite DNA of animals sampled in the California Current is significantly different from animals sampled further offshore and that genetic differences appeared larger in an east-west direction than in a north-south direction (Mesnick *et al.* 1999). Rendell *et al.* (2005, 2006) examined mitochondrial DNA variation among vocal clans of sperm whales from 194 individuals from 30 social groups belonging to one of three vocal clans. Results of statistical tests showed greater genetic subdivision among vocal clans than putative populations based on geography (Chile/Peru, Galapagos/Ecuador, SW Pacific) (Rendell *et al.* 2005, 2006).

The minimum population estimates for other sperm whale stocks within the U.S. EEZ are given below. There is no recent population estimate available for sperm whales in Alaska. The most recent data available is at least five years old, but suggests a population in the tens of thousands (Allen and Angliss 2012).

Table 6. Estimates of minimum sperm whale populations in the U.S.

Stock	Minimum population estimate	Population trend
North Pacific[1]	Unknown	No trend information
Hawaii stock[2]	3,805	No trend information
North Atlantic[3]	3,539	No trend information
Northern Gulf of Mexico[3]	1,409	No trend information
CA/OR/WA[2]	751	unknown

[1] Allen and Angliss 2012
[2] Carretta *et al.* 2013
[3] Waring *et al.* 2012

Sperm whales are found year-round in California waters (Dohl *et al.* 1983; Barlow 1995; Forney *et al.* 1995). They reach peak abundance from April through mid-June and from the end of August through mid-November (Rice 1974). They have been seen in every season except winter (Dec-Feb.) in Washington and Oregon (Green *et al.* 1992). A recent survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific revealed no apparent hiatus in distribution between the U.S. EEZ off California and areas farther west, out to Hawaii (Barlow and Taylor 2005).

A combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 26,300 (CV=0.81) sperm whales based on visual sightings, and 32,100 (CV=0.36) based on acoustic detections and visual group size estimates (Barlow and Taylor 2005). In the eastern tropical Pacific, the abundance of sperm whales has been estimated as 22,700 (95% C.I.=14,800-34,600; Wade and Gerrodette 1993), but this area does not include areas where sperm whales are taken by drift gillnet fisheries in the U.S. EEZ and there is no evidence of sperm whale movements from the eastern tropical Pacific to the U.S. EEZ. Barlow and Taylor (2001) also estimated 1,640 (CV=0.33) sperm whales off the west coast of Baja California. However, it is not known whether any or all of these animals routinely enter the U.S. EEZ.

Barlow and Taylor (2001) estimated 1,407 (CV=0.39) sperm whales in California, Oregon, and Washington waters during summer/fall based on pooled 1993 and 1996 ship line transect surveys within 300 nmi of the coast, while Barlow and Forney (2007) estimated 2,593 (CV= 0.30) sperm whales from a survey of the same area in 2001. A 2005 survey of this area resulted in an abundance estimate of 3,140 (CV=0.40) whales, which is corrected for diving animals not seen during surveys (Forney 2007). The most recent ship survey of the same area in 2008 resulted in an estimate of only 300 (CV = 0.51) sperm whales (Barlow 2010). This estimate is lower than all previous estimates within this region and may be due to interannual variability of sperm whale distribution in this region. The most recent estimate of abundance for this stock is the geometric mean of the 2005 and 2008 summer/autumn ship survey estimates, or 971 (CV = 0.31) sperm whales.

Clearly, large populations of sperm whales exist in waters that are within several thousand miles west and south of the California, Oregon, and Washington region; however, there is no evidence of sperm whale movements into this region from either the west or south and genetic data suggest that mixing to the west is extremely unlikely. There is limited evidence of sperm whale movement from California to northern areas off British Columbia, but there are no abundance estimates for this area. Based on the minimum population size (751) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species), the calculated PBR for the CA/OR/WA sperm whale stock is 1.5 animals per year.

Threats

Threats to sperm whales occur within the action area. A list of threats is detailed in the sperm whale recovery plan. The following section is a summary of some of the major threats to sperm whale recovery.

Historically, the major threat to sperm whales was commercial whaling. Approximately 258,000 sperm whales in the North Pacific were harvested by commercial whalers between 1947 and 1987 (*in* Hill and DeMaster 1999). However, both Japan (Kasuya 1998) and the Soviet Union (Kasuya 1998) under-reported catch of sperm whales, so a total of at least 436,000 individuals of this species were taken between 1800 and 1987. Of this total, about 33,842 sperm whales were taken by Japanese and Soviet vessels in the eastern North Pacific between 1961 and 1976, and 965 were taken in by land-based operations on the west coast of the United States between 1947 and 1971 (Ohsumi 1980). An additional 13 whales were taken by shore whaling stations between 1919 and 1926 (Clapham *et al.* 1997). Commercial whaling for sperm whales has been banned for over two decades, although there is always the possibility of illegal whaling or resumption of commercial whaling.

Entanglement in fishing gear poses a threat to individual sperm whales and overall to the CA/OR/WA sperm whale stock. The vulnerability of sperm whales to incidental entanglement in fishing gear especially gillnets set in deep water for pelagic fish (e.g., sharks, billfish, and tuna) is well documented (Di Natale and Notarbartolo di Sciara 1994; Haase and Felix 1994; Felix *et al.* 1997). Sperm whales may become entangled in fishing gear while attempting to take fish off of the gear (most often demersal long-line gear) (Angliss and Outlaw 2007). The effect of trailing fishing gear on large whale species is largely unknown. Observational studies cannot fully evaluate the potential for entanglement because many entangled animals may die at sea and thus not be seen or reported. Although instances of stomach obstruction caused by marine debris have been documented in sperm whales it is not believed to be a major threat to the species, but the unknown effect of entanglement and ingestion is unknown (NMFS 2010).

Sperm whales are also vulnerable to ship strikes as they raft on the surface after long dives. Quantifying the effects of ship-strikes on the US west coast is not possible. Harassment from whale watch boats on the US west coast is unlikely since sperm whales are not a species that are reliably seen in a given area and therefore sightings from whale watch boats are largely opportunistic.

Sperm whales are also vulnerable to marine pollution. A dramatic increase in the rate of sperm whale strandings in Western Europe since the early 1980's has raised concern that pollution might be implicated. Although tissues were analyzed for a wide range of contaminants and detailed pathological examinations were carried out, no clear link between contamination and stranding was found (Jacques and Lambertsen 1997). However, levels of mercury, cadmium, and certain organochlorines in the whale's tissues, were high enough to cause concern about toxicity and other effects (Bouquegneau *et al.* 1997; Law *et al.* 1997). Levels of contaminants in sperm whales killed off northwestern Spain indicated that the levels in females were consistently higher than those in males, a finding contrary to the usual situation in cetaceans (Aguilar 1983). The bottom-feeding habit of sperm whales, which might involve a suction mechanism, means they often ingest marine debris (Lambertsen 1997). One out of 32 sperm whales examined for pathology in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990).

A potential human-caused source of mortality is from accumulation of stable pollutants (e.g., PCBs, chlorinated pesticides (DDT, DDE, dieldrin, etc.), polycyclic aromatic hydrocarbons (PAHs), and heavy metals) in long lived, high -trophic level animals (NMFS 2010). Holsbeek *et al.* (1999) analyzed tissue samples obtained from 21 sperm whales that mass-stranded in the North Sea in 1994/1995. Their results indicated that mercury, PCB, DDE, and PAH levels were low and similar to levels reported for other marine mammals. However, cadmium levels were high, and double the reported levels in North Pacific sperm whales. While these strandings were not attributable to contaminant burdens, Holsbeek *et al.* (1999) do suggest that the stable pollutants might affect the health or behavior of North Atlantic sperm whales. Levels of organochlorine contaminants in sperm whales that stranded dead off northwestern Spain indicated that the levels in females were consistently higher than those in males; a finding contrary to the usual situation in cetaceans and intermediate between those found in fin whale and small odontocetes in the same region (Aguilar 1983).

Recently, Ocean Alliance, Inc. completed a five-year research voyage to collect baseline data on contaminants in the oceans. The team collected 955 sperm whale biopsy samples in 18 regions across the globe, with the goal of using sperm whales as global indicators of ocean contamination. The study will analyze levels of PCBs, DDT, and hexachlorobenzene in samples collected. Analysis of toxic metals contained in the samples revealed high levels of aluminum in all samples, with more significant levels in the Atlantic and Indian Oceans than in the Pacific Ocean or Mediterranean Sea. The range of chromium levels found in the sperm whale samples was much higher than previously reported for wildlife, and was higher in the Pacific and Indian Oceans than in the Atlantic Ocean or Mediterranean Sea. Previous to this study, aluminum and chromium were not considered to be major health concerns. Mercury and selenium were detected in the samples, but mercury levels were not considered to be toxic to the whales. Also detected in the samples were lead and cadmium (Ocean Alliance 2010).

Noise may disrupt sperm whale communication, navigational ability, and social patterns. Both anthropogenic and natural sounds may cause interference with these functions. The effects of anthropogenic noise are difficult to ascertain and research on this topic is ongoing. The possible impacts of the various sources of anthropogenic noise have not all been well studied on sperm whales. The severity of ship noise as a threat to the recovery of sperm whales is unknown. There have been no reported seismic-related or industry ship-related deaths or injuries to sperm whales where marine mammal observers are present, such as the Gulf of Mexico. However, it is uncertain what threat oil and gas exploration may be to the recovery of the sperm whale population. There is currently no evidence of long-term changes in behavior or distribution as a result of occasional exposure to pulsed acoustic stimuli. Furthermore, because of sperm whales' apparent role as important predators of mesopelagic squid and fish, changes in their abundance could affect the distribution and abundance of other marine species.

There is some evidence of disruptions of clicking and behavior from sonars (Goold 1999; Watkins and Scheville1975; Watkins *et al.* 1985), pingers (Watkins and Scheville 1975), the Heard Island Feasibility Test (Bowles *et al.* 1994), and the Acoustic Thermometry of Ocean Climate (Costa *et al.*1998). Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders (Watkins and Scheville 1975). Goold (1999) reported six sperm whales that were driven through a narrow channel using ship noise, echosounder, and fishfinder emissions from a flotilla of 10 vessels. Watkins and Scheville (1975) showed that sperm whales interrupted click production in response to pinger (6 to 13 kHz) sounds. They also stopped vocalizing for brief periods when codas were being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995).

Other studies identify instances in which sperm whales did not respond to anthropogenic sounds. Sperm whales did not alter their vocal activity when exposed to levels of 173 dB re 1 μPa from impulsive sounds produced by 1 g TNT detonators (Madsen and Mohl 2000). Richardson *et al.* (1995), citing a personal communication with J. Gordon, suggested that sperm whales in the Mediterranean Sea continued calling when exposed to frequent and strong military sonar signals. When Andre *et al.* (1997) exposed sperm whales to a variety of sounds to determine what sounds may be used to scare whales out of the path of vessels, sperm whales were observed to have startle reactions to 10 kHz pulses (180 db re 1 μPa at the source), but not to the other sources played to them.

The potential impacts of climate and oceanographic change on sperm whales will likely affect habitat availability and food availability. Site selection for whale migration, feeding, and breeding for sperm whales, may be influenced by factors such as ocean currents and water temperature. There is some evidence from Pacific equatorial waters that sperm whale feeding success and, in turn, calf production rates are negatively affected by increases in sea surface temperature (Smith and Whitehead 1993; Whitehead 1997). This could mean that global climate change will reduce the productivity of at least some sperm whale populations (Whitehead 1997). Any changes in these factors could render currently used habitat areas unsuitable. Changes to climate and oceanographic processes may also lead to decreased productivity, different patterns of prey distribution, and changes in prey availability. Such changes could affect sperm whales that are dependent on those affected prey. The feeding range of sperm whales is likely one of the greatest of any species on earth, and consequently, it is likely that the sperm whale may be more resilient to climate change, should it affect prey, than a species with a narrower range.

E. Sea Turtles

On October 10, 2012, NMFS announced a five year review of Kemp's ridley (*Lepidochelys kempii*), olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*) sea turtles under the Endangered Species Act of 1973, as amended (ESA) (77 FR 61573). A five year review is based on the best scientific and commercial data available at the time of the review. NMFS issued a request for information as the first part of the review process. The last review of these species occurred in 2007.

i. Leatherback Turtles

Information in this section is summarized from the 2004 biological opinion (NMFS 2004), the 5-year status review (NMFS and USFWS 2007a), the 2012 designation of critical habitat in the West Coast EEZ, and the 2012 biological opinion on Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific (NMFS 2012d) and other sources cited below.

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 collapse of some populations throughout the Pacific, such as in Malaysia and Mexico.

Species description and distribution

Leatherback turtles are the largest of the marine turtles, with a curved carapace length (CCL) of up to 140 cm (Eckert *et al.* 2012) and front flippers that are proportionately larger than in other sea turtles and may span 270 cm in an adult (NMFS and USFWS 2007a). The leatherback is morphologically and physiologically distinct from other sea turtles and easily identifiable on land and at sea.

Leatherback turtles are widely distributed throughout the oceans of the world. The species nests in three main regions of the world: the Pacific, Atlantic (including the Caribbean Sea), and Indian Oceans. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The main regional areas may further be divided into nesting populations. In the Pacific, leatherback nesting aggregations are found in the eastern and western Pacific. In the eastern Pacific, major nesting sites are located in Mexico, Costa Rica, and Nicaragua. Nesting in the western Pacific occurs at numerous beaches in Indonesia, the Solomon Islands, Papua New Guinea, and Vanuatu, with a few nesters reported in Malaysia and only occasional reports of nesting in Thailand and Australia (Eckert *et al.* 2012). In the Atlantic Ocean, leatherbacks are divided into seven groups or nesting populations that are genetically distinct: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007). In the Indian Ocean, leatherback nesting aggregations are reported in the Andaman and Nicobar Islands, India, Sri Lanka, and South Africa.

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 and neritic Pacific and in all other major pelagic ocean habitats (NMFS and USFWS, 1998a). 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 and tropical waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas for foraging in the open ocean, along continental margins, and in archipelagic waters (Morreale *et al.* 1994; Eckert 1998, 1999a; Benson *et al.* 2007a, 2011). Recent satellite telemetry studies have documented transoceanic migrations between nesting beaches and foraging areas in the Atlantic and Pacific Ocean basins (Ferraroli *et al.* 2004; Hays *et al.* 2004; James *et al.* 2005; Eckert 2006; Eckert *et al.* 2006; Benson *et al.* 2007a; Benson *et al.* 2011). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert, 1998). In the Pacific, leatherbacks nesting in Central America and Mexico migrate thousands of miles into tropical and temperate waters of the South Pacific (Eckert and Sarti 1997; Shillinger *et al.* 2008). After nesting, females from the Western Pacific nesting beaches make long-distance migrations into the a variety of foraging areas including the central and eastern North Pacific, westward to the Sulawasi and Sulu and South China Seas, or northward to the Sea of Japan (Benson *et al.* 2007a; Benson *et al.* 2011). Satellite tagging studies of leatherbacks from the western Pacific nesting population indicate that these turtles nest during different times of the year and have different migration patterns. Summer nesting turtles (July through September) have been tracked traveling to tropical and temperate northern hemisphere foraging regions including Malaysia, the Philippines, Japan and throughout the Pacific to temperate waters of the west coast of North America; inter nesters (November through February) traverse to tropical waters and temperate regions of the southern hemisphere (Benson *et al.* 2011).

Population status and trends

Leatherbacks are found throughout the world and populations and trends vary in different regions and nesting beaches. 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). A current global population estimate is not available at this time, but details on what is known of populations are provided below.

For the Indian Ocean and Southeast Asia, Nel (2012) identified four major areas of leatherback nesting; Southwest Indian Ocean, Northeast and East Indian Ocean, South China Sea and the Southwest Pacific region (discussed further below). For most of these regions, there is insufficient information to determine trends at nesting beaches. Data are available in the Southwestern Indian Ocean where the population has remained stable at less than 100 animals (Nel 2012). In the Eastern Indian Ocean numbers are low. In the South China Sea nesting occurs at remote beaches with little monitoring. This region includes the once very large nesting population at Malaysia which now is down to a few individuals observed each year (Nel 2012). Overall these regions have nesting numbers that are quite low with a total for all known nesting beaches in the low hundreds.

NMFS and the USFWS conducted an extensive review of the status of leatherbacks throughout the Atlantic in 2007. Atlantic leatherbacks are divided into seven genetically distinct populations across the eastern and western Atlantic, including the Caribbean Sea. Nesting data was available for six of the seven nesting sites. In West Africa there are insufficient years of data to determine trends as this is a large and important population with at least 30,000 nests laid along the coast of Gabon (Fretey *et al.* 2007). The analysis of the other six nesting populations indicated that populations are stable or increasing at all beaches except the Western Caribbean (TEWG 2007). The nesting beaches in the Western Caribbean are in Costa Rica and although there was not a clear increase in population, there was not a significant decline in nesting as has been observed at the nest sites on the Pacific side of Costa Rica. The most recent population estimate for the North Atlantic ranges from 34,000 to 94,000 adult leatherbacks.

In the Pacific leatherback populations are declining at all major Pacific basin nesting beaches, particularly in the last two decades (Spotila *et al.* 1996; Spotila *et al.* 2000; NMFS and USFWS 2007a). In the eastern Pacific, nesting counts indicate that the population has continued to decline since the mid 1990's leading some researchers to conclude that this leatherback is on the verge of extirpation (Spotila *et al.* 1996; Spotila *et al.*, 2000). Steep declines have been documented in Mexico and Costa Rica, the two major nesting sites for eastern Pacific leatherbacks. Saba *et al.* (2008) estimated the number of nesting females/year in Mexico were 200 animals, and similarly for Costa Rica, approximately 200 animals per year. Estimates presented at international conferences show the numbers declining even more in all of the major nesting sites in the eastern Pacific. Unlike western Pacific leatherbacks which nest year round, eastern Pacific leatherbacks all nest in the winter (December through March) and postnesting movements indicate that they stay within the eastern South Pacific (Eckert and Sarti 1997; Shillinger *et al.* 2008) and therefore are not expected to be found within the proposed action area.

The western Pacific leatherback metapopulation that nests in Indonesia, Papua New Guinea (PNG), Solomon Islands, and Vanuatu harbors the last remaining nesting aggregation of significant size in the Pacific with approximately 2700–4500 breeding females (Dutton *et al.* 2007; Hitipeuw *et al.* 2007). This 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 the addition of a number of nesting females from beaches that were not included in previous population estimates. Therefore, this is not indicative of a positive growth trend in the population. The current overall estimate for Papua Barat, Indonesia, Papua New Guinea, and Solomon Islands is 5,000 to 10,000 nests per year (Nel 2012). Although there is generally insufficient long term data to calculate population trends, in all of these areas, the number of nesting females is substantially lower than historical records (Nel 2012). This metapopulation is made up of small nesting aggregations scattered throughout the region, with a dense focal point on the northwest coast of Papua Barat, Indonesia; this region is also known as the Bird's Head Peninsula where approximately 75 percent of regional nesting occurs (Hitipieuw *et al.* 2007). Genetic results to date have found that nesting aggregations that comprise the western Pacific population all belong to a single stock (Dutton *et al.* 2007). The Bird's Head region consists of four main beaches, three that make up the Jamursba-Medi (JM) beach complex, and a fourth which is Wermon beach (Dutton *et al.* 2007).

The most recently available information on nesting numbers in northwest Papua reflects a disturbing decline. Tapilatu *et al.* (2013) estimated that the annual number of nests at Jamursba-Medi has declined 78.2 percent over the past 27 years (5.5% annual rate of decline), from 14,522 in 1984 to 1,532 in 2011. The beach at Wermon has been consistently monitored since 2002 and has declined 62.8 percent from 2,944 nests in 2002 to 1,292 nests in 2011 (11.6% annual rate of decline). Collectively, Tapilatu *et al.* (2013) estimated that since 1984, these primary western Pacific beaches have experienced a long-term decline in nesting of 5.9 percent per year. With a mean clutch frequency of 5.5 ±1.6, approximately 489 females nested in 2011.

A small number of leatherbacks nest along the east coast of Papua New Guinea along the Huon Coast. Based on Pilcher (2012) nesting data between 2000 and 2012, it appears that this area has 240 to 500 nests per year. Post nesting females from Papua New Guinea were tracked to foraging areas in the Southern Hemisphere, including the Coral Sea and the western south Pacific (Benson *et al.* 2011).

In the Solomon Islands, nesting 30 years ago occurred at more than 15 beaches (Vaughan 1981). Primary nesting beaches are now only found on Isabel Island (2 beaches), Sasakoloa and Litogarhira, with some additional nesting on Rendova and Tetepare (Dutton *et al.* 2007). Most nesting occurs from November through March. However, there is some summer nesting as evident from a foraging female caught in California in the fall, outfitted with a satellite transmitter and tracked to the Solomons, nested on Santa Isabel in May (Benson *et al.* 2011). This provides further evidence of a link between summer nesters and foraging areas off the west coast of North America. There is no long-term data to assess trends in the Solomon Islands, but the total number of nesting females is estimated to be around 100 per year (Petro *et al.* 2007).

Leatherback nesting in Vanuatu has only recently been reported (Dutton *et al.* 2007). There are low levels of nesting at four to five beaches with a total of about 50 nests laid per year (Petro 2007).

There is limited sporadic leatherback nesting activity in Vietnam and Thailand. In Australia nesting was sporadic and the last observed nesting event occurred in 1996 (Limpus 2009). The collapse of the nesting population in Malaysia has been documented through systematic beach counts or surveys in Rantau Abang, Terengganu. 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 (Chan and Lieu 1996).

Migratory routes of leatherback turtles originating from eastern and western Pacific nesting beaches are not entirely known for the entire Pacific population; 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. indicate that the leatherbacks found off the U.S. West Coast are from the western Pacific nesting populations, specifically boreal summer nesters. Given the relative size of the nesting populations, it is likely that the animals will be from the Jamursba-Medi nesting beaches, although some may come from the comparatively small number of summer nesters at Wermon in Papua Barat, Indonesia. As mentioned earlier, one female has been tracked traveling from foraging areas on the U.S. West Coast to the Solomon Islands.

Satellite tagging studies and nesting site monitoring of leatherbacks from this metapopulation indicate that turtles nest during different times of the year and have different migration patterns. Due to seasonal patterns of beach erosion, nesting occurs at Jamursba-Medi in May through September as monsoons cause the loss of beaches from November through February; nesting occurs year round at Wermon although higher numbers are recorded in the boreal winter (Hitipieuw *et al.* 2007). Similar bi-modal nesting behavior has been reported in PNG and the Solomon Islands (Benson, pers. comm. 2012). Summer nesting turtles (July through September) have tropical and temperate northern hemisphere foraging regions, while winter (November through February) nesters traverse to tropical waters and temperate regions of the southern hemisphere (Benson *et al.* 2011). Turtles nesting in Papua Barat, Indonesia during the summer months migrate through waters of Malaysia, Philippines, and Japan, across the Pacific past Hawaii to foraging grounds in temperate waters off North America, and to pelagic waters of the Kuroshio Extension or North Pacific Transition Zone (Benson *et al.* 2007a, b; Benson *et al.* 2011). The Papua Barat, Jamursba-Medi nesting population generally exhibits site fidelity to the central California foraging area (Benson *et al.* 2011; Seminoff *et al.* 2012). Based on satellite tracks of leatherbacks across the North Pacific, it is reasonable to assume that it is the summer nesting leatherbacks, particularly leatherbacks from Jamursba-Medi that are being exposed to the DGN fishery.

Based on satellite tracking data from leatherbacks nesting on Western Pacific beaches or foraging off California, some leatherbacks will move into U.S. coastal waters as early as the spring, often coming directly from foraging areas in the eastern equatorial Pacific (Benson *et al.* 2011). Leatherbacks will move into areas of high abundance and density of gelatinous prey, e.g., *Chrysaora fuscescens* and *Aurelia spp*, along the West Coast when upwelling relaxes and sea surface temperatures increase and retention areas develop (Benson *et al.* 2011). These coastal foraging areas are primarily upwelling "shadows," regions where larval fish, crabs, and jellyfish are retained in the upper water column during relaxation of upwelling. Three main areas of foraging have been documented on the U.S. west coast; in California over the coastal shelf in waters of 14-16° C, particularly off of central CA; along the continental shelf and slope off of Oregon and Washington, particularly off the Columbia River plume; and offshore of central and northern CA at sea surface temperature fronts in deep offshore areas, although this area was not regularly used (Benson *et al.* 2011). 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.* 2007b). Bioenergetics studies reveal that adults consume on average 65-117 kg jellyfish per day to meet their energetic demands (Jones *et al.* 2012). With jellyfish populations increasing in the Pacific, leatherbacks are likely not resource limited (*in* Jones *et al.* 2012), although the distribution of these dense prey patches may cause leatherbacks, which are primarily prey specialists, to concentrate in particular hot spots, as described above.

Threats

Threats to leatherbacks are detailed in the recent 5-year status review (NMFS and USFWS 2007a). The primary threats identified are fishery bycatch and impacts at nesting beaches, including nesting habitat, direct harvest and predation.

Leatherback are vulnerable to bycatch in a variety fisheries, including longline, drift gillnet, set gillnet, bottom trawling, dredge, and pot/trap fisheries that are operated on the high seas or in coastal areas throughout the species' range. On the high seas, bycatch in longline fisheries is considered a major threat to leatherbacks. There are U.S. flagged and international vessels participating in longlining for various HMS species, particularly tuna, shark and swordfish. Pan and Chan (2012) compiled a list of countries using longline to target HMS and sea turtle bycatch rates; the countries fishing in the Pacific included Panama, Mexico, Chile, Ecuador, Costa Rica, Australia, and Japan. The western and central Pacific Ocean (area west of 150°W longitude, and between 10°N and 45°S) 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

(10°N - 10°S). Annual tuna catches in this area have averaged around 1.5 million metric tons, with around 60 percent of the catch captured by purse seine vessels.

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.

The Hawaii longline fishery, which re-opened in 2004, is subject to a number of management measures that were designed to minimize bycatch and post-hooking mortality. The 2004 management measures have proven to reduce leatherback interaction rates by 83 percent (Gilman *et al.* 2007a, WPFMC 2008). Since the shallow-set fishery re-opened in 2004, 51 leatherbacks were taken through the November 18, 2011 closure (NMFS 2012a). Based on NMFS' post-hooking mortality criteria (Ryder *et al.* 2006), post-hooking mortality of leatherbacks in this fishery is 22.0 percent (NMFS 2012d), or 12 individuals. The Hawaii deep-set fishery occasionally interacts with leatherbacks and has an incidental take statement for up to 39 anticipated leatherback interactions and 18 anticipated mortalities over a three year period (NMFS 2005). In the deep-set fishery from 2005-2010, 17 (rounded up from 16.57) mortalities are estimated to have occurred (NMFS 2012d). Since 2004, the Hawaii-based longline fisheries combined have reduced their estimated mortality to five annually (NMFS 2012d). However, other longline fisheries operating out of other countries are still using traditional methods (J style hooks with squid bait), and are likely killing at least hundreds of leatherbacks annually in the Pacific although it is difficult to precisely quantify since bycatch rates for many international fisheries are not available. In addition, coastal fisheries using gillnets or trap nets are also resulting in high mortality (NMFS and USFWS 2007a).

At nesting sites, population declines are primarily the result of a wide variety of human activities, including legal harvests and illegal poaching of adults, immature animals, 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 feral pigs foraging on nesting beaches associated with human settlement and commercial development of coastal areas. 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 (*in* Eckert *et al.* 2012).

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 bioenergetics, thermoregulation, and foraging success during the oceanic phase of their migration and prey availability (Robinson *et al.* 2008; Saba *et al.* 2012). Based on climate change modeling efforts in the eastern tropical Pacific Ocean, for example, Saba *et al.* (2012) predicted that the Playa Grande (Costa Rica) nesting population would decline 7% per decade over the next 100 years. Changes in beach conditions were the primary driver of the decline, with lower hatchling success and emergence rates (estimated by Tomillo *et al.* (2012) to be a 50-60% decline over 100 years in that area. Climate change prediction models coupled with satellite tagged leatherbacks in the northeastern Pacific showed slightly favorable habitat over 100 years. Given that they are prey specialists, however, it was researchers found it difficult to how potential changes in prey distribution would affect this foraging population due to climate change (Hazen *et al.* 2012). Unlike other sea turtle species which may be prey limited due to climate changes to their forage base, leatherbacks feed primarily on jellyfish and some species are expected to increase in abundance due to ocean warming (Brodeur *et al.* 1999; Attrill *et al.* 2007; Purcell *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 relatively short temporal scale of the proposed action, climate change related impacts are not considered significant.

Marine debris is also a source of mortality to all species of sea turtles because small debris can be ingested and larger debris can entangle animals leading to death. Marine debris is defined by NOAA as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment. Manmade materials like plastics, micro plastics, and derelict fishing gear (e.g., ghost nets) that may impact turtles via ingestion or entanglement can reduce food intake and digestive capacity, cause distress and/or drowning, expose turtles to contaminants, and in some cases cause direct mortality (Arthur *et al.* 2009; Balazs 1985; Bjorndal *et al.* 1994; Bugoni *et al.* 2001; Doyle *et al.* 2011; Keller *et al.* 2004; Parker *et al.* 2011; Wabnitz and Nichols 2010). All marine turtles have pelagic stages; including when they leave the nesting habitat as hatchlings and enter a period known as the "lost years" that can last for years or decades (Lutz and Musick 1997; Zug 2002). While the impact of marine debris to Pacific turtles during pelagic life stages is currently unquantified, it is quite likely that impacts may be severe given the increase of plastics and other debris and pollution entering the marine environment over the past 20-30 years (Arthur *et al.* 2009; Doyle *et al.* 2011; Stewart *et al.* 2011; NMFS and USFWS 2007a-d; Hutchison and Simmonds 1992; Mrosovsky *et al.* 2009; Wabnitz and Nichols 2010).

The addition of debris from the earthquake and tsunami that hit Japan in March 2011 increases concern due to the large amount of debris that entered the water in a short time. The Japanese government estimated that 25 million tons of debris was generated but there is no confirmed estimate of how much entered the water, and little information as to the type of debris that entered the water. It is believed that it is highly unlikely that the debris is radioactive for several reasons; the vast majority of the debris was many miles away from the reactor that leaked, the leak of contaminated water from the reactor into the sea started days to weeks after the debris was washed out to sea, and vessels coming into the U.S. from Japan were monitored for radiation, and readings were below the level of concern. The large debris field that was initially generated has broken up so it is no longer visible by satellite, which means that it can no longer be monitored so the location of the debris is unknown and projections of when it will reach shore can only be predicted using models that take into account oceanic and wind conditions (NOAA Marine Debris Program). For leatherbacks, the greatest risk posed by marine debris is in the pelagic environment but there is no information to quantify what the impact will be.

Conservation

Since the 1980's considerable effort has been made to document and reduce the amount of bycatch in fisheries, particularly U.S. fisheries. Observer programs have been implemented in most U.S. fisheries that interact with leatherbacks to assist in quantifying impacts and also develop alternative gear and techniques to reduce impacts. These include development and implementation of large circle hooks with alternative bait in longline fisheries, and training with de-hooker gear. In the Hawaii based shallow set longline fishery, bycatch of leatherbacks has been reduced by 83 percent (Gilman *et al.* 2007a). On the east coast, Turtle Excluder Devices (TEDs) are used to provide a means of escape for sea turtles (including juvenile leatherbacks) that may get caught in trawl gear. The U.S. has worked internationally to export these gear modifications to other fisheries in order to reduce the overall bycatch of sea turtles globally, including a recent effort to help fishermen in Morocco switch from net fishing to buoy gear to target swordfish (C. Heberer, NMFS, personal communication, 2012).

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

Community-based village rangers at Wermon and Jamursba-Medi in Papua Barat have been hired over the past decade to collect population demographic data (tag turtles and record nesting activity). Through their presence on the beach, projects have been able to guard leatherback nests from predation by feral pigs and egg collectors, but this remains a significant problem. In Wermon, for example, during the 2006-07 nesting season the project used a few bamboo grids over nests as protection from dog predation (Bellagio Steering Committee 2008), however alternative protection measures are being investigated. Bamboo grids have been an effective conservation measure for the PNG project (Pilcher 2006). Prior to 2002, 100 percent of nests laid at Wermon beach were lost as a result of harvest (60%) or predation (40%) (Starbird and Suarez 1996). Therefore, as a result of monitoring efforts the Wermon project may have protected over 12,000 nests that have been laid since the project's inception (NMFS 2012d). Community support in the form of scholarships and church repairs has been provided to encourage local participation in leatherback conservation. Other community-based initiatives are currently being developed and coordinated among the groups working in Papua. From 2003 to 2007, the WPFMC supported a project at the Kei Kecil Islands, part of the Moluku Islands (Indonesia), to assess and help reduce traditional harvest of adult leatherbacks in coastal foraging habitats. Suarez and Starbird (1995) estimated that this traditional fishery captured at least 100 leatherbacks per year, however, the Kei Islands project acquired a more accurate harvest estimate of less than 50 turtles per year with the majority being juveniles or subadults (Lawalata and Hitipeuw 2006).

In PNG, a community-based program has monitored nesting activity, implemented conservation measures to protect nests from dog predation (e.g., bamboo grids), and has worked to reduce localized harvest through community development incentives (CDI) since its inception in 2003. Through CDI, communities at large experience the benefits of the leatherback turtle project over time even if they themselves have not personally gained (financially or otherwise) from the project's existence, but in many cases may have relinquished resource utilization by agreeing to participate in conservation efforts (e.g., no harvest). CDI projects to date have included repairing or improving fresh water supplies, building or expanding school facilities, repairing traditional village meeting houses, and developing or improving church and aid outpost facilities (Pilcher 2012). As a result, nest predation and harvest of eggs has been reduced and hatchling production has increased over time in associated communities from close to 0 percent to approximately 70 percent as a result of the CDI program and concurrent efforts to implement nest protection measures (Pilcher 2009). During the 2010-11 nesting season, the average hatching success rate was quantified to be 44.0 percent, resulting in an overall conservative estimate of 80,000 hatchlings released since the project's inception (Pilcher 2012; NMFS 2012d).

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

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

The conservation and recovery of leatherback turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the FAO Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, CITES, and others. In 2008 the Western and Central Pacific Fisheries Commission (WCPFC) adopted a Conservation and Management Measure (CMM 2008-03) to mitigate the impacts on turtles from longline swordfish fisheries in the Western Central Pacific Ocean. The measure includes the adoption of FAO guidelines to reduce sea turtle mortality through safe handling practices and to reduce bycatch by implementing one of three methods by January 2010. The three methods to choose from are: 1) use only large circle hooks, 2) use whole finfish bait, or 3) use any other mitigation plan or activity that has been approved by the Commission. As a result of these designations and agreements, many intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been reduced at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to reduce the take of turtles in foraging areas (Gilman *et al.* 2007b; NMFS and USFWS 2007a).

ii. North Pacific Ocean DPS Loggerhead Turtles

Global status

On September 22, 2011, the USFWS and NMFS published a final rule listing nine distinct population segments (DPS) of loggerhead sea turtles (76 FR 58868). The North Pacific Ocean DPS of loggerheads was listed as endangered. In the proposed action area, loggerheads comprise the North Pacific Ocean DPS, thus this biological opinion will focus on the status of this DPS.

Species description and distribution

The loggerhead belongs to the family Cheloniidae. Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters.

Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics. Natal homing of female loggerheads to nesting beaches maintains regional population structure.

Loggerheads can be distinguished by their relatively large head and beak compared to other hard-shelled turtles. And the carapace of adult and juvenile loggerheads is reddish-brown. Mean straight carapace length (SCL) of nesting females in Japan ranged from 83.2 to 85.6 centimeters (Kamezaki 2003).

Juvenile loggerheads originating from nesting beaches in the western Pacific Ocean appear to use oceanic developmental habitats and move with the predominant ocean gyres for several years before returning to their neritic foraging habitats (Pitman 1990; Bowen *et al.* 1995; Musick and Limpus 1997). The actual duration of the juvenile stage varies with loggerheads leaving the oceanic zone over a wide size range. Snover (2002) suggested a long oceanic juvenile stage duration for Northwest Atlantic loggerheads with a range of 9–24 years and a mean of 14.8 years over similar size classes. In the North Pacific, juvenile loggerheads do not disperse to neritic habitats until larger than around 60 cm (24 in) SCL (Ishihara *et al.* 2011). Adults may also periodically move between neritic and oceanic zones (Harrison and Bjorndal 2006). Hatase *et al.* (2002) used stable isotope analyses and satellite telemetry to demonstrate that some adult female loggerheads nesting in Japan inhabit oceanic habitats rather than neritic habitats. Kobayashi *et al.* (2011) identified that 34 non-reproductive loggerheads (size 64.0–92.0 cm (25.2–36.2 in) SCL) originally captured and satellite tagged in Taiwan spent portions of their time in neritic habitats of 12 nations, exhibiting a quasi-resident behavior between Taiwan, China, Japan, and South Korea, and 12.5 percent of their time in the high seas.

Tagging studies in the central North Pacific indicate that juvenile loggerheads are shallow divers that forage at depths between 0 and 100 m (0 and 328 ft) (Polovina *et al.* 2003; Polovina *et al.* 2004). Analysis of data from 17 juvenile loggerheads equipped with satellite-linked depth recorders foraging within the Kuroshio Extension Bifurcation Region (KEBR) of the North Pacific Transition Zone Chlorophyll Front suggest turtles may spend more than 80 percent of their time at depths less than 5 m (16.4 ft), and more than 90 percent of their time at depths less than 15 m (49.2 ft) (Howell *et al.* 2010). Diet analysis of 52 loggerhead sea turtles collected as bycatch from 1990 to 1992 in the high-seas driftnet demonstrated that these turtles fed predominately at the surface (Parker *et al.* 2005).

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 percent of the total clutches deposited by loggerheads in Japan (Kamezaki *et al*. 2003).

Loggerheads that have been documented off the U.S. west coast and southeastern Alaska are primarily found south of Point Conception, California in the Southern California Bight. In Alaska, only two loggerheads have been documented since 1960, with one carcass found in December 1991 off Shuyak Island (north of Kodiak Island) and one loggerhead sighted off Cape Georgena in July 1993 (both areas south of 60° N. lat. and east of 160° W. long.) (Hodge and Wing 2000). In Oregon and Washington, records have been kept since 1958, with nine strandings recorded over approximately 54 years (less than one stranding every 6 years) (NMFS Northwest Region stranding records database, 1958–2012, unpublished data).

A comparison of the physical and biological features within the Southern California Bight under El Niño and non-El Niño conditions with those in central Baja California reveals significant differences. This helps explain why loggerheads are found primarily off Baja and rarely off southern California. South of Point Eugenia on the Pacific coast of Baja California and particularly within the shelf waters of Ulloa Bay, pelagic red crabs have been found in great numbers, attracting top predators such as tunas, whales and sea turtles, particularly loggerheads (Blackburn 1969; Pitman 1990; Wingfield *et al.* 2011). This area is highly productive due to its unique geomorphological and physical oceanographic features, which promote upwelling. Within Ulloa Bay, water is recirculated in the upwelling shadow, providing warmer SSTs. Indeed, spatial analysis showed that three environmental conditions (SSTs, chlorophyll-a, and frontal probability) were significant to turtle presence. Within Ulloa Bay, this front, created by the convergence between cold and warm water, enhances prey abundance and, maintains high densities of red crabs in the nearshore area. Thus, foraging opportunities and thermal conditions are optimal for loggerhead sea turtles (Wingfield *et al.* 2011) and these turtles have been documented in the thousands in this area off Baja California (Pitman 1990; Seminoff *et al.* 2006). Pitman (1990) found loggerhead distribution off Baja to be strongly associated with the red crab, which often occurred in such numbers as to "turn the ocean red."

Allen *et al.* (2013) reported a significant difference in stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios between eight loggerheads bycaught by the California drift gillnet fishery in the Southern California Bight and loggerheads in Baja, Mexico. The team also found that isotope rations of Southern California Bight turtles were highly similar to those of loggerheads sampled in the central Pacific. However, of hundreds of loggerheads foraging in oceanic and neritic habitats of the North Pacific that have been studied via satellite telemetry (Polovina *et al.* 2003; Polovina *et al.* 2004; Polovina *et al.* 2006; Kobayashi *et al.* 2008; Howell *et al.* 2010; Nichols *et al.* 2000; Peckham *et al.* 2011), few turtles exhibited movements toward the U.S. west coast or toward the Baja California Peninsula. Further review of the loggerhead tagging database of turtles tagged in the central north Pacific showed only 2 out of 54,655 track records showed up in the U.S. west coast EEZ (Kobayashi 2012, pers. comm). In addition, Peckham *et al.* (2011) reported that of 40 loggerheads outfitted with satellite transmitters off the Baja peninsula, none of the turtles traveled north to southern California.

Population status and trends

The North Pacific loggerhead DPS nests primarily in Japan (Kamezaki *et al.* 2003), although low level nesting may occur outside of Japan in areas surrounding the South China Sea (Chan *et al.* 2007; Conant *et al.* 2009). Nesting beach monitoring in Japan began in the 1950s on some beaches, and grew to encompass all known nesting beaches starting in 1990 (Kamezaki *et al.* 2003). Along the Japanese coast, nine major nesting beaches (greater than 100 nests per season) and six "submajor" beaches (10–100 nests per season) exist, including Yakushima Island where 40 percent of nesting occurs (Kamezaki *et al.* 2003). Census data from 12 of these 15 beaches provide composite information on longer-term trends in the Japanese nesting assemblage. As a result, Kamezaki *et al.* (2003) concluded a substantial decline (50–90%) in the size of the annual loggerhead nesting population in Japan since the 1950s. As discussed in the 2011 final ESA listing determination, current nesting in Japan represents a fraction of historical nesting levels (Conant *et al.* 2009; 76 FR 58868). Nesting declined steeply from an initial peak of approximately 6,638 nests in 1990–1991, to a low of 2,064 nests in 1997. During the past decade, nesting increased gradually to 5,167 nests in 2005 (Conant *et al.* 2009), declined and then rose again to a record high of 11,082 nests in 2008, and then 7,495 and 10,121 nests in 2009 and 2010, respectively (STAJ 2008, 2009, 2010). At the November 2011 Sea Turtle Association of Japan annual sea turtle symposium, the 2011 nesting numbers were reported to be slightly lower at 9,011 (NMFS 2012d - Asuka Ishizaki, pers. comm. November 2011).

Thus, for the 20-year period 1990-2010, the total number of nests per year for the North Pacific DPS ranged between 2,064 – 11,082 nests. Assuming a clutch frequency of four nests per female per year (Van Houtan 2011), the number of nesting females recorded per year between 1990 and 2010 ranged between 516 – 2,771. The total number of adult females in the population was estimated at 7,138 for the period 2008-2010 by Van Houtan (2011).

Threats

A detailed account of threats of loggerhead sea turtles around the world is provided in recent 5-year status 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 DPS 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. Destruction and alteration of loggerhead nesting habitats are occurring throughout the species' range, especially coastal development, beach armoring, beachfront lighting, and vehicular/ pedestrian traffic. Coastal development includes roads, buildings, seawalls, etc., all of which reduce suitability of nesting beaches for nesting by reducing beach size and restricting beach migration in response to environmental variability. Beach armoring is typically done to protect coastal development from erosion during storms, but armoring blocks turtles from accessing nesting areas and often leads to beach loss (NMFS and USFWS 2007b).

In Japan, where the North Pacific loggerhead DPS nests, many nesting beaches are lined with concrete armoring, causing turtles to nest below the high tide line where most eggs are washed away unless they are moved to higher ground (Matsuzawa 2006). Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. In Japan, threats to nesting and nest success include light pollution, poorly managed ecotourism operations, and trampling due to the thriving tourist economy on Yakushima Island, and increasing numbers of beachfront hotels and roadways (Kudo *et al.* 2003). Overall, the Services have concluded that coastal development and coastal armoring on nesting beaches in Japan are significant threats to the persistence of this DPS (76 FR 58868; September 22, 2011).

Deliberate hunting of loggerheads for their meat, shells, and eggs is reduced from previous levels, but still exists. The North Pacific loggerhead DPS nests almost exclusively in Japan, especially on Yakushima Island. In 1973, a law was enacted on Yakushima Island prohibiting harvest of sea turtle eggs. A similar law was enacted in 1988 encompassing most of the other loggerhead nesting beaches in Japan, resulting in great reductions in egg harvest. The 1973 law may in part explain the increasing number of nesting turtles from 2001 to 2011, given that loggerheads mature in about 25 years (Ohmuta 2006). Predation of eggs also occurs, for example by raccoons and feral animals in Japan (NMFS and USFWS 2007b, and STAJ 2011). While sea turtles have been protected in Mexico since 1990 (Conant *et al.* 2009), studies have shown that loggerheads continue to be caught, both indirectly in fisheries and by a directed harvest of juvenile turtles (Peckham *et al.* 2007).

For both juvenile and adult individuals in the ocean, bycatch in commercial fisheries, both coastal and pelagic fisheries (including longline, drift gillnet, set-net, bottom trawling, dredge, and trap net) throughout the species' range is a major threat (Conant *et al.* 2009). Specifically in the Pacific, bycatch continues to be reported in gillnet and longline fisheries operating in 'hotspot" areas where loggerheads are known to congregate (Peckham *et al.* 2007). Interactions and mortality with coastal and artisanal fisheries in Mexico and the Asian region likely represent the most serious threats to North Pacific loggerheads (Peckham *et al.* 2007; Ishihara *et al.* 2009; Conant *et al.* 2009). More work is necessary to understand and quantify the impact of these Baja fisheries and to develop measures to reduce bycatch mortality. Between 2003 and 2010, annual stranding surveys to assess mortality have documented 3,096 dead loggerhead turtles (with a mean of 420 ± 274/yr) along 45 km stretch of beach of Playa San Lazaro in Baja California SUR, Mexico (Peckham 2010).

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

In the North Pacific, prior to 2001, longline vessels operating out of Hawaii are estimated to have captured 417 loggerheads per year (McCracken 2000). Applying a 40 percent mortality rate (Gilman 2007a) yields an average annual mortality of 167 loggerheads in the longline fishery. The shallow set longline component of the HI based longline fishery was closed in 2001 and re-opened in 2004 with mandatory measures to reduce sea turtle bycatch, particularly loggerheads. Over the past seven years, there have been seven loggerhead mortalities in the shallow set longline fishery which has 100 percent observer coverage (NMFS 2012d). In 2012, NMFS issued a new biological opinion on the shallow-set fishery which anticipates up to 34 interactions with 7 mortalities, per year. The Hawaii-deep set fishery occasionally interacts with loggerheads and has an incidental take statement for up to 18 anticipated loggerhead interactions and 9 anticipated mortalities over a three year period (NMFS 2005). The deep-set longline fishery is estimated to have caused the mortality of 9 loggerheads from the period of 2005 through 2010. Observer records indicate that loggerheads are more susceptible to being taken in the shallow set longline fishery than the deep-set longline fishery. The results of changing fishing techniques in the shallow-set longline fishery, i.e., much lower annual mortalities, are encouraging and many other countries have begun to adopt these or similar measures to reduce sea turtle bycatch, but many countries have not and as noted above, the level of sea turtle mortality within the North Pacific cannot be quantified.

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). 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 affect 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 nest 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).

Recent efforts have examined potential relationships between significant climate/environmental variables and influences on turtle populations. Van Houtan and Halley (2011) identified correlations between loggerhead nesting patterns and two strong environmental influences: sea surface temperature and the Pacific Decadal Oscillation index of ocean circulation (also in NMFS 2012d). The mechanisms that could influence loggerhead survival at important stages are logical, and this is a promising avenue of research. Relating environmental variance into population dynamics will be an important step in trying to understand the fate of marine species such as sea turtles. However, 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.

As mentioned in the leatherback threats section, marine debris, including debris resulting from the 2011 earthquake and tsunami that took place off Japan, threatens the North Pacific DPS of loggerheads through ingestion and entanglement.

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 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 beach 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 (NMFS 2013a). 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.

iii. Green Turtles

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 NMFS and USFWS (2007) 5-year status 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 and USFWS 2007c). 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 percent 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 percent. Causes for this decline include harvest of eggs, subadults and adults, incidental capture by fisheries, loss of habitat, and disease.

There are numerous populations with different status under the ESA. The central Pacific population also includes green turtles nesting in other archipelagos, such as Federated States of Micronesia and the Marshall Islands, and at least some of these sub-populations appear to be declining (Maison *et al.* 2010). The eastern Pacific population includes turtles that nest on the coast of Mexico, which are listed under the ESA as endangered. The western Atlantic population includes turtles that nest in Florida, which are listed under the ESA as endangered. All other green turtles (including those in the eastern Pacific population that nest outside of Mexico, and those in the western Atlantic population that nest outside of Florida) are listed as threatened. NMFS has recently established a biological review team to evaluate the status of the populations of green turtles to determine if nesting populations should be divided in to distinct population segments (similar to the agency's action on loggerhead sea turtles) and whether the listing status of some of the populations should be changed.

Species description and 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 1998b). 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 2000).

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 southern 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 southern California and along the Pacific coast of Baja California originate primarily from rookeries of the Islas Revillagigedos (Dutton 2003).

Population status and trends

NMFS and USFWS (2007c) 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, and 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). The overall nesting female population, based upon the mean annual reproductive effort, is estimated to be between 108,761 and 150,521. A 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 (NMFS and USFWS 2007c).

Green turtles are also known to migrate long distances from nesting areas to feeding grounds. In the Atlantic Ocean, green turtles migrated 2,200 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). Green turtles may be found within the action area nest in the 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 1998b). 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).

An estimated 3,319 – 3,479 eastern Pacific females nested annually (NMFS and USFWS 2007c), and nesting has been steadily increasing at the primary nesting sites in Michoacan, Mexico, and in the Galapagos Islands since the 1990s (Delgado and Nichols 2005; Senko *et al.* 2011). Recent information suggests that up to 10,000 nesting females may nest annually at Michoacan (SWOT 2011). Colola beach is the most important green turtle nesting area in the eastern Pacific; it accounts for 75 percent of total nesting in Michoacan and has the longest time series of monitoring data since 1981. Nesting trends at Colola have continued to increase since 2000 with the overall eastern Pacific green turtle population also increasing at other nesting beaches in the Galapagos and Costa Rica (Wallace *et al.* 2010; NMFS and USFWS 2007c).

Two populations of green turtles are found in two areas adjacent to the proposed action area and may be affected by the proposed action. South San Diego Bay serves as important habitat for a resident population of up to about 60 juvenile and adult green turtles in this area (Eguchi *et al.* 2010). There is also an aggregation of green sea turtles that appear to be persistent in the San Gabriel River and surrounding coastal area in the vicinity of Long Beach (Lawson *et al.* 2011). This group of turtles has only recently been identified and very little is known about their abundance, behavior patterns, or relationship with the population in San Diego Bay.

Threats

A thorough discussion of threats to green turtles worldwide can be found in the most recent 5-year review (NMFS and USFWS 2007c). Major threats include: coastal development and loss of nesting and foraging habitat; incidental capture by fisheries; and 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 2007c).

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 2007c). 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 2007c).

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

Marine debris is also a source of concern for greens due to the same reasons described for loggerheads. Green sea turtles can ingest small debris and larger debris can entangle animals leading to death.

Based upon available information, it is likely that green sea turtles may be affected by climate change, although no significant climate change-related impacts to green turtle populations have been observed to date. However, impacts from climate change are likely to influence biological trajectories in the future over the long-term, on a century scale (Paremsan and Yohe 2003). 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) similar to what has been observed during El Nino events in the western Pacific (Limpus and Nicholls 1994; Chaloupka 2001).

At this time, it is not possible to predict the impacts of future climate change on green turtles. The existing data on past trends and current scientific methods are not able to reliably predict the future magnitude of climate change and associated impacts or the adaptive capacity of this species (Hawkes *et al.* 2009; NMFS 2012d). 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.

As mentioned in the leatherback threats section, marine debris, including debris resulting from the 2011 earthquake and tsunami that took place off Japan, threatens green turtles through ingestion and entanglement.

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 2007c). 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.* 2007b).

iv. Olive Ridley Turtle

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.

Species description and 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 (NMF and USFWS 2007d).

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).

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 percent 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).

The eastern Pacific population is thought to be increasing, while there is inadequate information to suggest trends for other populations. The global status of olive ridleys is described in the 5-year status review (NMFS and USFWS 2007d). Eastern Pacific olive ridleys nest primarily in large *arribadas* on the west coasts of Mexico and Costa Rica. Since reduction or cessation of egg and turtle harvest in both countries in the early 1990s, annual nest totals have increased substantially. On the Mexican coast alone, in 2004-2006, the annual total was estimated at 1,021,500 – 1,206,000 nests annually (NMFS and USFWS 2007d). Eguchi *et al.* (2007) counted olive ridleys at sea, leading to an estimate of 1,150,000 – 1,620,000 turtles in the eastern tropical Pacific in 1998-2006. The 5-year status review (NMFS and USFWS 2007d) describes *arribadas* occurring in northeastern India at Gahirmatha and Ryshikulya, with 1,000 to 100,000 turtles and 10,000 to 200,000 turtles, respectively, occurring per *arribada*. A number of other locations in western and eastern India are also described as sites of potential solitary nesting activity, but nesting activity is unquantified at these locations (NMFS and USFWS 2007d). Survey effort on India beaches has fluctuated over the years and methods used to census nesting populations have also changed. As a result, reported trends and abundance numbers may be somewhat speculative and potentially unreliable. The most reliable abundance estimate for Gahirmatha during the 1999 *arribada* was approximately 180,000 nesting females, with long-term data indicating the population may be in decline (NMFS and USFWS 2007c). In contrast, there are no known *arribadas* of any size in the western Pacific, and apparently only a few hundred nests scattered across Indonesia, Thailand and Australia (Limpus and Miller 2008). Data are not available to analyze trends (NMFS 2005; NMFS and USFWS 2007d).

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

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. This is a large population. 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)). 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).

Threats

Threats to olive ridleys are described in the most recent five year status review (NMFS 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 deep-set long line 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 and 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; NMFS 2012d). 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.

As mentioned in the leatherback threats section, marine debris, including debris resulting from the 2011 earthquake and tsunami that took place off Japan, threatens olive ridleys through ingestion and entanglement.

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.* 2007b; NMFS and USFWS 2007d). 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.

IV. ENVIRONMENTAL BASELINE

The environmental baseline for a biological opinion includes past and present impacts of all state, federal or private actions and other human activities in the action area, anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). Information provided in this section comes from a review of the NMFS Southwest Region (SWR) and Northwest Region (NWR) marine mammal and sea turtle stranding databases, biological opinions, current scientific research permits, the 2012 SARs, the draft negligible impact determination (draft NID; NMFS 2013b) and other material as cited below. Section 101(a)(5)(E) of the MMPA (16 U.S.C. 1361 *et seq.*) states that NMFS shall allow for a period of up to three years the incidental taking[11] of marine mammal species listed under the ESA by persons using vessels of the United States or vessels which have valid fishing permits issued by the Secretary in accordance with section 204(b) of the MSA, while engaging in commercial fishing operations, after certain criteria are met, including a determination that the incidental mortality and serious injury from commercial fisheries will have a negligible impact on the affected species or stock. The draft NID is the document that contains the analysis required under MMPA that allows NMFS to issue authorization under the MMPA for the incidental take of ESA-listed marine mammals by the DGN fishery.

A. Whales

As described above in the status section, fin, humpback, and sperm whales have been and continue to be, affected by numerous activities within the proposed action area. Because impacts

[11] Under NMFS' regulations implementing the MMPA, "take" is defined, in part, as "harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect or kill any marine mammal." 50 CFR 216.3.

on all three species are similar, we look at the environmental baseline on all three species together, calling out differences among species as appropriate. Although the whales considered in this biological opinion are not listed as distinct population segments, they are identified by stock as required under the MMPA. The affected stocks are the CA/OR/WA stock of fin whales, the CA/OR/WA stock of sperm whales, and the CA/OR/WA stock of humpback whales.

Fisheries Interactions

Of the three large whales considered in this Opinion, fin whales are least commonly reported interacting with fishing gear off the U.S. west coast, perhaps due to their larger size and speed, which may cause them to break through fishing gear (Carretta *et al.* 2013). There is only one report of a fin whale observed entangled in gear: in 1999 a fin whale was entangled in the drift gillnet fishery that is the subject of this opinion. There have been three reports of fin whales observed with fishing gear on them, although the gear and fishery have not been identified. In 2006, a fin whale was killed by a ship strike and stranded off of Washington with brown rope wrapped around its mouth that may have impeded feeding. In 2009, one fin whale was observed off of Long Beach in Los Angeles County, California, towing unidentified fishing gear. The gear was wrapped around the body between the blow hole and the dorsal fin. Also in 2009, off of San Diego, California, a fin whale was observed with approximately 300 feet of polypropylene line attached to a buoy and wrapped around the caudal peduncle. In both instances, the fate of the animal is unknown. According to the 2011 SAR, the CA thresher shark/swordfish DGN fishery is the only fishery that has been identified as taking (i.e., mortality) a fin whale from the CA/OR/WA stock (Carretta *et al.* 2013).

There are a number of estimates available on the number of CA/OR/WA fin whales seriously injured or killed in commercial fisheries off the U.S. west coast. The most recent SAR provide the estimated total (and thus annual) five year rate of serious injury/mortality for fin whales fro 2004 through 2008 as zero (Carretta *et al.* 2013). NMFS also prepares an annual report with extrapolated bycatch for the DGN fishery based upon observations per year. In order to consider the most recent available information, the draft NID and the estimates therein were used for this biological opinion. The total serious injury and mortality in commercial fisheries from 1998 through 2011 is four fin whales, with an average of 0.3 animals per year. It is important to remember that the different of sources of NMFS estimates for marine mammal bycatch are derived using different approaches in the duration of time considered and methodologies employed, per the directives of those sources and their immediate purposes for use (e.g., SAR estimates are used for the List of Fisheries categorization of marine mammal bycatch impacts for individual fisheries). This Opinion considers these estimates as relevant information in the *Environmental Baseline*, but will rely upon the bycatch estimation approach described in the *Effects of the Action* section to describe the anticipated impacts of the DGN fishery going forward.

Sperm whales have been observed interacting with the DGN that is the subject of this opinion. After the 1997 implementation of the PCTRP, overall cetacean entanglement rates in the fishery dropped considerably (Barlow and Cameron 2003). Since the implementation of the PCTRP, one sperm whale was observed incidentally caught in 1998. This animal died in a net off central California which did not have the full complement of pingers. In late 2010, an observer recorded two sperm whales entangled in the CA thresher shark/swordfish DGN fishery. One animal was found dead and the other was released alive, but seriously injured with gear attached. The whales were likely from the CA/OR/WA stock of sperm whales.

With regard to other known fisheries interactions, one sperm whale was found dead in Marin County, California in 2004, with monofilament netting in its stomach (California Marine Mammal Stranding Network Database 2006). It is not known if the marine debris was the cause of death. Similarly, in 2008, two sperm whales stranded dead: one was found in Crescent City, CA with a stomach full of a variety of different nets; and the other in Point Reyes, CA with a variety of different netting, a plastic tarp, and rope marks on its pectoral flipper. Also, in 2008, an animal stranded dead in North Cove, Washington with apparent entanglement scars. It is not known if any of the animals' primary cause of death from 2008 was caused by interactions with gear; however, it seems possible entanglement could have been related to their death.

The most recent SAR estimated the annual number of serious injury/mortality of sperm whales due to fisheries based on data from 2006 through 2010 as 3.8 whales per year (Carretta *et al.* 2013). That estimate is largely driven by extrapolation of the observed catch of 2 sperm whales in the DGN fishery into an estimate of 16 individuals during the 2010 fishing season. As noted above, in order to consider the most recent available information, the draft NID and the estimates therein were also considered in this biological opinion. The draft NID includes the total serious injury and mortality in commercial fisheries from 1998 through 2011 of 7 sperm whales, with an average of 0.5 animals per year.

Of the three stocks included in this Opinion, humpback whales are the most commonly observed whale species to interact with fishing gear off the U.S. west coast. This may be due to their distribution, often feeding in coastal waters. It may also be related to their anatomy. Humpbacks have very long pectoral flippers, up to a third of their overall body length, and gear is commonly found wrapped around their flippers. Humpbacks have been reported interacting with gillnets, a variety of pot/trap fisheries and unknown fisheries.

A number of commercial fisheries based out of U.S. west coasts ports may incidentally interact with this stock of humpback whale, and documented interactions are summarized in the 2012 SAR (Carretta *et al.* 2013). From 1999-2003, a humpback cow-calf pair was seen entangled in Big Sur, California (1999) and another single humpback was seen entangled in line and fishing buoys off Grover City, California (2000), but the fate of these animals is unknown. In 2003, there were five separate reports of humpback whales entangled in crab pot and/or polypropylene lines. In 2004, a humpback was observed swimming with a small amount of white rope, approximately 1/8 inch thick, wrapped around its caudal peduncle. In 2005, three humpback whales were entangled in trap/pot gear. In 2006, seven humpback whales were reported entangled in gear. In 2007, five humpback whales were reported entangled in gear. In 2008, seven animals were reported entangled in gear. One of the seven was entangled in Dungeness crab pot gear, and although the fisherman's report indicated that he did not think the gear was life-threatening, the gear was left attached to the animal (reports indicated that the gear was on/near the chin area of the animal). In 2009, three humpback whales were reported entangled in gear, two stranded dead, and one was a fishermen's self-report from 2009 from the CA thresher shark/swordfish DGN fishery. In 2010, a total of eight humpback whales were reported entangled in gear. In 2011, seven humpback whales were observed entangled in gear and reported as serious injuries.

In addition to the humpback entanglements, there were 21 unidentified whales observed entangled in pot/trap gear or unknown gillnet gear during 1998-2011. Some of these animals may represent re-sightings of entangled humpback whales described above. It is likely that most of the unidentified pot/trap fishery entanglements involved humpback whales. Other unobserved fisheries may also result in injuries or deaths of humpback whales (Carretta et *al.* 2013).

In the 2012 SARs, NMFS estimated that the mean annual number of serious injuries/mortality of humpback whales in fisheries from 2004 through 2008 is greater than or equal to 3.2 whales per year (Carretta *et al.* 2013). As noted above, in order to consider the most recent available information, the draft NID and the estimates therein are also considered in this biological opinion. The draft NID includes the total serious injury and mortality in commercial fisheries from 1998 through 2011 of 46 humpback whales with an annual average of 3.6 animals.

Vessel Collisions

Boat collisions are a source of injury and mortality to whales along the west coast. The United States Coast Guard (USCG) is responsible for safe waterways under the Ports and Waterways Safety (PWSA) and establishes shipping lanes. The USCG recently completed Port Assess Route Studies (PARS) for the Santa Barbara Channel and the approaches to San Francisco made recommended to the International Maritime Organization (IMO) that the traffic separation schemes be modified, in part, to reduce the co-occurrence of large ships and whales. The IMO gave final endorsement by the IMO in November 2012. The USCG is currently working on domestic rule making under the PWSA to codify these IMO approved changes. Lane changes are expected to go into effect June 1, 2013.

Fin whales have been reported struck and killed by large vessels along the entire west coast. At least one, and probably more, fin whales were killed by collisions with ships off California in the early 1990s (Barlow *et al.* 1997). Between 1998-2005, seven fin whales were documented as killed due to ship strikes off of California; Oregon, and Washington between 1998-2005. In 2008, one fin whale was struck in 2008 and brought into the port of Los Angeles on the bow of a ship. In 2009, a total of four fin whales were reported as struck: two were struck off of San Clemente Island in Southern California, one came in on the bow of a vessel into Los Angeles Harbor, and one came in on a bow of a vessel into Tacoma, Washington. In 2010, a fin whale came in on the bow of a vessel in the port of Oakland, near San Francisco, CA. The whale was towed out to sea and within a few days another fin whale washed ashore near San Francisco with injuries believed to have been caused by a vessel collision. It is possible that this animal was the same animal as the one that came in on the vessel in Oakland; however, at the time of the issuance of this document, DNA evidence confirming the match was not available; thus both animals are counted as individual ship strikes. An adult female fin whale was also killed in 2011, and stranded in San Diego, CA, where it expelled a fetus, post-mortem. Additional mortality from ship strikes probably goes unreported because the whales do not strand, or if they do, they do not always have obvious signs of trauma (Carretta *et al.* 2013).

For this consultation, we considered the estimated number of vessel strikes from a variety of sources, including the most recent SAR and the draft NID. The average observed annual serious injury/mortality due to ship strikes along the west coast of the U.S. is 1.0 fin whale per year, for the period 2004-2008 (Carretta *et al.* 2013). NMFS reviewed all available records of vessel strikes of fin whales between 1998 and 2011 for the draft NID and estimated the total serious injuries or mortality due to vessel strikes to be 16 animals, with an annual average of 1.14 whales/year. The total number of known or assumed serious injury/mortality attributed to ship strikes from 2007 to 2011 is 8 fin whales, with an annual average of 1.6 animals.

Local researchers have photographed numerous humpbacks with fresh and healed gashes on their backs consistent with being struck by a vessel. Ship strikes were implicated in the deaths of at least two humpback whales in 1993, one in 1995, and one in 2000 (NMFS unpublished data, *in* Carretta *et al.* 2006). In 2004, a humpback whale stranded dead in Washington with injuries consistent with those caused by a vessel collision. In 2005, a free-swimming humpback whale was reported to have been hit by a USCG vessel in San Francisco Bay. In 2007, a humpback whale cow/calf pair swam into the Sacramento River with injuries consistent with a vessel collision. Also in 2007, a humpback whale stranded dead in Marin County, California, with a fractured skull, consistent with a vessel collision. In 2008, in Washington, two humpback whales stranded dead with injuries consistent with those caused by a vessel collision. In 2011, a humpback whale stranded dead with a large contusion near the dorsal fin, in Los Angeles County, CA with injuries consistent with those caused by a vessel collision. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not have obvious signs of trauma. Several humpback whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (J. Calambokidis, personal communication, *in* Carretta *et al.* 2013).

Based on the most recent SAR, the average number of humpback whale mortalities by ship strikes off the west coast of the U.S. from 2004-2008 is at least 0.4 per year (Carretta *et al.* 2013), but this is considered a minimum since animals struck by ships may not be realized or reported. NMFS reviewed all available records of vessel strikes of humpback whales between 1998 and 2011 for the draft NID and estimated the total number of estimated serious injuries/mortality of humpback whales confirmed as ship strikes to be 10 whales, with an annual average of 0.7 whales per year. The total number of known or assumed serious injury and mortality attributed to ship strikes from 2007 through 2011 is 6 humpbacks, with an annual average of 1.2 whales per year.

Sperm whales interactions with large vessels are rarely reported within the proposed action area, although they are likely vulnerable to ship strikes off the west coast of the U.S. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Two whales described as "possibly sperm whales" are known to have died in U.S. waters in 1990, after being struck by vessels (Barlow *et al.* 1997). In 2007, in Florence, OR, a calf stranded dead with obvious signs of propeller trauma, a deep gash on its dorsal side, and the caudal end of the body cut off at the peduncle. In 2009, a sperm whale carcass washed ashore at Point Reyes, CA with severe bruising and hemorrhaging along the dorsum, consistent with injuries likely to have been caused from a vessel collision. Based on the most recent SAR, the average observed annual serious injury/mortality due to ship strikes along the U.S. west coast is 0.2 sperm whales per year for the period 2006-2010 (Carretta *et al.* 2013). As summarized in the draft NID, the estimated total serious injury or mortality from 1998 through 2011 is four sperm whales, with an annual average of 0.29 whales per year. The total number of known or assumed serious injury and mortality attributed to ship strikes from 2007 through 2011 is 2 sperm whales, with an annual average of 0.4 animals per year.

Whale watching operations and scientific research

Whale watching boats and boats from which scientific research is being conducted specifically direct their activities toward whales and may have direct or indirect impacts on whales in the proposed action area. Directed scientific research permits allow a suite of activities by researchers that include tagging, tracking, and collection of biological data and samples. These activities are intended to be non-injurious, with only minimal short term effects. But the risks of a incurring an injury or mortality cannot be discounted as a result of directed research. Humpback and fin whales are likely one of the most affected of the species considered in this Opinion, by whale watching activities, particularly in California where their foraging areas overlap and provide opportunities for seeing multiple species. Sperm whales are likely less affected by whale watching, either professional trips or recreational boaters, primarily because coastal activities and the offshore nature of the CA/OR/WA stock of sperm whales rarely overlap. There is concern regarding the impacts of close vessel approaches to large whales, since harassment may occur, preferred habitats may be abandoned, and fitness and survivability may be compromised if disturbance levels are intense and continuous. As mentioned earlier, a 1996 study in Hawaii measured the acoustic noise of different whale-watching boats (Au and Green 2000) and determined that while the sound levels were unlikely to produce grave effects on the auditory system of humpback whale, the potential direct and indirect effects of harassment due to vessels cannot be discounted.

Other Threats

Other activities that occur in the action area and could have an impact on whales include: Navy exercises, seismic testing, and low frequency acoustic devices. More details on the impact of these activities can be found in NMFS' draft NID and in the recovery plans for fin whales, humpback whales and sperm whales.

B. Sea Turtles

As described above in the status section, loggerhead, green, leatherback and olive ridley sea turtles have been and continue to be affected by numerous activities within the proposed action area. Because impacts on all four species are similar, we look at the environmental baseline on all species together, calling out differences among species as appropriate.

Fisheries Interactions

All sea turtle species are occasionally reported and observed interacting with fishing gear, including pot/trap gear, gillnets, and hook and line recreational gear, with leatherbacks showing to be the species most interacting with gear (Figures 5 and 6). Sea turtles have not been observed entangled in the salmon or coastal pelagic species Federal fisheries. An interaction between gear used in the federal groundfish fishery and a leatherback was recently observed when a dead leatherback was found entangled in sablefish trap gear fishing offshore of Fort Bragg in October, 2008. The NWR recently completed a section 7 consultation on the Federal groundfish fishery and issued an ITS for leatherback sea turtles. The biological opinion found no jeopardy to leatherback sea turtles. No other sea turtle species have been observed entangled in the various components of the groundfish fishery.

All four species of sea turtles considered in this Opinion have been observed caught in the DGN (see effects section). There are two state gillnet fisheries: the set gillnet fishery targeting halibut and white seabass; and the small mesh gillnet fishery targeting yellowtail, barracuda, and white seabass. There have not been any recent records of species-specific entanglements in either of these fisheries, however, either or both of these fisheries could interact with sea turtles based on the records of sea turtles being seen entangled in unidentified gillnet gear or historically documented by fisheries observers back in the early 1990s.

Vessel Collisions

Vessel collisions are occasionally a source of injury and mortality to sea turtles along the west coast. A review of the strandings data base indicates that green and leatherbacks are reported most often as stranded due to the impact by vessels strikes, with olive ridleys rarely struck (Figures 5 and 6), likely because they are so rare off the California coast. Green turtles are particularly vulnerable to collisions when in foraging areas in San Diego and Long Beach, while leatherbacks have been reported struck off central California, likely when they are foraging in or near the approach to the San Francisco/Oakland port. The United States Coast Guard (USCG) is responsible for safe waterways under the PWSA and establishes shipping lanes. The USCG recently completed PARS for the Santa Barbara Channel and the approaches to San Francisco made recommended to the International Maritime Organization (IMO) that the traffic separation schemes be modified, in part, to reduce the co-occurrence of large ships and whales. It is not known how these changes may affect sea turtles. The IMO gave final endorsement by the IMO in November 2012. The USCG is currently working on domestic rule making under the PWSA to codify these IMO approved changes. Lane changes are expected to go into effect June 1, 2013.

Other Threats

All species have been observed entrained at power plants off coastal California, either alive, injured, or determined to be previously dead. A review of the stranding records indicates that green turtles are the most commonly reported species entrained at power plants (Figures 5 and 6). Since green turtles have been documented foraging in the warm water effluent near power plants, particularly in the San Diego and Long Beach California areas, it is reasonable that they would be most affected.

As documented in Figures 5 and 6, sea turtles have been documented stranded off California through their encounters with marine debris, particularly olive ridleys, either through ingesting debris or becoming entangled in the debris. Other documented threats include unknown injuries, illness, gunshot wounds and cold-stunning. Because not all stranded sea turtles are necropsied, particularly leatherbacks, many threats are not documented, but they are recorded in the stranding data base.

NMFS issues scientific research permits to allow research actions that involve take of sea turtles. Currently there are 4 permits that allow directed research on sea turtles, typically involving either targeted capture or sampling of individuals that may have stranded or incidentally taken in some other manner. These permits allow a suite of activities that include tagging, tracking, and collection of biological data and samples. These activities are intended to be non-injurious, with only minimal short term affects. But the risks of a incurring an injury or mortality cannot be discounted as a result of directed research.

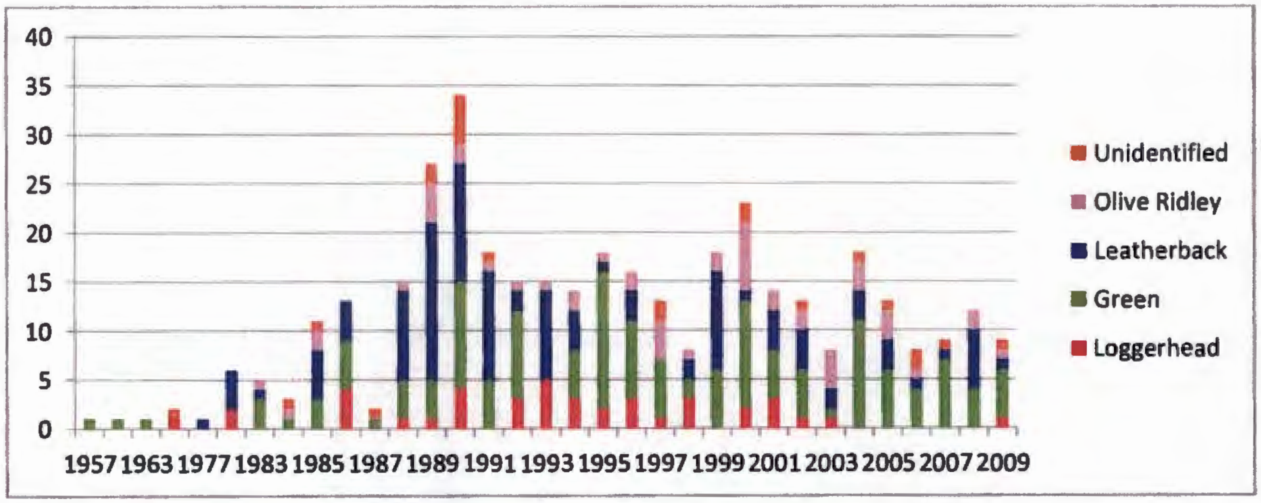

Figure 5. Sea turtle strandings documented off the U.S. west coast, 1957 – 2009.

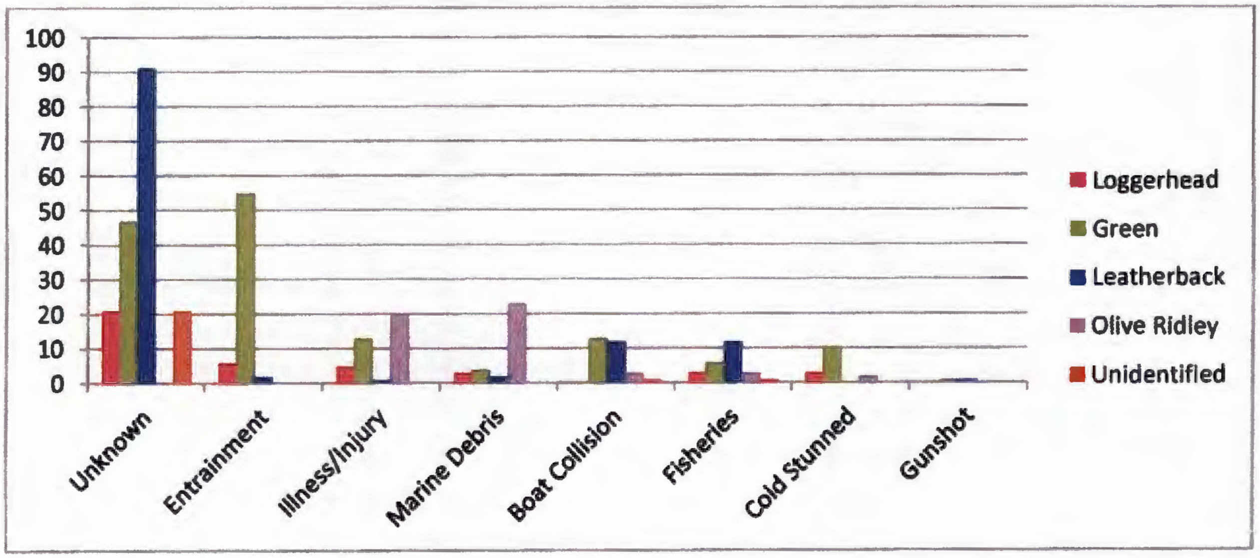

Figure 6. Known causes of sea turtle strandings off the U.S. west coast, 1957-2009.

V. EFFECTS OF THE ACTION

In this section of a biological opinion, NMFS assesses the probable effects of the proposed action on threatened and endangered species. "Effects of the action" refers to the direct and indirect effects of an action on species or critical habitat, together with the effects of other activities that are interrelated with or interdependent to that action, that will be added to the environmental baseline. "Direct effects" are those effects that are caused directly by the action. "Indirect effects" are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02). The effects of the action are considered within the context of the Status of the Species and together with the Environmental Baseline sections of this opinion and Cumulative Effects, and a determination is made as to whether the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02), otherwise known as the jeopardy determination.

Approach to the Effects Analysis

NMFS determines the effects of the action using a sequence of steps. In this analysis, the first step identifies stressors (or benefits) associated with the proposed action with regard to listed species. The second step identifies the magnitude of stressors (e.g., how many individuals of a listed species will be exposed to the stressors; *exposure analysis*). The third step describes how the exposed individuals are likely to respond to these stressors (e.g., the mortality rate of exposed individuals; *response analysis*). The final step in determining the effects of the action is establishing the risks those responses pose to listed resources (*risk analysis*). In this step of our analysis, we will relate information on the number, age (or life stage), and gender of the individuals likely to be exposed to the proposed action's effects, along with the likely responses of those individuals to the proposed action, to an expected impact on the populations or subpopulations those individuals represent.

For the purposes of this proposed action, NMFS has identified the impact of potential capture or entanglement in DGN gear as the primary effect of the DGN fishery on ESA-listed species. In this effects analysis, the terms bycatch and entanglement are used interchangeably, as the primary mode of bycatch for ESA-listed species in the DGN fishery is entanglement in the net or any component such as buoy extender lines that could result or contribute to an entanglement. There are other potential impacts that could occur as a result of the fishery, such as vessel collisions or impacts related to any pollution or marine debris generated by this action. It is also conceivable that impacts to prey might affect ESA-listed species[12], or that avoidance of DGN gear could lead to increased energetic expenditure or temporary exclusion from important foraging resources. At this time, the available information does not suggest that any of these factors are affecting ESA-listed species as a result of the continued operation of the DGN fishery. Without evidence to support analyses of how these factors may affect ESA-listed species as a result of the proposed action, NMFS assumes these factors are insignificant and discountable. As a result, the effects analysis will concentrate on the impact of bycatch of ESA-listed species in the DGN fishery.

Exposure

In order to determine the exposure of ESA-listed species to the DGN fishery, NMFS relies primarily upon data provided by fisheries observers. NMFS has been deploying observers in the DGN fishery since 1990, and the observer program represents an objective sampling scheme that constitutes the best available information regarding the frequency and trends in DGN fishery bycatch over time. In order to estimate the extent of ESA-listed species bycatch, SFD used observer data from past DGN effort that is consistent with effort expected in the current fishery

[12] See discussion of leatherback critical habitat in *Status of the Species* section for a specific analysis.

to produce bycatch rates in terms of the number of individuals per 1,500 sets, or the maximum effort expected in one season. These bycatch numbers were projected over a period of 5 years to produce estimates of bycatch by species over that time frame (see Table 7). In addition, SFD also calculated the probability of bycatch events for each species within a given year, based on the bycatch rates generated from observer data (Appendix A).

Given the data and projected effort, estimates of annual bycatch for each species are relatively low numbers (Table 7). Documented reports of ESA-listed species entanglements in this fishery occur vary rarely, especially during more recent time periods. Because rare events are inherently unpredictable, PRD also decided to look more broadly at the annual mean rate of bycatch by category (e.g., marine mammals and sea turtles) that has been observed recently to help describe what might happen in any given year in terms of bycatch scenarios, as opposed to what might be expected to occur purely based on average bycatch rates for any individual species. These estimates of what might occur in any given year are consistent with conservative interpretation of the probabilities of bycatch events generated using observer data provided by SFD. As a result, NMFS considers this more generalized approach as the best method for determining how many individuals of a given species may be entangled in any given year.

The exposure analysis below presents bycatch estimates from two perspectives: 1) what could be expected to occur in any 1 year; and 2) what would be expected to occur over a 5-year time period. Both concepts are useful for monitoring the impact of the DGN fishery on ESA-listed species, especially given the prospect of approximately 20 percent observer coverage in this fishery, and both will be used to frame the incidental take statement (ITS) of this biological opinion.

Response/Risk

In order to determine the response of individuals from entanglement in DGN gear, NMFS relies primarily upon the accounts of injury and mortality for each species provided from observer records. For some species (e.g., leatherbacks, sperm whales), there have been enough reports of entanglements over the years (including historical records from sets that may not be consistent with current regulations) to estimate expected mortality rates. For other species (e.g., fin and humpback whales), records of observed bycatch are so limited that a more general approach to estimating mortality rate is required. For these species, NMFS considers the fact that serious injury and mortality of any individual could occur, but that it would not be appropriate to assume that over a given timeframe all individuals would die as a result of entanglement as some have been observed released alive and apparently uninjured. In lieu a better information to more precisely inform or infer what the lethal rate of encounters are for this latter category of ESA-listed species, NMFS generally assumes that the chance of mortality is roughly equal to the chance of surviving, or 50 percent.

In order to measure the risk to the affected populations, NMFS calculates the expected mortality using the estimated rates of bycatch for each species and the expected mortality rates, from both the context of what could happen in a given year, and what would be expected to occur over a 5-year period. For marine mammal species, we assume that all individuals are of equal value regardless of age or sex, in terms of lost reproductive capacity to the population. For sea turtles, additional calculations are made to convert mortalities to adult female equivalents. This is a standard approach to assessing impacts to sea turtles as the only metrics of sea turtle population abundance and trends generally available relate to the number of nesting females or nesting production that has been recorded over time. In addition, PRD considers the likelihood that the maximum projected effort of 1,500 sets will occur in any year based on recent data and trends in the fishery, and how this is likely to influence subsequent bycatch totals given anticipated bycatch rates.

Consideration of Observer Data

It is clear that NMFS relies heavily upon the data generated by the observer program to predict and monitor the impact of the DGN fishery on ESA-listed species. Consequently, NMFS considers the relationship between observer coverage and the data produced that underlies the effects analysis of this biological opinion.

1. Exposure

All seven of the species considered in this biological opinion have been documented by fishery observers as bycatch in the DGN fishery over the last two decades[13]. In the biological assessment prepared for this consultation, NMFS SFD generated anticipated bycatch rates for seven ESA-listed species based on the historical record of bycatch events observed and the expectation that up to 1,500 sets per year could occur, based on the methodology described below (Table 7[14]; taken from Table 16 in NMFS 2012a).

[13] In 2009, NMFS received a report of a humpback whale caught in DGN fishery off the coast of San Diego from a commercial fisherman during an unobserved trip. The report indicated that the whale was released alive and actively swimming away with some unknown quantity of gear remaining attached.

[14] These estimates were calculated using the initial analysis provided by SFD (Table 16 in NMFS 2012a), which was subsequently updated to include all observer information collected as of January, 2013.

Table 7. Estimated bycatch of ESA-listed species in the DGN fishery per year (1,500 sets) and over a 5 year period, derived from observer data using sets consistent with current measures implemented for bycatch reduction that are pertinent to the various species 1990-2013.

Species	Number of Observed Sets Reviewed	Observed Bycatch	Proposed Annual Effort (sets per year)	Estimated Annual Bycatch Rate per 1,500 Sets	Estimated Bycatch Over 5 Years[1]
Fin Whale	4,033	1	1,500	0.37	2
Humpback Whale	4,033	2	1,500	0.74	4
Sperm Whale	4,033	4	1,500	1.48	8
Leatherback Turtle	5,476	7	1,500	1.91	10
Loggerhead Turtle	5,400	5	1,500	1.39	7
Olive Ridley Turtle	5,476	1	1,500	0.27	2
Green Turtle	5,476	1	1,500	0.27	2

[1]All 5-year bycatch rate estimate decimals are rounded up to frame estimates as "up to" scenarios, as fractional numbers of turtles or whales are not practical in reality.

As described previously, a number of significant actions have been taken to address bycatch of sea turtles and marine mammals, both ESA and non-ESA-listed species. As a result, the current DGN fishery is considerably different than the historical fishery; for example, gear modifications and time/area closures have been implemented to avoid areas prone to higher bycatch rates. In addition, the total effort by the fleet is much reduced and the spatial extent of the fishery has been largely constrained compared to historical effort as well. While overall bycatch rates for many species appear to be low, bycatch events still occur. However, these bycatch events are considered rare, making reliable estimates of bycatch challenging. For example, in the twelve years from 2001 through 2012 since the PLCA has been implemented, there have only been four observed interactions with sea turtles.

Method for calculating cetacean bycatch in the biological assessment

In order to produce the estimates in Table 7, NMFS used observer data from 1990 through 2013 using historical observed fishing effort (number of sets) that was conducted by vessels operating consistent with current regulations (e.g., the PCTRP and PLCA) addressing marine mammal and/or sea turtle bycatch in the DGN fishery.

The observed sets used for calculating mean rates of cetacean bycatch include only sets with the following criteria, consistent with some key elements of the PCTRP:

- a minimum of 25 functioning acoustic pingers were used,
- minimum extender lengths of 36 ft, and
- minimum net lengths of 1,200 m.

These criteria were used to ensure that the effort used to estimate bycatch rates reflect the current and future lawfully operating fishery. For example, following implementation of the PCTRP rates of cetacean bycatch have been significantly lower than in years when pingers were not required (Carretta *et al.* 2008; Carretta and Barlow 2011). This detectable effect in bycatch rates should be considered. Sets used for the cetacean analysis could have been fished anywhere within the current fishery (including the current Leatherback Conservation Area, which is closed to fishing between August 15 and November 15 each year) as there is no geographic bias affecting the likelihood of interactions and bycatch rates. Selecting sets using these criteria left 4,033 sets for inclusion in the cetacean analysis.

Method for calculating sea turtle bycatch in the biological assessment

A similar analysis was conducted for sea turtle bycatch rates, except that both observed sets with and without acoustic pingers and minimum extended lengths were included, as pinger use and extender length has not been demonstrated to reduce sea turtle bycatch. To reflect the current state of the fishery as it pertains to sea turtle management, historical sets fished within the current PLCA from August 15 to November 15 were not included in the calculation of turtle bycatch rates (for any turtle species). Selecting sets using these criteria left 5,476 sets for inclusion in the leatherback, olive ridley, and green turtle analyses.

The number of observed sets used in the loggerhead analysis was further reduced by excluding sets made during El Niño years (1992, 1993, 1997, and 1998) east of 120°W longitude during June, July, and August. This time and area corresponds to the current DGN time/area closure regulation[15] that is applicable during El Niño years. The assumption is that bycatch of loggerheads during El Niño years in the past do not reflect the current and future fishery as the time/area closure would be triggered. This left a total of 5,400 sets in the loggerhead turtle analysis.

The number of sets and observed bycatch represented in Table 7 above reflect the criteria described. It should be noted that more sets were considered for estimating sea turtle bycatch rates than marine mammal bycatch rates. Sea turtle bycatch rates were calculated using some observed sets that did not comply with the PCTRP. As mentioned above, pingers and extender lengths have yet to be associated with sea turtle avoidance or bycatch mitigation. A full description of the methodology used in selecting the appropriate observer data that best reflect the current DGN fishery for calculating these bycatch rates can be found in the biological assessment (NMFS 2012a).

As described above, the measures that have been implemented to reduce bycatch appear to be effective. Since regulations have been in place to reduce bycatch of marine mammals and sea turtles, observed bycatch of ESA-listed species in the DGN has been relatively low (see Table 8 in comparison to Table 9).

[15] Implemented in 2003, amended in 2007.

Estimated average bycatch over time

The primary usefulness of the bycatch rate estimates produced above (Table 7) is the representation of the expected average annual bycatch rates of ESA-listed species over a more extended period of time, as opposed to what might occur in any given year. Over time, it is likely that bycatch rates for these species will more closely align with totals that reflect average encounter and capture rates from the available empirical data, which may reflect annual variations in factors that influence the probability of bycatch, including distributions of species (target and non-target) that respond to changing environmental or oceanic conditions. The rarity of observed and reported interactions since 2001 does not support the assumption of consistent and/or multiple bycatch events each year, every year for any or all of these species over time. The bycatch levels presented below (Table 8) reflect the estimates generated from observed bycatch rates in Table 7 and offer an "up to" scenario for the bycatch expected over the longer term (5-year total). The choice of using a 5-year total to represent a long term view is consistent with how marine mammal stock assessment reports evaluate anthropogenic impacts to populations (average over most recent 5 years of data), and is consistent with the general scaling of 20 percent observer coverage and likelihood of observing any event that occurs in the DGN fishery (1 out of 5). These rates reflect the best available information and illustrate the fact that observed bycatch of ESA-listed species has become a rare event in the DGN fishery. Furthermore, while 1,500 sets may take place over a given year, as seen in 2006, the annual estimated number of sets made in the DGN fishery has been considerably lower in recent years - 492, 435, and 445 sets were made in fishing seasons during 2010, 2011, and 2012, respectively. Therefore, total bycatch estimates over the most recent five year period are likely to be considerably lower than those reflected in Table 8.

Table 8. Expected total of individual entanglements for each species over a 5-year period.

	5-year bycatch total
Fin whale	up to 2
Humpback whale	up to 4
Sperm whale	up to 8
Leatherback turtle	up to 10
Loggerhead turtle	up to 7
Olive ridley turtle	up to 2
Green turtle	up to 2

Bycatch in a given year

In addition to looking at what the expected bycatch rate and total will be over time, NMFS considered what scenarios of bycatch could occur in any given year for ESA-listed species as a way to analyze what the impact to potentially affected populations could be. Since the full suite of bycatch reduction measures was implemented in 2001, there have been a total of 4 sea turtle and 3 ESA-listed marine mammal interactions recorded in over 2,400 observed sets (Table 9). If a catch-per-unit-effort (CPUE) is calculated based on this level of observed bycatch and effort for each general species group (i.e., sea turtles and marine mammals) and applied that to an effort level of 1,500 sets per year, the estimated level of bycatch is no more than about 2.5 sea turtles and 2 ESA-listed marine mammals per year given a 1,500 set DGN fishery (2.49 sea turtles and 1.87 marine mammals to be exact for each species complex). In comparison, using the bycatch rates provided by SFD for individual species of marine mammals or sea turtles and applying the anticipated effort of 1,500 sets results in cumulative estimates of 3.85 sea turtle and 2.60 marine mammal entanglements annually (cumulative total using information from Table 7).

Table 9. Observed bycatch of ESA-listed individuals in the DGN fishery 2001-2013 since bycatch reduction measures have been in place.

Year	Month	Day	latitude	longitude	Species	Condition
2001	8	23	32° 04.7' N	118° 12.9' W	Loggerhead Sea Turtle	Alive
2004	11	15	32° 37.9' N	118° 19.8' W	Humpback Whale	Alive
2006	10	20	32° 23.9' N	119° 51.1' W	Loggerhead Sea Turtle	Alive
2009	9	26	35° 13.1' N	121° 30.3' W	Leatherback Sea Turtle	Alive
2010	12	5	31° 55.3' N	119° 38.5' W	Sperm Whale	Injured
2010	12	5	31° 55.3' N	119° 38.5' W	Sperm Whale	Dead
2012	10	11	35° 29.3' N	122° 06.3' W	Leatherback Sea Turtle	Alive

The numbers generated by each of these approaches are similar, illustrating the fact that observed bycatch rates of ESA-listed species in the modern DGN fishery have been low. Without question, fishing effort from the fleet as a whole has significantly decreased from the early 1990s when effort averaged over 4,000 sets annually (highest number was 5,442 in 1993), to an average of about 1,200 sets per year since 2000, with effort continuing to trend downward (see Tables 1 and 2 in Proposed Action section). It seems possible that this overall decrease in fishing effort is helping to further diminish the probability of bycatch for these protected species in comparison to historical reported bycatch prior to implementation of bycatch reduction measures (Table 10). However, the range of the DGN fishery has also been significantly affected by factors such as implementation of sea turtle conservation areas and diminishing participation among the DGN fleet, with effort more concentrated in the Southern California Bight during much of the season.

Table 10. Summary of observed bycatch of ESA-listed species in the DGN fishery 1990-2000 prior to implementation of all bycatch reduction measures.

	Alive	Dead/Injured/Unknown	Total
Fin Whale	0	1	1
Humpback Whale	2	0	2
Sperm Whale	3	5	8
Leatherback Sea Turtle	9	14	23
Loggerhead Sea Turtle	10	4	14
Green Sea Turtle	0	1	1
Olive Ridley Sea Turtle	1	0	1
Unidentified Sea Turtle	2	1	3

The overall relationships between changes in fishing effort, the distribution of fishing effort and protected species, implementation of bycatch reduction measures, and the observed bycatch, have yet to be well described. While it may not be possible to specifically attribute individual bycatch reductions measures with some species (e.g., the influence of pingers on reducing turtle bycatch, or the linkage between whale bycatch and the implementation of time/area closures to protect sea turtles), it may be reasonable to consider that the bycatch reduction measures in summation, working together in concert with the dynamics of fishing effort distribution and reduced total fishing effort, are combining to produce the low levels of bycatch observed in the current DGN fishery.

Given the rarity of observed bycatch events, bycatch rate estimation/prediction for any particular ESA-listed species may not be as precise as estimates generated for other species that are regularly caught with DGN gear. The inclusion/exclusion of a single bycatch data point or incidence of observed bycatch can have a significant effect on those estimates, both positively and negatively. Given this uncertainty, it may be appropriate to consider a broader view of bycatch rates across species groups to produce the best estimates of what could be expected to occur in the DGN fishery in any year given the current state of the fishery. As described above, utilizing observer records of the recent history of the DGN fishery since implementation of all significant bycatch reductions measures (since 2001) suggests that 2.5 sea turtles and 2 ESA-listed marine mammals would be caught each year on average in a 1,500 set DGN fishing season. Within any given year, it is likely that variable oceanographic or environmental conditions, as well other factors, impact the distribution of animals and fishermen and the relative likelihood of interactions by these species that may be affected by the DGN fishery.

We considered which species are likely to be affected if we estimate up to three turtles (rounding 2.5 up) will be entangled in DGN gear each year. If three sea turtles were caught in a given year, possible scenarios for individual turtles caught could include: a) 3 leatherbacks; b) 3 loggerheads; or c) some combination that includes some number of leatherbacks, and/or loggerheads and/or green or olive ridley turtles, based on the distribution of the fishery, historical takes, and what is known about the abundance, behavior, and distribution of these species within the proposed action area. Based on the number and species of observed turtle bycatch across all sets that are considered consistent with the current DGN fishery (7 leatherbacks to 5 loggerheads; Table 7), it seems reasonable to assume that the scenarios listed above are all probably equally likely as rare events during any given year, but that over time roughly half the turtles caught will be leatherbacks, and half loggerheads. Possible scenarios also include incidentally catching an olive ridley and/or green turtle as well, but only very rarely. This is based on the rarity of observed bycatch, only one for each species and both in 1999 when overall fishing effort was much higher. The majority of effort occurs within the Southern California Bight in September through November which is a time when sea turtles may be present in the area although not considered commonly observed. Leatherbacks and loggerheads are both known to occur in the action area, and while seasonality and oceanographic conditions have been correlated with their presence, we have limited information to suggest which species may be more susceptible to coming in contact with DGN gear. As described in Benson *et al.* (2007b and 2011), leatherbacks will travel along the U.S. west coast, but generally spend the majority of their time in the fall in central California and off of Oregon and Washington. Olive ridleys are not commonly observed in the waters off the U.S. west coast. There are known populations of green turtles foraging in areas adjacent to the proposed action area; in San Diego Bay and the San Gabriel River area.

Similarly, if 2 ESA-listed whales are caught in the DGN fishery in a given year, possible scenarios include: a) 2 sperm whales; b) 2 humpback whales; or c) some combination that includes a sperm whale and/or a humpback whale and/or a fin whale, but only very rarely. Similar to green and olive ridley sea turtles, there has been only one fin whale observed caught in the DGN fishery since 1990, and fin whale bycatch would only be expected to occur very rarely. Based on the very few reports of large whale bycatch (2 sperm and 1 humpback whale entanglements observed since 2001, and considering the 1 additional humpback whale entanglement self-report[16]) it is difficult to distinguish/predict which bycatch scenarios are more likely during any given year. All of these species are known to occur in the Southern California Bight. This is further complicated by the nature of the observed interactions; some of the sperm whale entanglement events in the DGN have involved more than one animal (e.g., in the observed entanglements in 1992, 1993, and 2010) and most of the other sperm whale entanglements occurred before implementation of measures to reduce bycatch (i.e., there has only been one observed incident of sperm whale bycatch (2 animals) in the DGN since the 1998 PCTRP regulations). As a result, it is logical to assume that all scenarios are equally likely as rare events during any one given year.

Based on this more qualitative approach that acknowledges the uncertainty surrounding predicting rare events, especially within any given year, and the observed fishery over the last 11 years, NMFS expects the following levels of bycatch could occur for each species in any given

[16] The fisherman entanglement self-report is consistent with concept of unobserved bycatch that is anticipated by the proposed action of observing only a fraction of the fishery effort.

year under the proposed action. The bycatch levels presented here offer an "up to" scenario from the annual bycatch perspective as a worst case scenario acknowledging that the probability of rare events is difficult to predict in any one year, especially for any one species in particular.

Table 11. Expected annual entanglements.

	Annual bycatch
Fin whale	up to 1
Humpback whale	up to 2
Sperm whale	up to 2
Leatherback turtle	up to 3
Loggerhead turtle	up to 3
Olive ridley turtle	up to 1
Green turtle	up to 1

These expected values reflect the possibility that 1 or 2 humpbacks, sperm whales, leatherbacks, or loggerhead sea turtles could be caught in a year, but no more than 1 fin whale, olive ridley, or green sea turtle would be expected to be caught in any year due to near absence of these species from the observer record in the recorded history of the DGN fishery. The scenarios presented above describe what could happen in any given year for each species but would not be expected to occur every year.

In addition to calculating a mean annual bycatch rate based on the observer data (Table 7), it is also possible to calculate the probability that a certain number of bycatch events could occur in a given year, based on that mean bycatch rate and the assumption that rare events can be considered to follow a Poisson distribution (NMFS 2012a). The average bycatch rate serves as a measure of lambda (λ) used in a Poisson model, where the probability of *k* bycatch events occurring is:

$$f(k;\, \lambda) = \frac{\lambda^k\, e^{-\lambda}}{k!}$$

In this equation, *e* is equal to the natural log (2.71828).

For example, if the mean rate of bycatch from observer data is two events per 100 fishing sets, then $\lambda = 2$ events. Using $\lambda = 2$ as an example, one could calculate the probability of 4 events (k=4) occurring in 100 fishing sets, which would simply be:

$$f(4;\, 2) = \frac{2^4\, e^{-2}}{4!} = \sim 0.09022$$

For all of the ESA-listed species considered in this Opinion, the probability that the number of entanglements that may be expected to occur in any given year (1,500 sets) will not exceed the anticipated maximum annual bycatch in Table 11 is greater than 80 percent[17] (see Appendix A for full table of bycatch probabilities for each species[18]). While this does not represent absolute certainty that bycatch of any of these species will not exceed these anticipated levels, it does represent a reasonable assurance of what is likely to occur in any given year based on the available information from the observer program. In addition, it is reasonable to assume that the long-term average of annual bycatch in the DGN fishery for any species is likely to be less than what might (worst case) occur in any given year, based on the relatively high probability that realized bycatch events for each species each year will be less than the maximum anticipated in this Opinion, as represented by the probabilities in Appendix A, including many years where no bycatch occurs.

For example, consider the following probabilities of annual bycatch totals for humpback whales in the DGN fishery generated from observer data, based on an assumption of 1,500 sets per year (Appendix A):

Number of Entanglements	Probability
0	0.477114
1	0.353064
2	0.130634
3	0.032223

The annual and 5-year bycatch total expectations also align well with the analysis of bycatch probability presented in Table 17 in the 2012 biological assessment provided by SFD. Over time, you would expect there would be zero humpback whale bycatch in a single year during about one-half of fishing seasons (48%). About one-third of the time (35%), there would be only one humpback whale caught. There is always a small probability that more individuals could be caught, but it would be very unlikely that repeated years of high humpback whale bycatch would occur unless underlying conditions that influence the interaction rates of humpback whales (and any other of these ESA-listed species) and the DGN fishery change significantly.

2. Response

A. Marine Mammals

The responses of fin, humpback, and sperm whales to capture in DGN gear and their ultimate fate is difficult to predict, due in large part to the few observed interactions with the DGN gear.

[17] Probability that the maximum anticipated bycatch in any given year presented in Table 11 will not be exceeded is over 95% for fin and humpback whales, loggerhead, olive ridley and green sea turtles; and over 80% for sperm whales and leatherback sea turtles (Appendix A).

[18] These estimates were calculated using the initial analysis provided by SFD (Table 17 in NMFS 2012a), which was subsequently updated to include all observer information collected as of January, 2013.

Historically, a wide variety of marine mammals have been entangled and killed in DGN gear. The number of species affected is most likely attributable to the large geographic range of the fishery and the number of species that may be found along the U.S. west coast, the non-selectivity of the gear, and the amount and location of fishing effort. Overall, marine mammal bycatch in the DGN fishery has declined substantially since implementation of the PCTRP, although a variety of marine mammals are still observed as bycatch in the fishery (Carretta *et al.* 2005; Carretta and Barlow 2011).

The probability that a marine mammal will initially survive an entanglement in fishing gear depends largely on the species and age or size of marine mammal involved. For instance, larger animals such as fin whales, humpback whales and sperm whales may encounter and even become entangled in gillnet gear, but often survive the initial contact with the gear by breaking some meshes and "punching" a hole through the gillnet webbing and continue swimming Fishermen have reported that large whales (e.g., blue and fin whales) break through drift gillnets without entangling, and that very little damage is done to the net (Carretta *et al.* 2013).

There are many variables to consider when evaluating how large whales are likely to respond when entangled. Marine mammals that become entangled and are either released by fishermen or release themselves, and may swim away with a portion of gillnet attached to their bodies. Observer records indicate that for large whales, there are generally three areas on their body where entanglement in a net occurs: 1) the gape of the mouth, 2) around the flippers, and 3) around the tail stock (although this area is often difficult to view, as most *balaenopterids* do not fluke frequently). Documented cases have indicated that entangled marine mammals may travel for extended periods of time and over long distances before either freeing themselves of gear, being disentangled by stranding network personnel, or dying as a direct result of the entanglement (Angliss and DeMaster 1998).

In most cases, it is unknown whether an entanglement results in an injury that is serious enough or debilitating enough to eventually lead to death.[19] If the debris fragments are heavy, the animal could become exhausted trying to repeatedly reach the surface to breathe and might eventually drown. Less heavy fragments may also lead the animal to exhaustion (not as quickly as expected with heavier gear), depletion of energy stores, and starvation due to the increased drag (Wallace 1985). Younger animals are particularly at risk if the entangling gear is tightly wrapped, for as they continue to grow, the gear will likely become more constricting. This is of particular concern as the majority of large cetaceans that become entangled in all types of fishing gear are juveniles (Angliss and DeMaster 1998). Data from the NMFS SWR Stranding Database do not provide conclusive information on the size or age of most whales that have been reported entangled, although reports of juvenile whale entanglements are certainly part of that record. NMFS assumes most marine mammals that die as a result of entanglement in drift gillnets have

[19] The criteria used for assessing the severity of injury to marine mammals follow the recommendations made by Andersen *et al.* (2008). NMFS is currently in the process of formalizing new recommendations and criteria.

succumbed to drowning. With a typical soak time of 12-14 hours, the animal is unable to survive without oxygen, especially if it is entangled at the beginning of the set, or deep in the net.

Marine mammals may also be affected in other sublethal ways as a result of being captured in a drift gillnet. If an animal's appendage is caught in the mesh, the debris can debilitate the animal, especially if it is constricting, causes lacerations, or impairs swimming or feeding ability (Scordino 1985), which may make the animal more susceptible to disease or predation (Angliss and DeMaster 1998). The lacerations themselves may become a source of infection. A sustained stress response, such as repeated or prolonged entanglement in gear or having gear left on the animal, may make marine mammals less able to heal and to fight infection or disease (Angliss and DeMaster 1998). Injuries sustained as a result from entanglement can also lead to subsequent mortality after release if they are serious enough to lead to other significant health problems.

In the DGN fishery, NMFS fisheries observers record detailed information on marine mammals entangled in the net. Animals that are released alive from the net, with netting attached, are classified as "injured." Animals that release themselves or are released from the net by fishermen and can swim normally, are recorded as "alive." Marine mammals that have been entangled in DGN gear and are released alive usually only have minor abrasions as a result of interaction with the net. There have been no long term studies to monitor the post-entanglement effects on marine mammals. Because only animals with minimal or no injuries are recorded as unharmed, NMFS will assume that most of the marine mammals released and reported as "uninjured" have no injuries that would lead to their death, and that latent effects are limited to short-term physiological stress or short term interruption of normal behavioral patterns. All marine mammal species that forage or migrate by diving or swimming at depth in areas of fishing effort are vulnerable to drift gillnets. Susceptibility to capture largely depends on a species' physical characteristics and behavior and survival rate likely varies among marine mammal species that may be incidentally entangled in DGN fishing gear. With the few observed large whale entanglements in the DGN from the 1990 to 2012 fishing seasons, it is difficult to speculate as to the likely survival rate of fin, humpback, and sperm whales that may be entangled in DGN gear under the proposed action. It is also difficult to quantify the encounter rate of these species to gillnet gear in general. As mentioned above, anecdotal evidence indicates that large whales will encounter DGN gear, but may avoid entanglement or may punch through the gear and thus not be observed by a NMFS observer or reported by the fishermen. These events are not reflected by the observer record of entanglement, but may be reflected in part by other reports of entangled whales received by the SWR Stranding Network, if any gear remains upon the whale after an encounter with gillnet gear. Not including reports from NMFS fisheries observers, there have been at least 7 reports of humpback and sperm whales found stranded that were entangled with some type of gillnet gear dating back to 1982, although DGN gear can only be positively attributed to 2 of these cases (Saez *et al.* 2013, *in prep*). Historically, gillnet fisheries other than the DGN, including domestic and foreign setnet fisheries, are more commonly associated with reported strandings of entangled whales (Saez *et al.* 2013, *In prep*). Without evidence from the stranding record that entanglements or events where large whales punch through gillnet gear are being significantly underestimated by the observer record, NMFS will continue to rely upon the observer record as the best information available.

i. Fin whales

The one fin whale that has been observed entangled in DGN gear is believed to have died as a result of the encounter. As mentioned before, fishermen report that large whales, such as blues and fin whales, will generally "punch through" nets. The observer records for the fin whale entanglement were reviewed and indicate that the animal was likely an adult, measured at 80 feet long. The animal caused extensive damage to the net, including imploded pingers and the loss of gear. Fin whales are large and fast and powerful enough to break through a drift gillnet. The reason for this one entanglement scenario where the whale did not break through is not known, but suggests possibility of such events occurring within the DGN fishery. Based upon the one observed bycatch and anecdotal reports from fishermen, it is unlikely that 100 percent of the fin whales that encounter DGN gear will be killed or that fin whales will be entangled every year. Given over 20 years of observer coverage in the DGN fishery, there has been only one observed entanglement of a fin whale. The paucity of data makes it difficult to assess the rate of mortality; however, based upon the limited available information, we will assume that, although entanglement rates will be extremely low, any fin whale entangled in DGN gear could be killed. However, given the relative size and strength of large whales, NMFS would not expect that all fin whale interactions or entanglements with DGN would result in serious injury or mortality. There is no specific data on fin whale serious injury/mortality rates based on the one lone record. Of the other large whale species that have been observed caught in the DGN fishery, many have escaped serious injury (e.g., all 3 observed humpback whales), while some appeared to have been seriously injured or killed (70% of sperm whales). In lieu of an available quantitative estimate, NMFS will rely on the qualitative estimate that some fin whales will be seriously injured or killed and some will not, and the chance of mortality is roughly equal to the chance of surviving, or 50 percent.

ii. Humpback whales

Since the 1997 implementation of the PCTRP, there have been two humpbacks entangled in DGN gear reported by fisheries observers. In 1998 and 2004 a humpback was entangled in a set documented as having a full complement of pingers, and in both cases the animals were released alive and were reported as uninjured. A third entanglement of a humpback caught in a DGN net was reported in 2009 from a fisherman. That animal was reported as alive, although the whale swam away with gear attached. There was also one observed entanglement in 1994 (in a non-pingered net as the PCTRP was not implemented until 1997), but again the animal was reported as released alive and uninjured. Humpbacks may be more surface oriented, that is, unlike sperm whales, humpbacks will feed near the surface of the water, even breaching out of the water to facilitate capture of concentrated prey. This surface orientation may cause the whales to get entangled closer to the top of the net.

The record of humpback bycatch observed in the DGN suggests that these animals would be expected to survive the entanglement without serious injury. However, given the rare event, it seems reasonable to assume there is some risk that any humpback whale entangled in DGN gear operated under the proposed action could be killed or potentially disentangled and released with an injury or trailing gear that could result in a life threatening situation based upon the nature of submerged drift gillnets gear and the observed serious injury and mortality of other large whale species. As noted previously, NMFS received a self-report of an entangled humpback that was released with trailing gear and thus considered seriously injured. As with fin whales, there does not seem to be enough observed take history to generate a reliable quantitative estimate of survival rate. In lieu of any additional information, NMFS conservatively relies on the qualitative estimate that some humpback whales will be seriously injured or killed and some will not, and assumes the relative risk of a humpback whale entangled in the DGN fishery being serious injured or killed is roughly equal to the chance of a escaping a serious injury, or 50 percent.

The response of humpback whales to a fully-pingered net is difficult to predict, given the small number of observed humpback entanglements and the fact that only one take was observed in a net without pingers (i.e., pre-PCTRP). However, based on vocalizations (Richardson *et al.* 1995; Au *et al.* 2006), reactions to sound sources (Maybaum 1993), and anatomical studies (Hauser *et al.* 2001), humpback whales appear to be sensitive to mid-frequency sounds, unlike other balaenopterids. Therefore, it seems reasonable to conclude that pingered nets may reduce interactions with humpbacks.

iii. Sperm whales

There have been a total of ten sperm whales observed entangled in DGN gear since 1990. Of those, four sperm whales have been observed entangled in DGN gear with pingers in three separate incidents since 1996 and all were seriously injured or killed. In two of the three incidents, the nets did not have the full complement of pingers (Carretta and Enriquez 2012). In 2010, two sperm whales were observed entangled in the same set with one animal recorded as dead and one animal recorded as released injured with netting trailing the whale upon release. In 1998, an entangled sperm whale was recorded as dead when retrieved from the net. The animal observed caught in 1996 was part of an experiment on the effectiveness of pingers and was seriously injured and likely died as a result of the encounter. Accounts from the incident indicate that the animal rammed the fishing vessel repeatedly, causing large gashes in its head and was trailing gear as the vessel left it (Carretta *et al.* 2005). Prior to implementation of the PCTRP in 1997, six sperm whales had been observed caught in DGN gear. Of these six, three sperm whales were caught in one single set, two were caught in another set, and one caught in another set. Of the three whales entangled together, all were 20 feet long or less suggesting that they were subadults.

The response of sperm whales to DGN gear that is configured with a full complement of acoustic deterrent devices (or pingers), as required by the PCTRP, is difficult to measure given the rarity of the observed entanglements. It is likely that sperm whales can hear the sounds being emitted by the pingers. Sperm whale sounds have dominant frequencies from 2.5 to 25 kHz, which matches their frequency range of best hearing (Madsen *et al.* 2002). Pingers broadcast a 10 kHz (± 2 kHz) sound at 132 dB (± 4 dB) re 1 micropascal at 1 m. Thus, there is no reason to believe that pingers are not heard by sperm whales, since they broadcast in the sperm whale's best hearing range. However, NMFS cannot determine from the available information whether or not this is deterring the animals from the nets or alerting them of the presence of the nets. Given limited data available and the low number of observed entanglements following the implementation of the PCTRP, it is not possible to determine if DGN encounter/entanglement rates have changed significantly, or if mortality rates have been significantly affected by the use of pingers or other changes to the fishery that have occurred over time. Of the total number of sperm whales (10) observed entangled in DGN gear, three were released alive, five dead, and two with a serious injury. If we assume that these responses to encounters with DGN gear are representative in lieu of any conclusive evidence to suggest otherwise, then 70 percent of the sperm whales that encounter this gear are likely to be killed during the entanglement or as a result of injuries sustained during the entanglement, while 30 percent are likely to be released alive without injury.

B. Sea Turtles

Potential impacts from the DGN on sea turtles will generally be related to injury or mortality, although any entanglement, whether or not it causes an injury or mortality, may also impact sea turtles. Injury of turtles entangled in a drift gillnet may result in mortality post-release due to impairment from debilitating effects of forced submergence, and/or wounds suffered as a result of net entanglement.

Sea turtles are prone to entanglement as a result of their body configuration and behavior (Balazs 1985). Records of stranded or entangled sea turtles reveal that fishing gear can wrap around the neck, flipper, or body of a sea turtle and severely restrict swimming or feeding. In drift gillnets, turtles are most likely to get entangled in the relatively large nylon mesh of the net, and may typically be released with little or no gear remaining on them. Large turtles such as leatherbacks do present a greater challenge to fishermen for safe release.

Once entangled, factors such as size, activity, water temperature, and biological and behavioral differences between species bear directly on metabolic rates and aerobic dive limits and will therefore also influence survivability in a gillnet. For example, larger sea turtles are capable of longer voluntary dives than smaller turtles, so juveniles may be more vulnerable to the stress of forced submergence than adults. During the warmer months, routine metabolic rates are higher, so the impacts of the stress due to entanglement may be magnified. In addition, disease factors and hormonal status may also play a role in anoxic survival during forced submergence. Any disease that causes a reduction in the blood oxygen transport capacity could severely reduce a sea turtle's endurance in a net, and since thyroid hormones appear to have a role in setting metabolic rate, they may also play a role in increasing or reducing the survival rate of an entangled sea turtle (Lutcavage and Lutz 1997). Sea turtles forcibly submerged for extended periods of time show marked, even severe metabolic acidosis as a result of high blood lactate levels. With such increased lactate levels, lactate recovery times are long (even as much as 20 hours) (Lutcavage and Lutz 1997). Therefore, sea turtles need to have an adequate rest interval at the surface in order to successfully recover from forcible submergence (Stabenau and Vietti 2003).

It is difficult to estimate whether sea turtles entangled and released from DGN gear would be at increased risk to entanglement again or perhaps exposed to an additional threat such as a ship strike or predation by sharks/killer whales. Presumably, a sea turtle recovering from a forced submergence would most likely remain resting on the surface, which would reduce the likelihood of being recaptured in a drift gillnet submerged at least 36 feet from the surface. Recapture would also depend on the condition of the turtle and the fishing pressure in the area, which is likely to be somewhat reduced from historical levels in the current DGN fishery. But the additional surface time could lead to an increase risk of a ship strike or predation. Currently, NMFS has no information on the relative likelihood of recapture of sea turtles by the driftnet fishery or increased risk from any other activity.

i. Leatherbacks

Of the 25 leatherbacks observed entangled in the DGN fishery from 1990 through 2012, 13 were assigned a condition of "Dead" (52%), 11 were assigned a condition of "Alive" (44%), and 1 was "Unknown." Since the leatherback with unknown condition was likely to be dead, based on the observer's notes (NMFS 2006a), the observed direct mortality of leatherbacks is 58 percent mortality rate in this fishery. Upon further review of the observer records by the SWR and SWFSC, it appears that as many as 3 of the leatherbacks released alive (and assigned a condition of "Alive") may have been severely compromised by their interaction with the gear and being forcibly submerged for a period of time. These animals showed some signs of life immediately after release, but did not give any indication of vigorous swimming or recovery (i.e., leatherback did not lift its head to breathe or the animal immediately sank out of view), and may have just as likely perished as survived (see NMFS 2006a details). The ultimate fate of all 3 turtles is unknown, but delayed or indirect mortality as a result is a distinct possibility.

Currently, there is no information on the survival rates of leatherbacks caught and released "alive" in the DGN fishery. However, survival rates have been proposed for various categories of interactions by sea turtles with longline gear (Ryder *et al.* 2006), which reflect elements of forced submergence as well as hooking or entanglement injuries. In the case of leatherbacks, the estimated mortality rate for fully disentangled individuals that were not hooked is 2 percent. While there are instances where leatherbacks may be released alive and fully disentangled in the DGN fishery, this may not be analogous since turtles may not be free to come to the surface and breathe when caught in DGN gear, which they usually can do in shallow-set longline gear. NMFS estimates the mortality rate for leatherbacks caught with longline gear when they have been comatose and resuscitated due to extended submergence and trauma is 70 percent. This estimate may in fact more analogous to the DGN as turtles are typically subject to extended submergence in a DGN net, and observer records indicate a number of leatherbacks have appeared to be struggling upon release, including the 3 individuals referenced above.

Based upon this further review, NMFS believes that a more appropriate means of expressing anticipated mortality rates for leatherbacks in the DGN fishery is through a combination of both immediate and delayed mortality. As described above, approximately 50 percent of the leatherbacks observed and released were clearly dead, however some animals showed relatively weak signs of survival. NMFS conservatively assumes that the 3 apparently compromised leatherbacks were also likely to succumb to delayed mortality. For the purposes of this opinion, we estimate the total mortality rate is approximately 16 dead individuals out of 25 observed leatherbacks, or approximately 65 percent.

ii. Hard-shell Turtles: North Pacific Loggerhead, Green, and Olive Ridley

Of the 16 loggerheads observed entangled in the DGN fishery from 1990 through the present, 4 were assigned a condition of "Dead" or "Injured"(25%), and 12 were assigned a condition of "Alive" (75%). The 1 green turtle observed entangled was reported "Dead", and the 1 olive ridley turtle was reported "Alive." There have also been 3 other unidentified turtles, presumably hard-shelled turtles assumed to be loggerheads in previous biological opinions on the HMS and DGN fishery (NMFS 2004), 2 recorded as "Alive" and 1 unknown turtle recorded as "Dead." In total, the direct mortality rate for all 21 hard-shelled species (including 1 loggerhead with an unspecified injury) is 33 percent (6 out of 21). It is not clear why the percentage of hard-shell turtles that are observed dead is so much lower than for leatherbacks. It is possible that because leatherbacks typically lead a completely pelagic existence, that they are unused to confinement of any sort (in Jones *et al.* 2012) and may continuously attempt to use their significant strength to fight their way out of the net and end up with more significant entanglements or reduced energy stores compared to smaller hard-shell turtles. Additionally, hard-shell turtle entanglements may occur much nearer to the time of haulback of net. The estimates of delayed mortality rates for hard-shell turtles caught in longline fishing gear are 1 percent for animals that were not hooked and were fully disentangled; and 60 percent for animals that were comatose and subsequently released (Ryder *et al.* 2006). NMFS does believe there is some delayed mortality impact for hard-shell turtles that may be released, although it is not clear what the magnitude may be as there is no data on delayed mortality for turtles caught in DGN gear. Based on the general concepts that longline delayed mortality rates were derived from, there is no reason to believe delayed mortality rates for hard-shelled turtles caught in DGN gear would be extremely high, as comatose or otherwise obvious signs of compromised health have not been frequently reported. Although only about one-third (33%)of hard-shelled turtles observed caught in DGN gear have been reported dead, for the purpose of this opinion, we assume that the total mortality rate is approximately 50 percent, accounting for some limited delayed mortality resulting from forced submergence or injury.

3. Risk

In this section, NMFS relates the anticipated exposure and response of individuals to the proposed action with the expected impacts to the population and/or species. In evaluating the risk to ESA-listed species that is associated with anticipated bycatch resulting from the maximum fishing effort associated with the proposed action, NMFS considers the likelihood that 1,500 sets will occur in the DGN fishery in a year. As described in the *Proposed Action*, DGN effort following implementation of the PLCA in 2001 was approximately 1,500 sets annually. Since that time effort has generally decreased, with 2006 being the last year that approximately 1,500 sets occurred. Recent effort (e.g., 2010, 2011, and 2012) has been less than 500 sets a year. However, the proposed action acknowledges that enough permits are still being issued annually such that it is possible that vessels which may have been inactive or fishing very little in recent years could return to more active status in the fishery. Based on the declining trend of effort since 2001, it is hard to gauge the probability that 1,500 sets will ever be made in the DGN fishery again, given the current state of the fishery, or that the long-term average of effort over the course of a period of years would ever approach 1,500 sets. It seems more likely that annual effort will be something less than 1,500 sets, probably by a considerable amount. As a result, it is also reasonable to assume that the anticipated bycatch rates for ESA-listed species generated upon the assumption of 1,500 sets annually that have been presented above are an overestimation of what will likely occur for any species, especially when considered over a period of time where the average effort is most likely to be something less than 1,500 sets. Consequently, NMFS considers the anticipated bycatch totals and relative risks to populations that are described below to be conservative estimates that are likely overestimating the effect of this action on these species to some degree.

A. Marine Mammals

i. Fin Whale

Under the proposed action, NMFS expects that up to 1 fin whale could be caught in the DGN fishery in any given year (Table 11); although no more than 2 individuals would be expected to be caught over a 5-year period (Table 8). Because there has only been one observed entanglement of a fin whale since 1990, it is difficult to determine what age-class or sex of fin whales may be most vulnerable to entanglement in the DGN fishery based on observer records.

For the purposes of this Opinion, NMFS will assume all individuals in the population are vulnerable and of equal significance, that is, an entangled fin whale could be male or female of any age class.

As stated above, the one fin whale observed in the DGN fishery was released alive, but with potential serious injury due to the amount of gear on the animal when it was released. As a result, NMFS assumes that 1 fin whale could be seriously injured or killed by the DGN fishery in any year. Over time, NMFS would not expect that all fin whale interactions or entanglements with DGN would result in serious injury or mortality given the relative size and strength of large whales. In lieu of an available quantitative estimate, NMFS will rely on the qualitative estimate that some fin whales will be seriously injured or killed and some will not. As a result, NMFS assumes that no more 1 fin whale is expected to be seriously injured or killed out of 2 that may be caught over a 5-year period (2 individuals x 0.50 mortality rate = 1 serious injury and mortality).

ii. Humpback Whale

Under the proposed action, NMFS expects that up to 2 humpback whales could be entangled in the DGN fishery in any given year (Table 11), and up to 4 individuals would be entangled over a 5-year period (Table 8). For the purposes of this Opinion, NMFS assumes that all age-classes are vulnerable and of equal significance and males are as vulnerable as females.

Although past reports suggest humpbacks would be expected to survive the entanglement without serious injury, it seems reasonable to assume there is some risk of serious injury or mortality and that any entanglement could be lethal. As with fin whales, there does not seem to be enough observed take history to generate a reliable quantitative estimate of survival rate. In lieu of any additional information, NMFS conservatively relies on the qualitative estimate that some humpback whales will be seriously injured or killed and some will not, and assumes the relative risk of a humpback whale entangled in the DGN fishery being serious injured or killed is 50 percent. As a result, NMFS expects that in any given year, 1 humpback whale will be entangled in manner which could be a lethal (up to 2 individuals x 0.50 mortality rate = 1 serious injury and mortality). Over a 5-year period, NMFS expects that up to 2 individuals could suffer serious injury or mortality (4 individuals x 0.50 mortality rate = 2 serious injuries and mortalities). This level of expected entanglements reflects the rarity of humpback whale bycatch and that it is reasonable to assume that entanglements will not occur annually.

iii. Sperm whale

Under the proposed action, NMFS expects that up to 2 sperm whales could be caught in the DGN fishery in any given year (Table 11), and up to 8 individuals would be expected to be caught over a 5-year period (Table 8). The observed record of bycatch includes animals of varying ages, although smaller and/or younger individuals may be slightly more vulnerable

(NMFS unpublished data). However, for the purposes of this Opinion, NMFS assumes that all individual sperm whales that may be entangled in DGN gear regardless of age or sex are of equal significance to the sperm whale population.

Although a majority of sperm whale bycatch occurred prior to implementation of PCTRT recommendations, there has been 70 percent observed serious injury and mortality rate for this species in this fishery when all entanglements are considered. NMFS assumes this injury/mortality rate will continue. As a result, in any given year, it is possible that up to 2 sperm whales could be entangled in a manner which could be lethal. Over a 5-year period, NMFS expects that up to 6 sperm whales could be seriously injured or killed (8 individuals x 0.70 mortality rate = 5.6 serious injuries and mortalities).

B. Sea Turtles

i. Leatherbacks

Under the proposed action, NMFS expects that up to 3 leatherbacks could be caught in the DGN fishery in any year (Table 11), and up to 10 could be caught over the course of 5 years (Table 8). As mentioned previously, the mortality rate of leatherbacks caught in the DGN fishery is expected to be around 65 percent. As a result, it is possible that as many as 3 mortalities could occur in a given year. NMFS assumes that 7 of 10 leatherback entanglements that may occur over a 5-year period will result in mortality. The leatherbacks that are typically foraging in the waters off coastal California and likely to interact with the DGN fishery are expected to be adult or sub-adult, based upon curved carapace lengths from leatherbacks observed caught in the DGN fishery and tagging studies being conducted in central California by the SWFSC (NMFS 2006a; Benson *et al.* 2007c; Benson *et al.* 2011). Data from these studies have suggested that females constitute about 67.5 percent of the individuals found in the action area (Benson *et al.* 2007c). This is consistent with other estimates of sex ratios for the western Pacific leatherback population (NMFS 2012d). As noted above in the status section, the leatherbacks exposed to the proposed action are most likely originate from beaches in the Western Pacific, with the majority comprised of summer nesters from Papua, Indonesia.

NMFS considers the impact of the DGN primarily in context of the impact on adult females, as the best information on the status of sea turtle populations is based on patterns of nesting activity and estimates of nesting females. Based on the available information, NMFS will assume it is possible that 3 adult females could be removed from the population in any given year. Over time, it reasonable to assume that the relative proportions of females caught in the DGN fishery will reflect the sex ratio of the population affected, and mortality rates will reflect the patterns observed in the past. Even though not all individuals found off California are mature adults, NMFS conservatively assumes that all individuals caught would be adults. Of the up-to-10 adults that may be caught over a 5-year period, 67.5 percent would likely be female, with a 65 percent mortality rate. This equates to the loss of up to 5 adult females over the course of 5 years

(10 adults x 0.675 female x 0.65 mortality rate = 4.4 adult females lost). Most of the females that are removed from the population as a result from the DGN fishery are expected to be from the western Pacific population, likely Jamursba-Medi.

ii. North Pacific Loggerheads

Under the proposed action, NMFS expects that up to 3 loggerheads from the North Pacific DPS could be caught in the DGN fishery in any year (Table 11), and up to 7 could be caught over the course of 5 years (Table 8). The mortality rate of loggerheads incidentally taken as bycatch is expected to be around 50 percent. As a result, it is expected that up to 2 mortalities could occur in a year. Over time, NMFS estimates that up to 4 out of 7 loggerhead entanglements that may occur over a 5-year period will result in mortality.

At this time, there is no specific available information about the sex ratio of loggerheads foraging in the Pacific that may be found off the U.S west coast. As a result, NMFS assumes the sex ratio is 50:50 (Conant 2009; NMFS 2012d). Based on data collected from loggerheads observed caught in the DGN fishery and other known information, NMFS assumes that loggerheads that are likely to be present off the U.S. west coast consist mainly of juveniles (NMFS 2004). The previous biological opinion assumed the expected survival rate of juvenile loggerheads to adulthood was 0.59 (NMFS 2004). This is generally consistent with the survival rates of juvenile loggerheads that may interact with the Hawaii longline fishery recently used in analysis of that fishery (0.56; NMFS 2012d).

Based on the available information, NMFS will assume it is possible that 2 individual loggerheads could be removed from the population in any given year, and it is possible that both could be female. However, this likely ultimately equates to the loss of only 1 adult female from the nesting population based on the estimated survival rate of a juvenile to adulthood. Over a 5-year period, NMFS expects that the entanglement of up to 7 juvenile loggerheads in the DGN fishery equates to the loss of 1 adult female from the population (7 juveniles x .59 survival rate x 0.50 female x 0.50 mortality rate = 1.0 adult females lost). The females that are removed from the population are expected to be part of the North Pacific DPS.

iii. Olive ridley and green turtles

Under the proposed action, NMFS expects that up to 1 olive ridley and 1 green turtle could be entangled in the DGN fishery in any year (Table 11), although no more than 2 individuals of either species would be expected to be caught over a 5-year period (Table 8). As specified above, the mortality rate of hard-shelled turtle species is assumed to be around 50 percent. The lack of observed bycatch history of these two species makes it difficult to distinguish the age-class, size, or sex of individuals that are likely to interact with the DGN fishery. As a result, NMFS will conservatively assume that adult females from each species could be caught. In any given year, this could result in mortality for that individual. Over time, NMFS will assume that there is a 50 percent probability that any hard-shelled turtle capture will result in mortality, and leading to a loss of up to 1 adult female during a 5-year period (2 female adults x 0.50 mortality = 1.0 adult female lost).

3. Relationship between Observer Coverage and Analysis of Effects of the Proposed Action

The observer program is an integral part of this proposed action, as the information that is necessary for monitoring current and estimating future impacts of the DGN fishery on ESA-listed species comes almost exclusively from observer records. The DGN fishery has maintained an observer coverage goal of 20 percent since the implementation of the DGN observer program in 1990. This goal had been met, or nearly so, in most years until 2007, when coverage slipped from 16 percent down to 12 percent in 2010 (Table 3 *in Proposed Action* above). This recent reduction in coverage rate has raised some concern about the reliability of bycatch estimates produced from the observer data. Observer coverage increased back to target levels in 2011 after some renewed effort from the observer contractor to improve coverage. The total effort in the fishery dropped from about 3,000 sets per year in the late 1990s down to about 1,100 sets in the mid-2000s, and to nearly half that effort from 2010-12. Statistically speaking from a sampling point of view, as total fishing effort is reduced, observer coverage may need to be increased in order to maintain confidence in the bycatch estimates produced for species that rarely interact with the DGN fishery (Babcock *et al.* 2003; Carretta 2012). As such, the recent National Bycatch Report suggested that observer coverage of 30 percent would be a more appropriate target for documenting bycatch of rare or sensitive species in the DGN fishery (NMFS 2011).

The proposed action intends to maintain the coverage goal in the DGN of 20 percent given the primary challenge of funding limitations in the current observer program. There are also challenges in how observer coverage could be increased given that a relatively large portion of the total fishing effort takes place on vessels that are not observable for the reasons discussed below. Alternatives to traditional observers to augment existing observer coverage, such as electronic monitoring or alternative platforms, have been considered in the past (and some tested), but it is not clear if they are economically and technologically feasible at this point and what it might take to implement these measures into the observer program of the DGN fishery. At the 2009 meeting of the TRT, the team discussed the feasibility of electronic monitoring and noted that challenges still remain regarding the use of this technology to replace observers, particularly with species identification and pinger detection. There are also challenges regarding the effectiveness of using a hydrophone deployed off the stern of the vessel to check pinger presence and configuration during setting and/or haulback or whether electronic monitoring could be used to improve the effectiveness of monitoring unobserved and unobservable vessels.

Underlying many of the questions related to observer coverage targets (e.g., the representative quality of observer coverage, and the overall reliability of bycatch estimates produced by observer data in the DGN fishery), is the issue of unobservable vessels. From inspections of individual vessels at the beginning and throughout the season by the observer program a portion of the fleet has been deemed unobservable in any given year. These reasons are generally related to observer safety, including the size of the vessel and subsequent lack of appropriate accommodation, an unsafe vessel, or unsafe working conditions for the observer. The percentage of the DGN fishery (both in terms of boats and total fishing effort) that is unobservable appears to have been increasing over time, although the active fleet size has decreased significantly in recent years perhaps leaving a greater percentage of unobservable boats remaining. Some of these unobservable vessels are very active participants in the fishery, and it has been estimated that as much as 40-45 percent of total effort (number of sets) in the DGN was made by vessels that are unobservable in some recent years (Carretta and Enriquez 2012). The concept of using data gathered from observing 20 percent of fishing effort is based on the concept of sampling and the fundamental assumption that the 20 percent of the effort that is documented is proportionally representative of the other 80 percent of the effort that is not, in terms of catch or encounter rates for target and non-target species. When certain portions of the fishery are never "sampled," in this case boats that are unobservable, it raises questions about whether the fishing effort of the unobservable vessels is represented by the observer data gathered from the rest of the fleet and the reliability or accuracy of bycatch estimates produced from data that may not represent the whole fleet. Factors such as any difference in compliance with bycatch mitigation measures and general fishing behaviors that could lead to increased encounters with protected species onboard DGN vessels without the presence of fisheries observers could bias the observed record of protected species bycatch rates compared to the bycatch rate of the entire fleet.

During this consultation, SFD and PRD staff met to discuss the potential implications of the questions about the observer coverage that were mentioned above, specifically observer coverage targets, representative observer data, and unobservable vessels (summarized in NMFS 2012b). Initially, PRD generally analyzed the relative observer coverage both north and south of Point Conception, and before and after November 15, the end of the Pacific Leatherback Conservation Area restrictions, to see if the distribution of observed DGN fishing effort aligned with the effort reported by fishermen in logbooks. Based on the logbook data that was available, there did not appear to be any gross or obvious gaps in observer coverage, either spatially or temporally. It is important to note that logbook data was provided in terms of statistical reporting area fished, and fine scale comparisons analysis of fishing positions with the observer data was not possible due to the relative large size of these fishing reporting areas. During these discussions between SFD and PRD, there was consideration of a more rigorous examination of observer coverage, the location/timing of observed takes, and the distribution of effort across the fishery, but this would likely involve a future significant effort including involvement from SWFSC and the observer program.

In response to questions about the overall reliability of the observer data, given unobservable vessels and the potential for biases generated by observer placement (or absence) on DGN vessels, SFD completed an analysis of some of these issues in March, 2013, using the information that was available to them (NMFS 2013c). A more detailed comparison of logbook reporting for the entire DGN fishery and the location of observed fishing effort were presented. In general, the relative frequency of effort across logbook reporting blocks has been similar, both since 1990 and over the most recent 5 years (2007-2011) of available data. There is an apparent discrepancy where observed locations are more frequent in a range of reporting blocks that represent offshore southern waters near the U.S. - Mexico border than the logbook reported sets. However, this may be a result of an incomplete map of reporting blocks that is provided to fishermen in the California State gillnet logbook that is used for reporting DGN catch and effort data. The map in the logbook does not provide a complete representation of the statistical reporting blocks for those offshore southern waters, and fishermen are likely reporting catch and effort in the logbooks to other familiar blocks that are reasonably close in their minds. Otherwise, the relative distribution of observed effort compared to overall effort as reported in the logbook across statistical reporting blocks appears to be similar. As a result, SFD was not able to detect evidence of bias in observer coverage that could be affecting the observed rate of bycatch of ESA-listed species compared to the overall fishery in terms of exposure based on fishing locations.

In addition, an analysis of CPUE was conducted to look for indications that fishermen could be fishing differently with an observer on board compared to sets where observers are not present, as reflected by the catch of target species. Comparing the CPUE of swordfish per set for boats in the DGN fishery 2001-2011 that had taken an observer at least once since 2001, there was no significant difference between vessels fishing when they had observers present and when they were unobserved, although the mean catch rates overall were slightly higher for unobserved sets (2.75 to 2.27 swordfish per set; p=0.09). Interestingly, the overall CPUE for boats that had not taken an observer since 2001 during this time period was 1.89 swordfish per set, which does not support a conclusion that vessels that are unobservable are doing anything substantially different in terms of fishing practices that enhances swordfish production at the risk of ESA-listed bycatch. Therefore, SFD concluded there was no evidence that swordfish CPUEs were indicative of any bias that might be created by fishing or operating differently in the presence of a fishery observer compared to unobserved fishing effort. As a result, SFD concludes that the observer data that has been collected is representative of both the observed and unobserved fishing effort in the DGN fishery.

Finally, SFD sought to examine the record of enforcement/compliance history through information provided by NOAA Office of Law Enforcement (OLE). The purpose was to gauge the overall level of compliance of DGN vessels and look for any indications that unobservable vessels or unobserved trips were more prone to regulation violations that could influence the bycatch of protected species. Information was provided on investigations that occurred from 1991-2007, although vessel names were not provided which precluded distinguishing vessels that may have been unobservable or might have been carrying an observer at the time of the alleged infraction. In general, the majority of investigations involved pinger compliance (16 out of 27), although only one incident was reported after 2001. Given the new implementation of pinger requirements in 1997, initial struggle with compliance would not be unexpected. Other investigations included compliance with maximum net length, failure to notify observer program of fishing activity, and other aspects unrelated to gear or closure requirements that are designed to minimize the bycatch of protected species. Of all investigations, 23 of them occurred from 1991-2000. In total, the information did not provide much insight into the relative compliance of unobservable vessels or vessels not carrying an observer, compared to observed fishing effort. There was no description of the compliance rate of vessels that were boarded or were observed, and it was not possible to distinguish the nature of vessels or fishing effort associated with compliance infractions. Although the available data indicate that compliance investigations have been relatively few since 2001, data after 2007 were not provided, and it is not clear if the decrease in compliance investigations is related to improved compliance, reductions in the fishery, and/or reduction in OLE inspections or monitoring. As a result, SFD was unable to determine whether vessels without an observer were more prone to regulatory violations that could be influencing bycatch rates.

These analyses provided by SFD do not provide evidence that biases are being created by the presence (or absence) of fisheries observers on DGN vessels that may influence the observed record of ESA-listed species bycatch, and consequently, the expected bycatch rates of these species for the entire DGN fishery. The available information appears to suggest the observed portion of the DGN fishery is similar to the unobserved portion, at least in terms of the overall distribution of observed/unobserved effort and the relative outcome of swordfish catch. While some level of uncertainty about the influence of unobservable vessels or appropriate observer coverage rates remains, there appears to be nothing contained in the analyses that would inform modification of the expected bycatch rates generated from observer data at this time. As a result, NMFS will continue to rely primarily upon the data generated from the observer program in order to monitor the bycatch of ESA-listed species.

Annual estimates of bycatch in the DGN fishery have been traditionally calculated by a relatively straightforward extrapolation of the numbers of observed bycatch to the proportion of the total fishing effort observed. Rare bycatch events can be extrapolated into relatively large estimates of bycatch based simply on the relative observer coverage level, which in turn can be affected significantly by the distribution of observer placement and unobserved fishing effort. As mentioned before, inclusion/exclusion of rare events can have a significant impact on bycatch estimates and predictions. The recommendation for increasing observer coverage targets is aimed at reducing some of the uncertainty associated with the likelihood of witnessing a rare event given proportional sampling of all fishing effort. However, the benefits in terms of reduced uncertainty and increased confidence in estimates of rare bycatch events produced from 30 percent observer coverage in the DGN fishery (or any other coverage level) has not been fully described. At this point, the recommendation to increase observer coverage is based on the qualitative assessment that more observer coverage will reduce the uncertainty in bycatch estimates produced from observer data, especially for rare events. A more thorough evaluation of the relationship between observer coverage levels and the uncertainty of bycatch estimates is needed before NMFS can fully assess the benefits and feasibility of obtaining higher levels of observer coverage. In the meantime, NMFS views the relative effectiveness of 20 percent observer coverage that has been in place for more than two decades as offering a representative sample of what has happened in the fishery over a long period of time that is more informative than focusing on the observer record in any single year, regardless of the specific observer coverage level achieved in any single year (as long as the observer coverage over the long term is approximately 20 percent), and concludes that the estimates of bycatch expected to occur in the DGN fishery produced from this long-term data set and anticipated in this Opinion are reasonably certain.

While NMFS will continue to evaluate the need for increased observer coverage, other tools may also be useful for reducing some of the uncertainties associated with unobserved or unobservable fishing effort. Vessel monitoring systems (VMS) could be used to monitor the location of all DGN fishing effort, simplifying the ability to track compliance with closed areas designed to minimize the risk of bycatch, such as the PLCA, and monitoring the relative distribution of observed and unobserved fishing effort. Additionally, vessels that may be unobservable could be located for placement of observers in an alternative platform setting where the catch is monitored by an observer and the safety and crew accommodation issues on unobservable vessels could be avoided. DGN vessels could also be more easily located and identified for inspection by law enforcement personnel to inspect vessels for compliance with various take reduction measures such as proper use of pingers. Electronic monitoring of fishing effort where cameras and other electronic equipment are used to document the catch of fishing vessels without the physical presence of an observer is another tool that should be explored as a way to get information from unobserved or unobservable fishing effort.

In this Opinion, the effects analysis has estimated the total number of ESA-listed individuals that will be affected by the DGN fishery. Because will not be present on all boats at all times, NMFS does not expect all bycatch events to be observed, recorded, and reported. As a result, NMFS will look to the proportional record of observation compared to the total effort of the DGN fishery to provide indications of the total impacts on ESA-listed species from the fishery. This biological opinion relies upon the proposed action and the assumption that 20 percent observer coverage will be maintained over time. It also assumes that bycatch rates between observed and unobserved DGN vessels are similar. Based on these assumptions, NMFS has anticipated the level of bycatch that would be expected to be observed and reported, given the effects of the proposed action discussed previously and summarized in Table 13 in the *Incidental Take Statement*. In any given year, it is possible that the expected entanglements of ESA-listed sea turtles and marine mammals could occur in the observed portion of the fishery. The actual probability of observing any event that occurs 1 time in a year is 1 out 5 (20%) if you observe 20 percent of the total fishery. If an event occurs 5 times in a year, you would expect to see it once during a year if you observe 20 percent of the total fishery. However, in any 5-year period, you would not expect to see a multitude or series of events where any of these ESA-listed species are caught consistently in the observed portion of the fishery given the historical observer data that suggests interaction/entanglement rates for these species are events that occur once or twice in a year at most. In other words, although we expect that up to three leatherbacks may be entangled in the DGN fishery in any year, and up to 10 over a 5-year period, we do not expect that leatherback entanglements will be observed every year based upon the 20 percent observer coverage. Ultimately, NMFS expects that over time (i.e., over a 5-year period) the observed record of DGN fishery bycatch will reflect the total take level analyzed in the *Effects of the Action* and *Integration and Synthesis* sections of this Opinion in proportion to the percentage of total DGN fishery effort that is observed.

Impact of data collection

As part of the data collection process, as prescribed by the observer program and the *Terms and Conditions* of this biological opinion, fisheries observers will collect information and relevant biological samples from ESA-listed species that are caught in DGN gear. It is unlikely that any ESA-listed whales will be sampled by observers as they are unlikely to be brought aboard the fishing vessel due to their large size and the general difficulty and safety concern of trying to handle large animals, especially if they are still alive. NMFS expects that fishing vessels will take appropriate measures to handle and release these individuals while minimizing injury to the animal and damage to their gear, per the regulations in 50 CFR § 223.206(d)(1) and the *Reasonable and Prudent Measures* and *Terms and Conditions* of this Opinion. Smaller species, such as hard-shelled sea turtles, are likely to be brought aboard the boat and should be available for sampling. Observers will, if practicable, measure, photograph, and apply flipper and passive integrated transponder (PIT) tags to any live sea turtle, and salvage any carcass or parts or collect any other scientifically relevant data from dead sea turtles, per authorization in 50 CFR § 222.310 and § 223.206 regarding the handling of endangered and threatened sea turtles by designated NMFS agents. In addition, observers will also collect skin tissue samples for genetic studies. Tissue biopsies would be taken using the antiseptic protocol described by Dutton and Balazs (1995). The biopsy site would be scrubbed with an isopropyl alcohol swab before and after sampling. The tissue biopsy would be obtained using a 4-mm sterile biopsy punch from the trailing edge of a rear flipper when possible, with the resulting plug less than the diameter of the punch. Following the biopsy, an additional antiseptic wipe would be used with modest pressure to stop any bleeding. A new sterile biopsy punch would be used on each animal.

NMFS routinely authorizes biological sampling of sea turtles captured in directed research that includes tissue sampling, as well as more invasive sampling techniques. Based on the described methods of cleansing and disinfection, infection of the tissue biopsy site would not be expected. At most, NMFS expects turtles would experience brief, minimal discomfort during the process. It is not expected that individual turtles would experience more than short-term stress during tissue sampling. Researchers who examined turtles caught two to three weeks after sample collection noted the sample collection site was almost completely healed. During a more than 5 year period of tissue biopsying using sterile techniques, NMFS researchers encountered no infections or mortality resulting from this procedure (NMFS 2006b). Bjorndal *et al.* (2010) investigated the effects of repeated skin, blood and scute sampling on juvenile loggerhead growth. Turtles were sampled for each tissue type three times over a 120-day period. The authors found that repeated sampling had no effect on growth rates; growth rates of sampled turtles were not significantly different from control animals. Turtles exhibited rapid healing at the sampling site with no infection or scarring. Further, all turtles increased in body mass during the study indicating that sampling did not have a negative impact on growth or weight gain. The authors conclude that the sampling did not adversely impact turtle physiology or health (Bjorndal *et al.* 2010). Consequently, NMFS believes the impact of collecting tissue samples is minor and will not have any significant effect on any species of sea turtle that may be captured in the DGN fishery.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of all future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. For the purposes of this analysis, the action area includes the EEZ off the coasts of Washington, Oregon and California and adjacent high seas areas. Activities that may occur in these areas will likely consist of state or federal government actions related to ocean use policy and management of public resources, such as fishing or energy development projects. Changes in ocean use policies as a result of government action are highly uncertain and may be subject to sudden changes as political and financial situations develop. Examples of actions that may occur include development of aquaculture projects; changes to state or federal fisheries which may alter fishing patterns or influence the bycatch of ESA-listed marine mammals and sea turtles; installation of hydrokinetic projects near areas where marine mammals and sea turtles are known to migrate through or congregate; designation or modification of marine protected areas that include habitat or resources that are known to affect marine mammals and sea turtles; and coastal development which may alter patterns of shipping or boating traffic. However, none of these potential state, local, or private actions, can be anticipated with any reasonable certainty in the action area at this time. Even if some of the projects were developed with any certainty, the level of direct or indirect effects associated with most of these types of actions appear speculative at this point. Current and continuing non-federal actions that may occur in the action area and may be affecting ESA-listed marine mammals and sea turtles are addressed in the environment baseline section.

VII. INTEGRATION AND SYNTHESIS

Using the projected fishing effort that could occur in the DGN fishery based on the permitted vessels and recent history of the fishery, and the bycatch rates that have occurred since implementation of measures to reduce interactions between protected species and the DGN fishery, NMFS has estimated the capture and resulting injuries and mortality of ESA-listed marine mammals and sea turtles that may occur as a result of this proposed action. The rest of this Opinion will be focused on how this anticipated level of effect, when added to the status and environmental baseline for each of these species, affects the likelihood of both the survival and recovery of each species. As mentioned previously, NMFS assumes that the anticipated effects that have been described above based on maximum levels of fishing effort that could, but may not be likely, to occur are conservative estimates. NMFS expects the actual effects to these species will be less than what is presented.

A. Marine Mammals

When assessing the impact of proposed or ongoing projects on marine mammals under the MMPA, NMFS relies upon the concept of potential biological removal level, or PBR, to assist or guide decision making about acceptable or appropriate levels of impact that marine mammal stocks can withstand. As described in the MMPA, PBR[20] is defined as "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (16 U.S.C. 1362 (20)." In addition, the MMPA states that PBR is calculated as the product of three elements: the minimum population estimate (Nmin) of the stock; half the maximum net productivity rate (0.5R max) of the stock at a small population size; and a recovery factor (Fr). PBR is an approach developed to calculate allowable incidental take of marine mammals under the MMPA. It uses conservative minimum population estimates and a recovery factor based on the population status and is also comprehensive because it calculates take (total take) per stock. The underlying analysis supporting the PBR concept examined the impact of population removals for a period of 100 years in terms of delay in populations reaching carrying capacity. These simulations evaluated the robustness of each case over a range of bias or uncertainty in productivity rates, abundance estimation, and mortality estimation (Wade 1998). Given this long term simulation approach used to support this concept, the levels established under the PBR are most appropriate for examining the impact of annual average removals over a long period of time.

It is important to note that while PBR serves as a useful metric for gauging the relative level of impact on marine mammal stocks as defined in the MMPA, PBR by itself does not equate to a species or population level assessment under the ESA where analyses are conducted at the level of the species as listed as threatened or endangered. The concept of managing impacts to marine mammal populations at levels that do not significantly affect recovery times shares the general intent of the jeopardy standard of the ESA in terms of looking at both the continued existence and recovery of a population, but the ESA does not rely specifically on the same metrics or directly relate the likelihood of recovery to potential delay. For the purposes of this Opinion, NMFS will use the PBR concept from the MMPA to help characterize the relative impact of the

[20] Included in the 1994 amendments to the MMPA.

DGN on the stocks of ESA-listed marine mammals that have been identified as likely to be affected by the DGN fishery, and then relate those findings to the species as a whole under the jeopardy standard of the ESA.

i. Fin Whales

In this Opinion NMFS has identified the CA/OR/WA stock of fin whales as the population of fin whales that may be affected by the DGN fishery occurring off the U.S. west coast. NMFS anticipates that up to 1 fin whale may become entangled or captured in DGN gear in any year. It is possible this may result in a serious injury or mortality, so NMFS will consider the worst case scenario that this would occur. Over a 5-year period, NMFS expects that no more than 2 fin whales will be taken by the DGN fishery. NMFS does not assume that every fin whale entanglement will result in serious injury or mortality, so NMFS expects that no more than 1 fin whale would be removed from the CA/OR/WA stock of fin whales during a 5-year period as a result of this proposed action.

The best estimate of fin whale abundance of this stock is about 3,000 whales. In the most recent SAR, the potential annual PBR level for this stock is calculated as the minimum population size (2,624) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.3, resulting in a PBR of 16 (Carretta *et al.* 2013). In any given year, the loss of 1 fin whale represents about 6.3 percent of the PBR for this stock. Consistent with the approaches typically used in the SAR and in negligible impact determination analyses to compare known serious injuries/mortality to PBR and impacts that occur over a broader period of time to gauge effects, the loss of 1 animal over a 5-year period represents 1.3 percent of PBR on an annual basis, well below any level that would be expected to impact the ability of the CA/OR/WA stock of fin whales to recover.

As mentioned in the *Environment Baseline* section, significant threats to this stock include ship strikes and incidental entanglement in commercial fishing gear. NMFS SWR PRD conducted a negligible impact determination analysis for a permit under MMPA 101(a)(5)(E) for fisheries that affect the CA/OR/ WA fin whale stock, including the DGN fishery, that considered the cumulative impact to this stock from all human sources (see NMFS 2013b). This analysis is required under the MMPA to authorize the taking, by persons using vessels of the United States while engaging in commercial fishing operations, of marine mammals designated as depleted because of their listing under the ESA. In that analysis, NMFS found that the 14 year annual average serious injury and mortality to the CA/OR/WA stock of fin whales from all human-caused sources, including commercial fisheries (0.3 animals) + ship strikes (1.1 animals), is 1.4 animals, which is 8.8 percent of this stock's PBR (16 animals/year). The 5 year annual average serious injury and mortality to the CA/OR/WA stock of fin whales from all human-caused sources, including commercial fisheries (0.6 animals) + ship strikes (1.6 animals), is 2.2 animals, which is 13.8 percent of this stock's PBR.

In this Opinion, NMFS must consider that the DGN fishery is expected to occur each year in the foreseeable future. In lieu of any information that suggests the magnitude of impacts resulting from all sources of serious injury and mortality to this stock will change, NMFS anticipates that the magnitude of impacts that have occurred in the past are expected to continue into the foreseeable future, including the occasional take in the DGN fishery. Therefore, the analyses reflected in the draft NID are assumed to represent the future effects from threats that can be readily assessed in the SAR.

While there is some indication that fin whales have increased in abundance in coastal waters off California in the late 1970s and mid-1990s, the trend is not statistically significant. However, surveys likely underestimate the abundance of fin whales by excluding animals that could not be identified. Since receiving protection from whaling, the stock is likely stable or increasing, as indicated most recently from abundance estimates from four surveys conducted off the U.S. west coast from 1996 through 2008. During the past 14 years, only one fin whale has been observed taken by the DGN fishery (1999), indicating that the likelihood that a fin whale would be taken in the DGN fishery is very low. The two fin whales estimated or assumed to have either been killed or seriously injured in 2009 were identified as taken by an unidentified fishery. In combination with ship strikes and other known fishery interactions that lead to serious injury and mortality, NMFS expects that the proposed action is not contributing to sources of mortality at a level that would threaten the ability of this stock of whales to recover. Based on the criteria that are used under MMPA section 101(a)(5)(E), NMFS SWR PRD concluded that the DGN fishery, in combination with other sources of human-caused impacts that are considered in the *Environment Baseline*, is having a negligible impact on the CA/OR/WA stock of fin whales.

In this Opinion, NMFS must consider the impacts from the DGN fishery on the globally-listed population of fin whales. Similar to the CA/OR/WA stock, the trend in the global population of fin whales is not definitive, although protection from the threat of whaling is believed to have relieved the major source of mortality for this species, particularly in the Northern Hemisphere. Based on the relatively small level of impact expected from the proposed action and the draft NID analysis for the stock of fin whales found off the U.S. west coast, there is no reason to expect these anticipated impacts would lead to effects on the global population that would be significant or detectable. As a result, NMFS concludes that the incidental take and resulting mortality of fin whales associated with the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of fin whales.

ii. Humpback Whales

In this Opinion NMFS has identified the CA/OR/WA stock of humpback whales as the population of humpback whales that may be affected by the DGN fishery occurring off the U.S. west coast. NMFS anticipates that up to 2 humpbacks may become entangled or captured in DGN gear in any year. It is possible these may result in a serious injury or mortality, although NMFS does not expect that every humpback whale entanglement will lead to such fate, so

NMFS assumes that 1 humpback could be removed from the population in any given year as a result of the proposed action. Over a 5-year period, NMFS expects that no more than 4 humpback whales will be taken by the DGN fishery, causing no more than 2 serious injuries and mortalities leading to removals from the CA/OR/WA stock of humpback whales.

The best estimate of humpback whale abundance for this stock is about 2,000 individuals. The PBR level for this stock is calculated as the minimum population size (1,878) times one half the estimated population growth rate for this stock of humpback whales (½ of 8%) times a recovery factor of 0.1 (for an endangered species), resulting in a PBR of 22.5. Because this stock spends approximately half of its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11.3 whales per year (Carretta *et al.* 2013). In any given year, the loss of 1 humpback whale represents about 8.8 percent of PBR for this stock. Consistent with the approaches typically used in the SAR and in negligible impact analyses that look at PBR and impacts that occur over a broader period of time to gauge effects, the loss of 2 animals over a 5-year period represents 3.5 percent of PBR on an annual basis, well below any level that would be expected to impact the ability of the CA/OR/WA stock of fin whales to recover.

As mentioned in the *Environmental Baseline* section, significant threats to this stock include ship strikes and incidental entanglement in commercial fishing gear. NMFS SWR PRD conducted a negligible impact determination analysis for a permit under MMPA 101(a)(5)(E) for fisheries that affect the CA/OR/ WA humpback whale stock, including the DGN and WA/OR/CA sablefish pot fishery, that considered the cumulative impact to this stock from all human sources (see NMFS 2013b). In that analysis, NMFS found that the 14 year annual average serious injury and mortality to the CA/OR/WA stock of humpback whales from all human-caused sources, including commercial fisheries (3.6 animals) + ship strikes (0.7 animals), is 4.3 animals, which is 38.1 percent of this stock's PBR (11.3 animals/year). Total human-related serious injury/mortality is therefore below PBR. The 5 year annual average serious injury and mortality to the CA/OR/WA stock of humpback whales from all human-caused sources, including commercial fisheries (6.0 animals) + ship strikes (1.2 animals), is 7.2 animals, which is 63.7 percent of this stock's PBR.

In this Opinion, NMFS must consider that the DGN fishery is expected to occur each year in the foreseeable future. In lieu of any information that suggests the magnitude of impacts resulting from all sources of serious injury and mortality to this stock will change, NMFS anticipates that the magnitude of impacts that have occurred in the past are expected to continue into the foreseeable future, including the occasional take in the DGN fishery. Therefore, the analyses reflected in the draft NID analysis are assumed to represent the future effects from threats that can be readily assessed in the SAR.

This stock of humpback whales has appeared to increase significantly since implementation of legal protections under law, growing at a rate of about 6.5 percent over the last few decades. Although several humpback whales were entangled in recent years in crab pot gear and in unknown pot/net fisheries in California, the total fisheries-related serious injury and mortality for both the 14 and 5 year annual average is less than this stock's PBR. Since the beginning of the NMFS observer program in 1990, no deaths of humpback whales have been attributed to the DGN fishery and after the implementation of the PCTRP, overall cetacean entanglement rates in the DGN fishery dropped considerably. Given the hearing capabilities of humpback whales in the range of the pingers, the implementation of the PCTRP has likely benefited humpbacks by alerting them to the presence of the net. However, in 2009 a humpback whale was reported seriously injured after interacting with the DGN fishery. Fisheries that use pot and trap gear do have a history of causing death and serious injury of this stock as noted in the listing of pot/trap fisheries as Category II fisheries in the 2013 List of Fisheries (CA spot prawn pot fishery; CA Dungeness crab pot fishery; Oregon Dungeness crab pot fishery; WA/OR/CA sablefish pot fishery; WA coastal Dungeness crab pot/trap fishery; 78 FR 23708). In combination with ship strikes and other known fishery interactions that lead to serious injury and mortality, NMFS expects that the proposed action is not contributing to sources of mortality at a level that would threaten the ability of this stock of humpback whales to recover. Based on the criteria that are used under MMPA section 101(a)(5)(E), NMFS SWR PRD concluded that the DGN fishery, in combination with other sources of human-caused impacts that are considered in the *Environment Baseline*, is having a negligible impact on the CA/OR/WA stock of humpback whales.

In this Opinion, NMFS must consider the impacts from the DGN fishery on the globally-listed population of humpback whales. Similarly to the CA/OR/WA stock, the trend in the global population of humpback whales is generally indicating increasing populations where data is available. As with most large whales, removal of the threat of whaling has relieved the primary source of mortality that resulted in reduced population sizes and the listing of this species as threatened. Although a number of threats facing humpback whales remain, this species does not appear to be at significant risk of extinction, especially in the North Pacific. There is no reason to expect the relatively small impact of removing two humpback whales from the population every 5 years would lead to effects on the global population that would be significant or detectable. Based on the relatively small level of impact expected from the proposed action and the draft NID analysis on the stock likely to be affected, NMFS concludes that the incidental take and resulting mortality of humpback whales associated with the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of humpback whales.

iii. Sperm Whales

In this Opinion NMFS has identified the CA/OR/WA stock of sperm whales as the population of sperm whales that may be affected by the DGN fishery occurring off the U.S. west coast. NMFS anticipates that up to 2 sperm whales may become entangled or captured in DGN gear in any year. It is possible these may result in a serious injury or mortality. Although NMFS does not expect that every sperm whale entanglement will lead to this, the available data do suggest that both could result in serious injury or mortality. As a result, NMFS assumes the worst case scenario that 2 sperm whales could be removed from the population in any given year as a result of the proposed action. Over a 5-year period, NMFS expects that no more than 8 sperm whales will be taken by the DGN fishery, causing no more than 6 serious injuries and mortalities leading to removals from the CA/OR/WA stock of sperm whales.

The best estimate of sperm whale abundance for this stock is about 1,000 individuals. The PBR for this stock is calculated based on the minimum population size (751) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (the default value for an endangered species), resulting in a PBR for the CA/OR/WA sperm whale stock of 1.5 whales per year (Carretta *et al.* 2013). In any given year, the loss of 2 sperm whales represents about 130 percent of PBR for this stock, which is greater than the estimated value that would delay recovery of this stock by more than 10 percent (not to be confused with reducing the likelihood of recovery under the ESA jeopardy standard). However, consistent with the approaches typically used in the SAR and in negligible impact determination analyses to look at PBR and impacts that occur over a broader period of time to gauge effects, the loss of 6 animals over a 5-year period represents 80 percent of PBR on an annual basis, less than the PBR threshold for removals that might have a significant delay on recovery for the CA/OR/WA stock of sperm whales.

As mentioned in the *Environment Baseline* section, significant threats to this stock include ship strikes and incidental entanglement in or ingestion of commercial fishing gear. NMFS SWR PRD conducted a negligible impact determination analysis for a permit under MMPA 101(a)(5)(E) for fisheries that affect the CA/OR/ WA sperm whale stock, including the DGN fishery, that considered the cumulative impact to this stock from all human sources (see NMFS 2013b). In that analysis, NMFS found that the 14 year annual average serious injury and mortality to the CA/OR/WA stock of sperm whales from all human-caused sources, including commercial fisheries (0.5 animals) + ship strikes (0.3 animals), is 0.8 animals, which is 53 percent of this stock's PBR. The 5 year annual average serious injury and mortality to the CA/OR/WA stock of sperm whales from all human-caused sources, including commercial fisheries (1.0 animals) + ship strikes (0.4 animals), is 1.4 animals, which is 93.3 percent of this stock's PBR.

In this Opinion, NMFS must consider that the DGN fishery is expected to occur each year in the foreseeable future. In lieu of any information that suggests the magnitude of impacts resulting from all sources of serious injury and mortality to this stock will change, NMFS anticipates that the magnitude of impacts that have occurred in the past are expected to continue into the foreseeable future, including the occasional take in the DGN fishery. Therefore, the analyses reflected in the draft NID are assumed to represent the future cumulative effect from threats that can be readily assessed in the SAR.

Considering the potential/ongoing proposed action of continued operation of the DGN fishery in combination with ship strikes and other known fishery interactions that lead to serious injury and mortality, it appears that annual human-caused mortality may be at or near PBR for this stock. One sperm whale was incidentally taken in the DGN fishery in 1998, but the net did not have a full complement of pingers; therefore, it is difficult to evaluate whether pingers have an effect on sperm whale entanglement. However, pingers have been shown to have a positive effect on other odontocetes (i.e., lower entanglement rates) (Barlow and Cameron 2003). Two more sperm whales were taken in 2010 (one killed; one released seriously injured) in the DGN fishery and the net did have a full complement of pingers. However, based on the infrequency of sperm whale interactions with active fishing gear in the last 14 years, the likelihood that a sperm whale would be taken by the DGN fishery in any given year is low.

Sperm whale abundance appears to have been variable off California between 1979/80 and 1991 (Barlow 1994) and between 1991 and 2008 (Barlow and Forney 2007). The most recent estimate from 2008 is the lowest to date, in sharp contrast to the highest abundance estimate obtained from 2001 and 2005 surveys. However, there is no reason to believe that the population has declined; the most recent survey likely reflects interannual variability with the study area. Sperm whales are found year-round in California waters, but they reach peak abundance from April through mid-June and from the end of August through mid-November. They were seen in every season except winter (Dec-Feb) in Washington and Oregon. Although populations are expected to have increased due to the cessation of whaling, there has not been a statistical analysis to detect trends in abundance for the CA/OR/WA stock of sperm whales. This is in part because sperm whale migration patterns are not well understood (patterns seem to vary with age and sex) and because sperm whales occur in larger groups and tend to range more widely, making abundance estimates more variable than those of other large whales with similar population sizes.

Assessment of sperm whales solely based on this stock definition is particularly problematic for this species. As described in the Status section, abundance estimates for this stock have been highly variable. Surveys conducted in 2001 and 2005 both suggested the abundance of CA/OR/WA stock of sperm whales was estimated to be approximately 3,000 individuals. The most recent survey (2008) estimated only 300 individuals. While some threats to sperm whales do remain despite the advent of whaling protections, NMFS does not believe this stock has experienced any dramatic decline in abundance, as might be suggested by these recent survey results. Jaquet and Gendron's (2002) research suggests that sperm whales changed their distribution in response to a decline in jumbo squid. The distribution and relative abundance of sperm whales in relation to key environmental features may also influence the distribution of their prey and thus, sperm whale relative abundance. The population of the CA/OR/WA sperm whale stock has fluctuated since 1979/80 without apparent trend and appears relatively stable (Barlow 1994).

It seems more likely that inter-annual variability in their distribution is a significant factor that has affected the abundance assessment of this stock of sperm whales. This is reasonable considering that sperm whales exhibit more offshore patterns of distribution than many other large whale species, and may have just been missed by that survey. As a result, the low PBR value estimated for this stock may be overly influenced by one survey result that may not be representative of this stock. In addition, the stock structure of sperm whales in the northern Pacific is uncertain. Based on this information and the criteria that are used under MMPA section 101(a)(5)(E), NMFS SWR PRD concludes that the DGN fishery, in combination with other sources of human-caused impacts that are considered in the *Environment Baseline*, is having a negligible impact on the CA/OR/WA stock of sperm whales.

In this Opinion, NMFS must consider the impacts from the DGN fishery on the globally-listed population of sperm whales. Similar to the CA/OR/WA stock, trends in the abundance estimates of other Pacific populations, or the species globally, are not clear, but it is more likely sperm whale populations are showing signs of increasing and the overall population of sperm whales has increased worldwide since it was listed under the ESA in 1973. As mentioned in the Status section, estimates of sperm whale abundance in the North Pacific and eastern tropical Pacific in the 1990s was over 20,000 in each area. The degree to which individuals that may be found in either area may come into U.S. waters is not known. Protection from whaling has eliminated the primary source of mortality that occurred historically. Although a number of threats facing sperm whales remain, this species does not appear to be at significant risk of extinction, especially in the North Pacific. There is no reason to expect the relatively small impact of potentially removing about 1 sperm whale per year would lead to effects on the global population that would be significant or appreciable. Based on the relatively small level of impact expected from the proposed action and the draft NID analysis on the stock likely to be affected, NMFS concludes that the incidental take and resulting mortality of sperm whales associated with the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival or recovery of sperm whales.

B. Sea Turtles

There have been recent efforts to derive a quantitative approach for establishing turtle bycatch control and management frameworks for U.S. and international fisheries (Curtis and Moore 2013). Based on similar concepts underlying marine mammal serious injury and mortality management under the PBR approach, Curtis and Moore (2013) have demonstrated that development of such a framework for sea turtles that may be robust to a number of uncertainties is possible. However, the implications of applying such a framework into the ESA management and policy decision making process have not been fully described. It is clear that there will have to be reconciliation between the mandates of the ESA and details of any bycatch management controls before NMFS can implement any such framework. In the future, it does seem possible that such approaches could yield insight into appropriate short and long-term limits for sea turtle bycatch based on variable population status or conditions. Until then, NMFS will continue to rely on the best available information in hand.

i. Leatherbacks

In this Opinion, NMFS had identified that leatherback sea turtles from the western Pacific subpopulation are most likely to be affected by the DGN fishery occurring off the U.S. west coast. Given the proposed action and a projected 1,500 sets per year in the DGN, NMFS anticipates that up to 3 leatherbacks may become entangled or captured in DGN gear in any year. It is possible these may result in a serious injury or mortality, so NMFS will consider the worst case scenario that all 3 of these takes would lead to removals from the population. Over a 5-year period, NMFS expects that no more than 10 leatherbacks will be taken by the DGN fishery. Assuming a 70 percent mortality rate, NMFS expects that no more than 7 leatherbacks would be removed from the western Pacific population during a 5-year period as a result of this proposed action. Assuming a 67.5 percent sex ratio and the relative reproductive value of adults, this equates to 4.7 adult females lost over the course of 5 years, or approximately 1 per year.

The most current estimate of adult nesting females in the western Pacific subpopulation of leatherbacks is 2,700-4,500, with approximately 38 percent of the nesting occurring at Jamursbi-Medi (Dutton *et al.* 2007), which is a likely origin of most of the leatherbacks that may be found off the U.S. west coast (Benson *et al.* 2011). At a minimum, this suggests there were an estimated 1,000 adult females from Jamursbi-Medi in the total western Pacific population when data were being compiled (1999-2004). However, the most recent information suggest that the population has been on the decline (29%) between 2005-2011 (Tapilatu *et al.* 2013), suggesting the current population is likely lower than what was estimated previously (at least ~700 females[21]). The exact proportion of the population that uses the California coast and U.S. west coast EEZ is not known, but long-term observations in neritic waters in central and northern California estimate that, on average, approximately 180 leatherbacks (both male and females, adults and sub-adults) would be expected to be found in this survey area during any given year (Benson *et al.* 2007c). Based on studies involving large-scale movements of leatherbacks into the California Current Ecosystem, fewer turtles would be found in the action area during the DGN fishing season, since leatherbacks have been documented typically arriving in the southern California Bight in the springtime, traveling in the nearshore area as they approach the central/northern California areas (Benson *et al.* 2011) Considering the prospect of losing up to 3 adult females in 1 year, this represents about 0.4 percent of the total Jamursbi-Medi adult female population, and approximately 0.1 percent of the total western Pacific adult female population (given the lower estimate from Dutton *et al.* (2007). These are very small fractions of the total population that may be affected.

NMFS must consider that the DGN fishery is expected to occur each year in the foreseeable future at maximum projected levels of 1,500 sets per year. Over the long-term, NMFS expects that the western Pacific leatherback population will lose about 1 adult female each year as a result of this proposed action. Therefore, we must assess whether the population is capable of

[21] Based on minimum estimate of 1000 adult females in 2004 declining by 29% in 2011.

sustaining the loss of an adult female each year over time. The western Pacific population appears to be in a state of decline compared to a few decades ago. Although it is not possible to confidently describe the current status of juveniles, sub-adults, or males, there has been a sustained history at this point indicating reproductive females are not being replaced as nesting counts continue to decline. The major threats identified to leatherbacks in this region are related to activities on nesting beaches (e.g., coastal erosion, feral pigs, environmental perturbations in the marine environment, directed take (in Tapilatu *et al.* 2013), and bycatch in fisheries. Modeling results of climate change on the eastern Pacific population of leatherbacks indicate a trend showing Central America becoming considerably warmer and drier, which could influence hatching success and emergence rates. Less could be predicted on the impacts of climate change on leatherback bioenergetics, thermoregulation and foraging strategy in the marine environment off the eastern tropical Pacific and south Pacific (Saba *et al.* 2012). In the north Pacific region, where the western Pacific population of leatherbacks primarily forage, less is known about the impact of climate change and decadal oscillations, although some modeling efforts have proposed a correlation between decadal oscillations and positive trends of neonate leatherback survival rates (Van Houtan 2011). Conservation action to address many of these threats has been significant, and there is optimism that some of the efforts may begin to show measurable increases in productivity on the nesting beaches soon, allowing for the lag in population dynamics for long-lived and slow-maturing species such as leatherbacks. This type of recovery has been shown by leatherback populations on other beaches such as St. Croix, USVI, where nesting females increased at 13 percent per year, following approximately 10 years after protection of nesting beaches (Dutton *et al.* 2004).

Previous consultations on the DGN fishery or similar actions in the U.S. west coast EEZ have considered the impact of small numbers of leatherback mortality. The 2004 biological opinion concluded that up to 3 deaths of leatherbacks per year was likely below a level that would appreciably affect survival and recovery (NMFS 2004). This was supported by some demographic modeling simulation and the qualitative considerations of this small level of impact. Other actions looking at the effect of losing 1 female considered the prospect that conservation actions in recent years were likely to facilitate the chance that increases in young turtles would act as a buffer to provide more recruits into the adult population, in context with the very small level of impact expected (NMFS 2008). The anticipated impact of the DGN fishery going forward is even less than what has been previously considered in prior biological opinions on the DGN fishery, due in large part to the implementation of sea turtle bycatch mitigation measures over the last decade (e.g., the 2001 time/area closure). In addition, as mentioned, while the proposed action projects that effort in the DGN fleet could increase to near 2006 levels, given the effort estimated in the last 6 seasons, the realized effort is likely to be much lower.

At this time, there seems to be little change in the outcome of analyses using the tools available to quantitatively assess the impact of removing very small numbers of adult females from the western Pacific population. In a recent biological opinion on the shallow-set longline fishery in Hawaii, two different modeling approaches considered the impact of removing about 4 adult female equivalents from this population per year (NMFS 2012d). Both of these models looked at the impact of adding fishery removals from the underlying population dynamics derived from the pattern of nesting activity that has occurred in recent decades amidst all of the threats that face this population, although one model incorporated environmental variables that may be related to survival and/or reproductive rates. Neither of these models offered evidence that a significant or meaningful difference in relative extinction risk was detectable under this scenario. In comparison, expected impacts to this leatherback population from the DGN fishery are substantially less than what was analyzed in those models, and the resultant impact of repeating these modeling exercises with a smaller level of adult female removal would be expected to be less. These results are consistent with other previous modeling results that have yet to quantitatively describe changes in extinction risks to leatherback in the Pacific attributed to the type of low level of impact anticipated under this proposed action.

A compelling factor that must be considered in a more qualitative analysis of impacts from the DGN fishery under the ESA jeopardy standard is the most recent information suggesting that the western Pacific leatherback population appears to be in a continual state of decline, as opposed to possibly stabilizing in recent years, as has been previously suggested (Tapilatu *et al.* 2013). Previous analyses, such as models used in the recent biological opinion on the shallow-set fishery in Hawaii, have been using the same source of nesting data as Tapilatu *et al.* (2013), although the interpretation of the nesting trend indicating the decline has only recently come to light. Using the latest assessment, it seems implausible to expect that this population could sustain this decline if it were to continue at similar rates for more than few decades before the threat of extirpation becomes a real possibility. Unfortunately, based on the information presented in the *Status of the Species* and *Environmental Baseline*, it is clear that this scenario could be realized with or without the existence of, and bycatch resulting from, the DGN fishery unless recruitment to sexually reproductive age and/or reproductive success changes.

In order for the western Pacific population of leatherback sea turtles to remain viable, it is reasonable to expect that the dominant factors currently (and historically for such a long-lived species) affecting survival must improve. As mentioned previously, leatherbacks are vulnerable to international fisheries across the Pacific which are likely responsible for the mortalities of hundreds of juvenile, sub-adult, and adult mortalities. In addition, there have been threats documented on the nesting beaches, including the directed harvest of adults and eggs, as well as other major threats to egg and hatchling survival from predators and coastal erosion. Pacific decadal oscillations and global climate change could affect leatherbacks through increased sand temperatures, rising sea levels, and changes in recruitment and dispersal patterns. As mentioned previously under the Conservation heading of the *Status of the Species* section, many of these factors are currently being addressed through regular monitoring, mitigation, and outreach to village communities. There are indications that natural fluctuations in environmental and oceanic conditions could be dominant influences on survival rates across various life stages or on reproductive rates (NMFS 2012d; Van Houtan 2011; Tomillo *et al.* 2012). It is also reasonable to expect that the variability in the number of leatherback turtles killed each year throughout the Pacific is greater than the scale of impact considered here (i.e., assuming that total western Pacific leatherback bycatch/mortality across international fisheries is somewhere in the hundreds, the annual variation is likely on the orders of 10s or 100s as opposed to 3 or less). In the face of these large threats and variation in natural and human-induced survivability rates, it does not seem reasonable or possible to detect how the small impact of the occasional removal of leatherback sea turtles from the DGN fishery has any effect on this trajectory for the foreseeable future. At some point, however, if the current decline continues, the population will reach a critically low level where the fate of each and every individual has a significant influence on the survival and/or recovery of this population and the leatherback species as a whole. At this time, such a critical point has not been identified for this population or for sea turtles in general.

In addition to the risk of extinction for leatherback populations, NMFS must also consider the impact of proposed actions on the prospects for recovery of ESA-listed species under the jeopardy standard. The NMFS and USFWS (1998a) recovery plan for leatherbacks in the U.S. Pacific contains a number of goals and criteria that should be met to achieve recovery for this species. A number of these goals are being addressed through the research efforts determining stock structure of populations and monitoring their status, at least for populations that range into U.S. waters. It seems likely that any abundance goals for leatherback populations, including the western Pacific, rest on the productivity of nesting beaches in concert with increased survival rates of individuals throughout their range and life-cycle.

The optimal chance of leatherback sea turtle recovery in the Pacific rests in the reproductive capability and the relatively high fecundity of sea turtles. Each female leatherback produces around 400 eggs each time they reproduce (about 80 eggs per clutch [Tapilatu and Tiwari 2007] x about 5 clutches per year [Hitipuew *et al.* 2007; Dutton *et al.* 2007]). Regardless of how many times a female does reproduce, only one out of all these offspring hatchlings needs to survive as an adult female to achieve replacement, although we should not discount the importance of male survival to ensure reproductive capacity into the future. The current sex ratio of this population has been estimated at 68 percent female based on leatherbacks captured off central California. While skewed sex ratio could be a problem in general, it may also underlie the potential for relatively high productivity and population growth rates should other factors affecting survival across their life-cycle become more favorable. The mating system of sea turtles is both polyandrous (1 female fertilized by more than 1 male) and polygynous (1 male mates with more than 1 female) and occurs in areas where turtles congregate near natal home ranges (see Bell *et al.* 2010 review). Males from some sea turtle species have been found to return to waters adjacent to some nesting beaches more often than females, but it is unclear whether potentially reduced males due to climate change variability (hotter sand temperatures produce more female hatchlings) may impact the maintenance of breeding rates (Hayes *et al.* 2010). It seems possible that fewer males than females may be needed for adequate mating, with the added benefit that increased percentage of females could lead to more nesting activity and egg production[22].

A recent study concluded that there was no evidence for depensation (reduced fertility due to small population size) for various green and loggerhead sea turtle populations that were examined, even for very small turtle populations (Bell *et al.* 2010). These factors suggests that recovery potential is definitely there for small turtle populations of turtles that are much smaller than the current western Pacific leatherback population, and a number of small populations of turtles have shown signs of recovering fairly quickly after conservation efforts have been implemented (see Bell *et al.* 2010 for review). It has also been documented that much smaller populations of much less productive species have rebounded quickly given the right conditions (e.g., Mediterranean monk seals; Martinez-Jauregui *et al.* 2012).

The limited mortality of 1 adult female per year would present negligible additional risk to survival and recovery of the western Pacific leatherback sea turtle population. We would not expect the proposed activity to prohibit leatherback nesting populations from increasing or maintaining a stable population in perpetuity, nor would it substantially impair or prohibit increases to leatherback foraging populations at key foraging grounds. As a result, it seems unlikely that the effects of the proposed action on the survival and recovery of this population would be detected.

Given the best available information, NMFS concludes that the anticipated occasional removal of leatherback turtles by the DGN fishery is not likely to appreciably reduce the likelihood of survival or recovery of this species.

ii. North Pacific Loggerheads

In this Opinion, NMFS had identified that loggerhead sea turtles from the North Pacific DPS are likely to be affected by the DGN fishery occurring off the U.S. west coast. NMFS anticipates that up to 3 loggerheads may become entangled or captured in DGN gear in any year. It is possible that 2 may result in serious injury or mortality. Given the relative age and sex ratios of loggerheads (or even assuming both female), this is equivalent to the removal of 1 adult female. Over a 5-year period, NMFS expects that no more than 7 loggerheads will be taken by the DGN fishery. Assuming a 50 percent mortality rate, NMFS expects that no more than 4 loggerheads would be removed from the North Pacific DPS during a 5-year period as result of this proposed action. Considering the sex ratio and the estimated survival rate of a juvenile to adulthood of the juvenile loggerheads expected to interact with the DGN fishery, this equates to approximately 1 adult female lost over the course of 5 years.

[22] This assumes no genetic limitations or complications for small populations, which would be expected to be moderated by some degree by polyandrous behavior (Bell *et al.* 2010).

The trend in loggerhead nesting in Japan has been gradually increasing over the past decade, following substantial declines since the 1950s. The most current estimate of adult females in the North Pacific population of leatherbacks is about 7,000, up from only about 3,000 adult females less than a decade ago. The removal of 1 adult female in a year constitutes less than 0.1 percent of the estimated adult female population even if the population is closer to 3,000. This is a very small proportion of the total population. Over time, the expected impact of the DGN fishery may reduce the population by about 1 adult female every 5 years. This level of impact is essentially undetectable compared to the variations in nesting patterns that have been seen in the last two decades. Currently, the dynamics in place are suggesting that recruitment is outpacing removals, despite the fact that known sources of mortality are quite large, particularly from bycatch in fisheries. While accurate or reliable totals of bycatch interactions or mortality for loggerheads across the Pacific are not available, based on what is known about threats off Baja California, Mexico and Japan, it seems likely that loggerhead bycatch totals can be measured in the hundreds, if not thousands. Other impacts associated with threats to nesting beach activity and nesting habitat in Japan are not easily quantified, but it appears that conditions at some primary and secondary beaches are improving.

Previous consultations on the DGN fishery on similar actions in the U.S. west coast EEZ have considered the impact of small numbers of loggerhead take and mortality. The 2004 biological opinion assumed that up to 5 loggerheads would have been captured with 2 mortalities as a result of the DGN fishery each year. Similar to the analysis of leatherback effects in that biological opinion, NMFS used demographic population simulation models based on nesting trends to help conclude that the level of impact would not appreciably affect survival and recovery (NMFS 2004). At the time loggerheads were globally listed under the ESA and the jeopardy standard was applied to the entire species, although the 2004 analysis did focus on this same population that has become listed as the North Pacific DPS. Observed bycatch rates since that 2004 consultation have been less than anticipated, perhaps due to oceanographic conditions over recent years or a decline in fishery effort or practices. As a result, the expected impacts of the current DGN fishery going forward are even less than what has been previously analyzed.

At this time, there seems to be little change in the outcome of analyses using the tools or approaches available to quantitatively assess the impact of removing very small numbers of loggerheads from the North Pacific DPS. The most current information suggests that any change in the status of this population is likely trended toward an increasing population. In a recent biological opinion on the shallow-set longline fishery in Hawaii, 2 different modeling approaches considered the impact of removing about 1 adult female from this population per year. Both of these models looked at the impact of adding fishery removals from the underlying population dynamics derived from the pattern of nesting activity that has occurred in recent decades amidst all of the threats that face this population, although one model incorporated environmental variables that may be related to survival and/or reproductive rates. Neither of these models offered evidence that a significant or meaningful difference in relative extinction risk was detectable under this scenario. Considering an equivalent level of impact anticipated from the DGN fishery, these results are consistent with other previous modeling results that have yet to quantitatively describe changes in extinction risks to loggerheads in the Pacific attributed to the low level of impact anticipated under this proposed action.

In addition to the risk of extinction for loggerhead populations, NMFS must also consider the impact of proposed actions on the prospects for recovery of ESA-listed species under the jeopardy standard. The recovery tasks and goals identified by NMFS and USFWS (1998b) for loggerheads in the U.S. Pacific are very similar to those for leatherbacks. NMFS has been actively engaged in research and conservation efforts that are pointed toward facilitating recovery. As with leatherbacks, it seems likely that any abundance goals for populations, including the North Pacific DPS, rest on factors of productivity and mortality throughout their range that are not likely to be affected by the occasional removal of adult reproductive potential every few years. As a result, the limited mortality of 1 adult female every 5 years would present negligible additional risk to this DPS of loggerheads. This would not be expected to prohibit this nesting population from increasing or maintaining a stable population in perpetuity, nor would it substantially impair or prohibit increases to the foraging population at key foraging grounds. As a result, it seems unlikely that this anticipated effect from this proposed action will appreciably affect the survival or recovery of this population.

Given the best available information, NMFS concludes that the anticipated occasional removal of loggerhead sea turtles from the North Pacific DPS by the DGN fishery is not likely to appreciably reduce the likelihood of survival or recovery of the North Pacific DPS of loggerheads.

iii. Green Turtle

In this Opinion, NMFS had identified that green sea turtles from the eastern Pacific nesting population are most likely to be affected by the DGN fishery occurring off the U.S. west coast. NMFS anticipates that no more than 1 green turtle may become entangled or captured in DGN gear in any year. It is possible this may result in a serious injury or mortality, so NMFS will consider the worst case scenario that this take would lead to a removal from the population. Over a 5-year period, NMFS expects that no more than 2 green turtles will be taken by the DGN fishery. Assuming a 50 percent mortality rate and unknown sex ratio, NMFS expects that no more than 1 green turtle would be removed from the eastern Pacific during a 5-year period as result of this proposed action, resulting in the loss of up to 1 adult female every 5 years.

Green turtles from Mexican nesting beach origins are listed as endangered, although nesting data indicates the population appears to be increasing, presumably in response to the significant conservation efforts across the region to address the numerous threats. Annual nesting in the eastern Pacific is believed to number in the thousands of females. Although the significance of the northern foraging aggregations off southern California is not fully understood, it is possible that healthy and robust groups of green turtles living at the relative edge of their home range is indicative of a population showing some signs of recovery as opposed to being on the verge of extinction. Threats to green turtles within the U.S. west coast EEZ include occasional bycatch in some coastal fisheries and exposure to boating and vessel traffic, especially in dense population centers such as southern California. However, stranding reports of green turtles along California's coast are not common, and NMFS has yet to identify any serious threat to the population of green turtles in this area.

The potential bycatch and loss of one adult female green turtle in the DGN fishery during a year could affect the reproductive potential in terms of lost nesting production for that year. Over time, NMFS believes that lost nesting production as a result of the DGN is likely to be no more than 1 adult female per every 5 years. Considering the natural variation in factors such as environmental productivity and survival rates for all sea turtles, including green turtles, resulting from both natural and human-induced factors including green turtles, it does not seem likely that the occasional removal of 1 female every few years would be detectable, especially in light of evidence that the outlook for this population appears to be improving. An occasional mortality is more comparable to a random chance event than any systemic stress upon the population.

In addition to the risk of extinction, NMFS must also consider the impact of proposed actions on the prospects for recovery of ESA-listed species under the jeopardy standard. The recovery tasks and goals identified by NMFS and USFWS (1998b) for eastern Pacific green sea turtles are focused on the research and conservation activities that NMFS has been actively engaged in. As with other ESA-listed sea turtle species in the Pacific it seems likely that any abundance goals for populations, including the populations in the eastern Pacific, rest on factors of productivity and mortality throughout their range that are not likely to be affected by the occasional removal of one adult female every few years. In any one year, this small impact will be insignificant to the future recovery potential of the species. In 2004, NMFS concluded that the periodic loss of one green turtle as a result of the DGN fishery at that time was not likely to appreciably reduce the likelihood of survival or recovery of this species due to the low level of expected impact. Considering there is no evidence that the impact of the DGN fishery on green sea turtles has increased since that time, and the status of this species, especially in the eastern Pacific, has likely improved, the results of that analysis appear to remain valid.

Given the best available information, NMFS concludes that the anticipated occasional removal of green sea turtles by the DGN fishery is not likely to appreciably reduce the likelihood of survival or recovery of this species.

iv. Olive Ridleys

In this Opinion, NMFS had identified that olive ridley sea turtles from the eastern Pacific nesting population are most likely to be affected by the DGN fishery occurring off the U.S. west coast. NMFS anticipates that no more than 1 olive ridley may become entangled or captured in DGN gear in any year. It is possible this may result in a serious injury or mortality, so NMFS will consider the worst case scenario that this take would lead to a removal from the population. Over a 5-year period, NMFS expects that no more than 2 olive ridleys will be taken by the DGN fishery. Assuming a 50 percent mortality rate and unknown sex ratio, NMFS expects that no more than 1 olive ridley would be removed from the eastern Pacific during a 5-year period as result of this proposed action, resulting in the loss of up to 1 adult female every 5 years.

Olive ridley sea turtles from Mexican breeding populations are listed as endangered, although the available nesting data suggest the population is increasing substantially, presumably in response to the significant efforts to reduce nesting beach harvest across the region. Annual nesting in Mexico alone is estimated to be more than 1 million nests, with well over 1 million individual olive ridleys estimated to inhabit eastern tropical Pacific waters. Olive ridleys are generally a tropical species, and based on stranding records, they are likely more occasional visitors to the offshore water of the U.S. EEZ, and seem to only be very rarely encountered by most activities, including the rare, chance entanglement with DGN gear. In a population that numbers in the hundreds of thousands at a minimum, the loss of one individual, male or female, in any given year would not result in a detectable effect.

In addition to the risk of extinction, NMFS must also consider the impact of proposed actions on the prospects for recovery of ESA-listed species under the jeopardy standard. The recovery tasks and goals identified by NMFS and USFWS (1998d) for U.S Pacific populations of olive ridley sea turtles are focused on the research and conservation activities that NMFS has been actively engaged in. Similar to the green turtles, the occasional removal and lost reproductive value of an adult female every few years is insignificant to the natural variation in factors that are likely to be influencing the status and potential for recovery of this species. In 2004, NMFS concluded that the periodic loss of one olive ridley as a result of the DGN fishery at that time was not likely to appreciably reduce the likelihood of survival or recovery of this species due to the low level of expected impact. Considering there is no evidence that the impact of the DGN fishery on olive ridley sea turtles has increased since that time, and the status of this species in the eastern Pacific has likely improved, the results of that analysis appear to remain valid.

Given the best available information, NMFS concludes that the anticipated occasional removal of olive ridley sea turtles by the DGN fishery is not likely to appreciably reduce the likelihood of survival or recovery of this species.

VIII. CONCLUSION

After reviewing the current status of ESA-listed fin whales, humpback whales, sperm whales, leatherback sea turtles, North Pacific DPS loggerhead sea turtles, green sea turtles, and olive ridley sea turtles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action of continued management of the DGN fishery is not likely to jeopardize the continued existence of these seven species, and is not likely to destroy or adversely modify any ESA-listed designated critical habitat. As described previously in the *Description of the Proposed Action* section, other fisheries authorized by the HMS FMP that were analyzed in the 2004 biological opinion will continue to operate under that biological opinion. Given the conclusion of this Opinion in conjunction with the analysis of the other HMS fisheries in the 2004 biological opinion and the deep-set longline fishery in the 2011 biological opinion, NMFS maintains the determination that the HMS FMP in total is not likely to jeopardize any ESA-listed species and is not likely to destroy or adversely modify any ESA-listed critical habitat.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, unless there is an applicable exception. 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 NMFS for the exemption 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 Federal 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. The ESA 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 in compliance with terms and conditions identified in the incidental take statement is exempt from ESA taking prohibitions pursuant to section 7(o) of the ESA.

A marine mammal species or population which is listed as threatened or endangered under the ESA is, by definition, also considered a strategic stock and depleted under the MMPA. Section 7(b)(4) of the ESA provides for an incidental take statement for threatened and endangered marine mammals only if authorized pursuant to section 101(a)(5) of the MMPA. Until the proposed action receives authorization for the incidental taking of marine mammals under section 101(a)(5)(E) of the MMPA, the incidental takes of marine mammals described below are not exempt from the ESA taking prohibitions pursuant to section 7(o) of the ESA.

1. Amount or Extent of Take

NMFS anticipates the following incidental take and mortality of ESA-listed marine mammals and sea turtles may occur as a result of continued operation of the DGN fishery within the current regulatory framework governing the effort in the fishery up to 1,500 sets annually off the U.S. west coast (from Tables 8 and 11, and effects analysis).

Table 12. Amount and extent of take on individuals expected in the DGN fishery.

	Annual take	5-year take total	Expected mortalities[23] during 5-year period
Fin whale	up to 1	up to 2	up to 1
Humpback whale	up to 2	up to 4	up to 2
Sperm whale	up to 2	up to 8	up to 6
Leatherback turtle	up to 3	up to 10	up to 7
Loggerhead turtle	up to 3	up to 7	up to 4
Olive ridley turtle	up to 1	up to 2	up to 1
Green turtle	up to 1	up to 2	up to 1

The interaction and mortality rates were estimated based on observed and reported takes in the DGN fishery from historical data that is considered to be consistent with the manner of current and future operation of this fishery, including the measures that have previously been implemented to avoid protected species interactions. As described previously in this Opinion, these interaction rates must be viewed in the context of less than 100 percent observer coverage of the DGN fishery. As a result, NMFS must interpret the record of observed interactions in relationship to the expected total incidental take anticipated in this Opinion. This Opinion acknowledges that there are underlying issues that could affect the reliability of estimating the anticipated bycatch in the entire fishery from observer data. However, NMFS has yet to identify any definitive gap in observer coverage that may be influencing or biasing bycatch estimates, and assumes that the observed record of interactions will be approximately proportional to the total impact of the prosecuted DGN fishery consistent with the proposed action. The proposed action indicates that NMFS will target an observer coverage level of 20 percent. While it is unlikely that observer coverage will equal exactly 20 percent each year, NMFS expects this number to represent the general average over time, that is, in some years overall observer

[23] Includes animals that may be determined to have experienced either serious injury or mortality as a result of interaction with the fishing gear.

coverage levels may be slightly below or above 20 percent. As a result, NMFS expects the observer record to comply with the following anticipated incidental take, which is proportionally consistent with the total incidental take and observer coverage levels described above.

Table 13. Amount of take of individuals expected to be documented by fisheries observer over a 5-year period in the DGN fishery given the anticipated observer coverage.

	Observed take during 5-year period
Fin whale	1
Humpback whale	1
Sperm whale	up to 2
Leatherback turtle	up to 2
Loggerhead turtle	up to 2
Olive ridley turtle	1
Green turtle	1

These numbers reflect the expected observed take based on the proportional assumption that 1 out of every 5 takes in the DGN would be expected to occur during observed fishing effort with approximately 20 percent observer coverage. Given the relatively low numbers of observed takes stipulated here and sporadic frequency of observed interactions, NMFS assumes that the expected observed take within a 5-year period for any and/or all of these species could occur within any one given season. This includes 2 observed takes in a season for sperm whales, leatherback and loggerhead sea turtles.

As discussed, these anticipated observed take levels are based on the proposed action of targeting 20 percent observer coverage. In order to monitor the effect of the DGN fishery, NMFS will rely on the realized observer coverage rates in relation to observed interactions with protected species. If actual observer coverage rates are significantly higher or lower than 20 percent, this could influence how NMFS interprets the effect of the DGN fishery on ESA-listed species against the anticipated effects considered in this Opinion. NMFS will continually assess the reports of observer coverage and observed interactions with ESA-listed species required by the terms and conditions of this Opinion and make those determinations as appropriate. Based on the proposed action and anticipated observer coverage of 20 percent, if more than one fin or humpback whale or more than one olive ridley or green turtle is observed taken in the DGN fishery in any 5-year period, NMFS is likely to determine that the ITS for these species has been exceeded. Similarly, if more than two sperm whales or more than two leatherback or loggerhead sea turtles are observed taken in any 5-year period, NMFS is likely to determine that the ITS for these species has been exceeded.

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 fin, humpback, or sperm whales; or leatherback, loggerhead, olive ridley, and green sea turtles.

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. 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 continued operation of the DGN fishery along the U.S. west coast.[24]

1. NMFS shall monitor the DGN fishery to ensure compliance with the regulatory and conservation measures included in the proposed action, including collection and evaluation of data on the capture, injury, and mortality of sea turtles, marine mammals, and other protected species, as well as life history information for species that may interact with the DGN fishery.
2. NMFS shall provide training to DGN fishery vessel operators and observers on sea turtle and marine mammal status and biology and on methods that may reduce injury or mortality during fishing operations.

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. These terms and conditions are non-discretionary.

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

   1A. NMFS shall continue to maintain an observer program to collect and disseminate 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 the DGN fishery shall be prepared and disseminated to the Southwest Region Protected Resources Division. Annual reports from each fishing season should be submitted to PRD by April 1st each year. Information on any ESA-listed species bycatch shall be

[24] The reasonable and prudent measures and associated terms and conditions in this Opinion are applicable only to the DGN fishery. The other HMS fisheries remain subject to the reasonable and prudent measures and associated terms and conditions of the 2004 Biological Opinion on the HMS FMP and the 2011 Biological Opinion on the deep-set longline fishery that remain in effect for all the other fisheries covered under the HMS FMP.

reported as soon as possible after verification of report to the PRD and the Office of Law Enforcement, including species, condition, date of interaction, and location. A copy of the observer report shall be provided to both offices, following review by SFD staff.

1B. NMFS shall continue to collect life history information on marine mammals and sea turtles, including species identification, measurements, condition, skin biopsy samples, and the presence or absence of tags. If feasible, NMFS observers shall directly measure or visually estimate tail length on all sea turtles captured by DGN gear.

1C. NMFS collected data and other available information shall be submitted to PRD upon receipt of any reports of ESA-listed species interactions to determine whether observed or estimated takes of ESA-listed sea turtles and/or marine mammals has exceeded the level of anticipated take over the course of one fishing season, and/or over the course of the most recent last 5-year period, as described in Table 12 and 13 in the *Incidental Take Statement*. SFD will also review the annual report of protected species bycatch and confer with PRD on the current status of protected species and any management concerns prior to beginning of the fishing season May 1.

1D. NMFS shall evaluate the need and/or feasibility of modifying the existing observer coverage targets or implementing additional measures in the DGN fishery to produce more reliable estimates of protected species interactions that are scientifically defensible. This assessment should focus on the precision and uncertainty of existing observer coverage targets relative to current protected species interaction rates, and the relative benefits and short comings of other observer coverage levels. This assessment shall be completed by May 1, 2014. SFD will confer with PRD on the results of this assessment and shall initiate implementation of any necessary and feasible measures identified by this assessment by August 14, 2014.

1E. NMFS shall establish a vessel monitoring system (VMS) program in the DGN fishery by August 14, 2015. The VMS program should provide NMFS and OLE the ability to monitor compliance with time/area closures such as the PLCA, provide OLE the opportunity to deploy enforcement personnel to inspect vessels for compliance with take reductions measures such as proper use of pingers, provide NMFS an opportunity to deploy observers to monitor catch in alternative platform, and provide NMFS the ability to more closely examine and compare the distribution of observed and unobserved fishing effort. This data will be used to inform the assumption that observed and unobserved vessels have similar exposure to protected species, and similar bycatch rates.

1F. NMFS will evaluate the usefulness and feasibility of implementing additional measures or actions, such as electronic monitoring of fishing effort or instituting alternative observer platforms, to ensure the DGN fishery is accurately monitored and compliant with the existing regulatory requirements implemented to minimize the incidental take of ESA-listed species identified in the proposed action. This assessment should focus on improved coverage of fishing effort that might otherwise be unobserved or unobservable under the current fishery observer program. This assessment shall be completed by December 31, 2014, in coordination with the PFMC, if necessary, and any additional NMFS guidance on implementation of electronic monitoring programs that may be issued by the NMFS Office of Policy prior to completion of this assessment. SFD will confer with PRD on the results of this assessment and shall initiate implementation of any useful and feasible measures identified by this assessment in consultation with the PFMC and any additional national NMFS guidance, as necessary, by May 1, 2015.

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

   2A. NMFS shall continue to provide DGN skipper education workshops, required for skippers of DGN vessels upon notification from NMFS as described in 50 CFR 229.31(d), with a module on sea turtle handling, resuscitation, and release requirements, as outlined in 50 CFR § 223.206(d)(1), as well as appropriate handling and release procedures for marine mammals.

   2B. NMFS shall also include in skipper education workshops a module of information on sea turtle biology and methods to avoid and minimize sea turtle impacts.

   2C. NMFS shall continue to produce a pamphlet describing sea turtle species, biology, and recommended techniques for releasing and resuscitating incidentally captured sea turtles that will be distributed during skipper training workshops.

X. CONSERVATION RECOMMENDATIONS

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

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

1. While NMFS is in the process of evaluating observer coverage goals and implementation of any additional measures for monitoring impacts to protected species from the DGN fishery, such as VMS and electronic monitoring, NMFS should commit to obtaining as much observer coverage in the DGN fishery in excess of the current 20 percent observer

coverage target rate as resources and the ability to deploy observers on DGN fishing vessels will allow.

2. NMFS should continue exploring the possibility of modifying existing DGN fishing gear or developing new fishing strategies to reduce the likelihood of interactions with sea turtles and marine mammals, utilizing work being done in the U.S. and overseas.

3. NMFS should explore the feasibility of using biological and oceanographic modeling outputs/measures to determine when ESA-listed marine mammals and sea turtles may be in an area where the DGN fishery occurs.

4. NMFS should continue exploring and developing new approaches to improve the understanding of how ecosystem and climatic variables may affect the presence, abundance, and distribution of marine mammals and sea turtles along the U.S. west coast.

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 continue to promote the reduction of marine mammal and sea turtle bycatch in Pacific fisheries by supporting:

   a. The Inter-American Convention for the Protection and Conservation of Sea Turtles

   b. Any binding Regional Fishery Management Organizations' marine mammal and sea turtle conservation, mitigation, and management measures for commercial fisheries operating in the eastern Pacific Ocean

   c. Technical assistance workshops and research to assist other nations in reducing marine mammal and sea turtle bycatch in DGN.

   d. A trans-Pacific international agreement that would include relevant Pacific Rim nations for the conservation and management of marine mammal and sea turtle populations.

XI. REINITIATION NOTICE

This concludes formal consultation on the continued management of the drift gillnet fishery under the U.S. West Coast HMS FMP. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take 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 modified in a manner that causes an effect to listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR § 402.16). In instances where the amount or extent of incidental take is exceeded, the Sustainable Fisheries Division, Southwest Region, NMFS, should immediately request initiation of formal consultation. In addition to any limits regarding observed takes of ESA-listed species specified in the incidental take statement of this Opinion, NMFS maintains the discretion to reinitiate consultation based on any information related to estimates of impacts from the DGN fishery that provide cause for concern about the structure of DGN fisheries management and/or impacts to ESA-listed species that may result from the fishery.

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Appendix A. Probability of entanglement events expected to occur in any one year based on the proposed action of 1,500 sets in the DGN fishery (NMFS 2012a; updated March, 2013.

	Fin Whale	Humpback Whale	Sperm Whale	Leatherback Turtle	Loggerhead Turtle	Olive Ridley Turtle	Green Turtle
Number of entanglement events	**Probability**	**Probability**	**Probability**	**Probability**	**Probability**	**Probability**	**Probability**
0	0.690734	0.477114	0.225373	0.146607	0.249075	0.763379	0.763379
1	0.255572	0.353064	0.335805	0.281485	0.346215	0.206112	0.206112
2	0.047281	0.130634	0.250175	0.270226	0.240619	0.027825	0.027825
3	0.005831	0.032223	0.124254	0.172945	0.111487	0.002504	0.002504
4	0.000539	0.005961	0.046284	0.083013	0.038742	0.000169	0.000169
5	3.99E-05	0.000882	0.013793	0.031877	0.01077	9.13E-06	9.13E-06
6	2.46E-06	0.000109	0.003425	0.010201	0.002495	4.11E-07	4.11E-07
7	1.3E-07	1.15E-05	0.000729	0.002798	0.000495	1.58E-08	1.58E-08
8	6.02E-09	1.06E-06	0.000136	0.000671	8.61E-05	5.35E-10	5.35E-10
9	2.47E-10	8.75E-08	2.25E-05	0.000143	1.33E-05	1.6E-11	1.6E-11
10	9.15E-12	6.47E-09	3.35E-06	2.75E-05	1.85E-06	4.33E-13	4.33E-13

III. Objectivity of Information Product

Synthesized Products

Key pieces of synthesized products in this document were developed as part of analyses done by scientists from the NMFS Southwest Fisheries Science Center in La Jolla. Their analyses involved deriving bycatch rates using data obtained from fisheries observer records from the drift gillnet fishery estimated future impacts to ESA-listed species based on anticipated fishing effort. Additional synthesized products include analyses done to examine the relative location of observed and unobserved fishing effort, and the relative catch success (target species) of observed and unobserved vessels. The development of these analyses represents a scientific step forward in both the knowledge and approach to understanding this topic in a way that will carry over into the future. These analyses have been reviewed by a number of biologists and analysts in the Southwest for clarity of presentation and consistency with current policy and previous documents related to similar actions and species.

Interpreted Products

There are additional interpreted products derived from the information that was generated from the synthesized products provided in this document. As with the synthesized product, the interpreted products have been reviewed by other biologists and analysts in the Southwest Region for scientific credibility and quality of presentation. The sources of data found in these analyses and interpretations are clearly referenced and the limitations of conclusions and assertions are stipulated whenever appropriate.

Natural Resource Plan

This document was prepared in accordance with the Endangered Species Act (ESA) in support of a Magnuson-Stevens Fishery Conservation and Management Act Fishery Management Plan for the Highly Migratory Species drift gillnet fishery off the coast of Washington, Oregon, and California. As required by the ESA, this biological opinion does represent and incorporate the best available science in the analyses presented in the document and the policy decisions made in accordance with the conclusions of this opinion. The document does attempt to clearly distinguish quantitative elements of analysis from the more qualitative elements, which are significant in this document. The limitations of the analyses and points of uncertainty are highlighted, especially in the most relevant contexts as they apply to policy implications. Sources of data and references have been clearly identified and referenced. In addition, this document has been reviewed by a number of biologists and policy analysts in the Southwest Region for clarity of presentation and consistency with current policy and previous documents related to similar actions and species.