DRAFT
Marine Mammal Protection Act Section 101(a)(5)(E) Negligible Impact Determination CA/OR/WA Humpback Whale CA/OR/WA Sperm Whale

National Marine Fisheries Service
Protected Resources Division
West Coast Regional Office
January 2017

Table of Contents

List of Abbreviations

AIC_c	Akaike information criterion with correction for finite sample sizes
CA	California
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CV	Coefficient of variation
DPS	Distinct Population Segment
ENP	Eastern North Pacific (gray whales)
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FR	Federal Register
FMP	Fishery Management Plan
F_r	Recovery factor
g(0)	Probability of trackline detection
in	inch
GAMMS	Guidelines for Assessing Marine Mammal Stocks
HMS	Highly Migratory Species
IFQ	Individual fishing quota
IWC	International Whaling Commission
lb	pounds
LOF	List of Fisheries
MMPA	Marine Mammal Protection Act
MNPL	Maximum Net Productivity Level
M/SI	Mortality and serious injury
N_{min}	Minimum population estimate
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
OR	Oregon
PBR	Potential biological removal
PSRG	Pacific Scientific Review Group
R_{max}	Maximum theoretical net productivity rate
SAR	Stock assessment report
Team	Pacific Offshore Take Reduction Team
POCTRP	Pacific Offshore Cetacean Take Reduction Plan
WA	Washington
WNP	Western North Pacific (gray whales)

List of Tables

List of Figures

Executive Summary

Section 101(a)(5)(E) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. 1361 *et seq.*, requires NOAA's National Marine Fisheries Service (NMFS) to authorize the incidental taking of marine mammals from a species or stocks designated as depleted because of its listing under the Endangered Species Act (ESA), 16 U.S.C. 1531 *et seq.*, in the course of commercial fishing operations if NMFS makes certain determinations. NMFS must determine, among other things, that mortality and serious injury (M/SI) incidental to commercial fishing will have a negligible impact on the affected species or stock.

The purpose of this document is to conduct the analysis necessary to determine whether the M/SI incidental to U.S. commercial fisheries will have a negligible impact on ESA-listed marine mammals taken in commercial fisheries in the U.S. Exclusive Economic Zone (EEZ) off the West Coast. The determination follows a process previously described and implemented by NMFS when issuing incidental take permits under MMPA section 101(a)(5)(E) (*e.g.*, 78 FR 54553, September 4, 2013; 80 FR 22709, April 23, 2015).

Marine Mammals Included in this Analysis

The ESA-listed marine mammals determined to interact with commercial fisheries off the U.S. West Coast under NMFS' jurisdiction include the California (CA)/Oregon (OR)/Washington (WA) stock of humpback whale (*Megaptera novaeangliae*) and the CA/OR/WA stock of sperm whale (*Physeter microcephalus*).

NMFS recently conducted a global status review of humpback whales (Bettridge *et al.* 2015), and revised the ESA listing by identifying 14 distinct population segments (DPSs) and listing four as endangered and one as threatened (81 FR 62259; September 8, 2016). The MMPA stocks of humpback whales do not necessarily equate with DPSs under the ESA. NMFS is currently conducting a review of humpback whale stock delineations in waters under U.S. jurisdiction to determine whether any stocks should be realigned in light of the ESA DPSs. Until such time as the MMPA stock delineations are reviewed and potentially revised, NMFS is conducting this analysis under the current MMPA stock structure.

Fisheries Considered for Authorization

As required by the MMPA, the annual List of Fisheries (LOF) classifies U.S. commercial fisheries into one of three categories (I, II, or III) according to the level of incidental M/SI of marine mammals. This classification is based on the rate, in numbers of animals per year, of incidental M/SI relative to a stock's potential biological removal (PBR) level. The MMPA and implementing regulations define PBR as the maximum number of animals (*e.g.*, whales per year), not including natural mortality, 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); 50 CFR 229.2).

A fishery may qualify as one category for one marine mammal stock and another for a different marine mammal stock. A fishery is categorized on the LOF at its highest classification (*e.g.*, a fishery qualifying for Category III for one marine mammal stock and for Category II for another marine mammal stock will be listed under Category II). Category I fisheries have frequent

incidental M/SI of marine mammals and Category II fisheries have occasional incidental M/SI of marine mammals (16 U.S.C. 1387(c)(1); 50 CFR 229.2). Category III fisheries have a remote likelihood of, or no known incidental M/SI of marine mammals.

The Category I CA thresher shark/swordfish drift gillnet fishery (≥14 inch (in) mesh) and the Category II WA/OR/CA sablefish pot fishery, as identified in the 2016 LOF (81 FR 20550; April 8, 2016), are the two federally-managed fisheries currently considered for authorization. There are no other Category I fisheries operating off the West Coast. All other Category II fisheries are state-managed, and while they are considered as part of this negligible impact determination, these fisheries are not currently authorized to take ESA-listed marine mammals and thus are not considered for authorization under the MMPA 101(a)(5)(E) permit. Category III fisheries are not subject to the permitting requirements of MMPA section 101(a)(5)(E).

The total human-caused M/SI analyzed to make a negligible impact determination for this authorization includes all human sources, such as federally- and non-federally-managed commercial fisheries and ship strikes.

Criteria for Determining Negligible Impact

In 1999, NMFS adopted criteria for making negligible impact determinations for MMPA 101(a)(5)(E) permits (64 FR 28800; May 27, 1999). In applying the 1999 criteria to determine whether M/SI incidental to commercial fisheries will have a negligible impact on an ESA-listed marine mammal stock, Criterion 1 (total known, assumed, or extrapolated human-caused M/SI are less than 10% of PBR) is the starting point for analysis. If this criterion is satisfied (*i.e.*, total known, assumed, or extrapolated human-caused M/SI are less than 10% of PBR), the analysis would be concluded as a negligible impact. The remaining criteria describe alternatives under certain conditions, such as fishery mortality below the negligible threshold but other human-caused M/SI above the threshold or fishery and other human-caused mortality between the negligible threshold and PBR for a stock that is increasing or stable. If Criterion 1 is not satisfied, NMFS may use one of the other criteria as appropriate.

Criterion 2: If total human-caused serious injuries and mortalities are greater than PBR, and fisheries-related mortality is less than 10% of PBR, individual fisheries may be permitted if management measures are being taken to address non-fisheries-related serious injuries and mortalities. When fisheries-related M/SI is less than 10%, the appropriate management action is to address components that account for the major portion of the total.

Criterion 3: If total fisheries-related serious injuries and mortalities are greater than 10% of PBR and less than PBR and the population is stable or increasing, fisheries may be permitted subject to individual review and certainty of data. Although the PBR level has been set up as a conservative standard that will allow recovery of a stock, there are reasons for individually reviewing fisheries if serious injuries and mortalities are above the threshold level. First, increases in permitted serious injuries and mortalities should be carefully considered. Second, as serious injuries and mortalities approach the PBR level, uncertainties in elements such as population size, reproductive rates, and fisheries-related mortalities become more important.

Criterion 4: If the population abundance of a stock is declining, the threshold level of 10% of PBR will continue to be used. If a population is declining despite limitations on human-caused serious injuries and mortalities below the PBR level, a more conservative criterion is warranted.

Criterion 5: If total fisheries-related serious injuries and mortalities are greater than PBR, permits may not be issued.

Time Frame Considered for Analysis

We considered two time frames for this analysis: the most recent 5-year period (2010-2014) for which data are available and have been analyzed, and a 14-year period (2001-2014). The most recent five-year period (here, January 1, 2010 through December 31, 2014) is typically used for negligible impact determination analyses because it provides enough data to adequately capture year-to-year variations in take levels while reflecting current environmental and fishing conditions, as they may change over time. However, NMFS' Guidelines for Assessing Marine Mammal Stocks (GAMMS; NMFS 2016a) suggest that M/SI estimates could be averaged over as many years as necessary to achieve a coefficient of variation (CV) of less than or equal to 0.3, so we also consider a longer timeframe, as described below.

Carretta and Moore (2014) recommend pooling longer time series of data particularly when bycatch is a rare event[1]. Rare bycatch events typically involve smaller marine mammal populations (low abundance) paired with low observer coverage for that fishery. If true bycatch mortality is low, but near PBR, then estimation bias needs to be reduced to allow reliable evaluation of the bycatch estimate against a low removal threshold (PBR). Pooling 10 years of fishery data, for example, results in bycatch estimates within 25% of the true bycatch rate over 50% of the time (*i.e.*, estimates were within 25% of the true value more often than not) (Carretta and Moore 2014). When pooling data, it is important that the data reflect a fishery with relatively constant characteristics (effort, gear, locations, etc.).

Currently, the CA/OR/WA stocks of sperm whales and humpback whales meet both conditions of having relatively low minimum population estimates (N_{min}) (Moore and Barlow 2014; Carretta *et al*. 2016a) and rarely reported or observed M/SI in the CA thresher shark/swordfish drift gillnet fishery ($\geq$ 14 in mesh). Pooling post-2000 data for this fishery is appropriate given the establishment of the Pacific Leatherback Conservation Area in 2001, which altered patterns in fishing effort by prohibiting drift gillnet fishing within the area at certain times of the year. The 2001-2014 time period is used to calculate mean annual bycatch estimate for sperm whales and humpback whales in this fishery. For consistency, estimates of other fishery-related (including the WA/OR/CA sablefish pot fishery) and non-fishery human-caused M/SI of these stocks were also assessed for 2001-2014.

[1] The Pacific Offshore Cetacean Take Reduction Team met in February 2014 and reached consensus on recommendations to reduce sperm whale bycatch in the fishery. As part of their consensus recommendations, the Team recommended that NMFS and the Scientific Review Groups examine the efficacy of increasing the number of years used in the mortality estimates for a stock, beyond five years, in cases where mortality/serious injury events are very rare and a larger pool of years might improve the precision and accuracy of mortality/serious injury. In order to increase the accuracy of the bycatch estimate, Carretta and Moore (2014) recommend pooling longer time series of data.

Negligible Impact Determinations

The determinations were based on the following summary data, which are described in more detail in the body of this document:

Estimate		**CA/OR/WA humpback whale**	**CA/OR/WA sperm whale**
PBR		11.0	2.7
5-year period (2010-2014)	Avg. annual human-caused M/SI	6.8	0.6
	% of PBR	62%	22.2%
	Avg. annual fishery-related M/SI	5.6	0.4
	% of PBR	51%	14.8%
14-year period (2001-2014)	Avg. annual human-caused M/SI	5.1	0.9
	% of PBR	46.4%	33.3%
	Avg. annual fishery-related M/SI	4.1	0.6
	% of PBR	37.3%	22.2%

Criterion 1 was not satisfied for either stock in either time period considered because the total known, assumed, or extrapolated *human-caused* M/SI for each stock is *not less than* 10% of the stock's PBR. Therefore, the other criteria were examined.

Criterion 2 was not satisfied for either stock in either time period considered because *human-caused* M/SI is *not greater than* PBR and *fisheries-related* M/SI is *not less than* 10% of PBR. Therefore, the other criteria were examined.

Criterion 3 was satisfied for both stocks in both time periods because the total known or extrapolated *fishery-related* M/SI is *greater than* 10% of and *less than* 100% of PBR, and the populations are stable or increasing (humpback whale stock is increasing 8% per year and the sperm whale stock is stable).

In conclusion, based on the 1999 negligible impact determination criteria (64 FR 28800), the 2015 U.S. Pacific Marine Mammal Stock Assessment Reports (SAR; Carretta *et al.* 2016a), Carretta and Moore (2014), Moore and Barlow (2014), and the best scientific information and data available, mortality and serious injury incidental to the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) and the WA/OR/CA sablefish pot fishery will have a negligible impact on the CA/OR/WA stock of humpback whales, and the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) will have a negligible impact on the CA/OR/WA stock of sperm whales.

1.0 Introduction

Section 101(a)(5)(E) of the Marine Mammal Protection Act (MMPA), 16 U.S.C. 1361 *et seq.*, states that NOAA's National Marine Fisheries Service (NMFS), as delegated by the Secretary of Commerce (Secretary), shall for a period of up to three years allow the incidental taking of marine mammals from species or stocks designated as depleted because of its listing under the Endangered Species Act (ESA), 16 U.S.C. 1531 *et seq.,* by persons using vessels of the United States and those vessels which have valid fishing permits issued by the Secretary (50 CFR 216.103; 50 CFR 229.2) in accordance with section 204(b) of the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1824(b) (50 CFR 660), while engaging in commercial fishing operations, if NMFS makes certain determinations. NMFS must first determine, after notice and opportunity for public comment, that:

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

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

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

The purpose of this document is to explain the analyses and rationale for determining whether mortality and serious injury (M/SI) incidental to U.S. commercial fisheries off the West Coast will have a negligible impact on ESA-listed marine mammals (*i.e.,* determination (1) above). Determinations related to (2) recovery plans and (3) the requirements of MMPA section 118 will be made in a *Federal Register* notice to issue the MMPA 101(a)(5)(E) permit.

1.1 Process and Criteria for Issuing an MMPA section 101(a)(5)(E) Permit

Among the requirements of MMPA section 101(a)(5)(E) to issue a permit to take ESA-listed marine mammals incidental to commercial fishing, NMFS must determine whether the taking of marine mammals would have a negligible impact on the affected stock or stocks of marine mammals. Such determinations are required only in MMPA section 101(a)(5) and are currently required in authorizing the take of small numbers of any stock of marine mammals incidental to activities other than commercial fishing (Sections 101(a)(5)(A) and (D)) or in permitting the take of threatened or endangered marine mammals incidental to commercial fishing operations (Section 101(a)(5)(E)).

Within the MMPA's provisions, NMFS must determine if the taking (by harassment, injury, or mortality – or a combination of these) incidental to specified activities will have a negligible impact on the affected stocks of marine mammals. Under the MMPA, to authorize the take of threatened or endangered marine mammals incidental to fishing operations, NMFS must

determine if mortality and serious injury incidental to commercial fisheries will have a negligible impact on the affected species or stock(s) of marine mammals.

NMFS has implemented procedures including a qualitative definition of negligible impact, through regulations at 50 CFR 216.103 and has relied upon qualitative and quantitative approaches to determine the levels of taking that would result in a negligible impact to affected stocks of marine mammals. The quantitative approach is better suited for mortality and serious injury than for non-lethal takes because mortality and serious injury are considered removals from the population and can be evaluated by well-documented models of population dynamics.

NMFS' regulations implementing the MMPA amendments of 1981 included a regulatory definition for "negligible impact":

> Negligible impact *is an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival* (50 CFR 216.103)[2].

This qualitative definition of negligible impact was the standard NMFS used to implement the Small Take Program from its beginning in 1981 through 1994, when additional amendments to the MMPA were enacted and a more quantitative approach was developed for assessing what level of removals from a population stock of marine mammals could be considered a negligible impact. The qualitative definition remains the only regulatory definition of negligible impact for implementing the MMPA.

In 1998, NMFS published a notice (63 FR 71894; December 30, 1998) advising the public that the agency was extending for a 6-month period the 3-year permit issued nationwide to fisheries in 1995 to authorize the taking of threatened or endangered marine mammals. This notice also informed the public that NMFS considered the 6-month extension of the permit as an opportunity to review existing criteria for the issuance of permits and to address issues that have arisen since the permits were first issued. NMFS solicited public comments to develop alternatives to 10% of PBR as a criterion for determining negligible impact; however, none were received.

Having received no comments upon which to develop alternatives for determining negligible impact, NMFS published a notice proposing to issue permits under MMPA section 101(a)(5)(E) in 1999 (64 FR 28800; May 27, 1999). The notice contained a statement that NMFS, through internal deliberation, had adopted the following criteria for making negligible impact determinations for such permits:

> 1. The threshold for initial determination will remain at 10% of PBR. If the total human-related M/SI are less than 10% of PBR, all fisheries may be permitted.

[2] 50 CFR 216.103 specifically applies to the Small Take Program (the Small Take Program no longer called by this name, rather the information is found under NMFS' Incidental Take Authorizations under the MMPA). However, the definition of "negligible impact" in 50 CFR 229.2, which implements MMPA sections 101(a)(5)(E) and 118, provides, "*Negligible impact* has the same meaning as in §216.103 of this chapter."

2. If total human-related M/SI are greater than PBR, and fisheries-related mortality is less than 10% of PBR, individual fisheries may be permitted if management measures are being taken to address non-fisheries-related serious injuries and mortalities. When fisheries-related M/SI is less than 10% of the total, the appropriate management action is to address components that account for the major portion of the total.

3. If total fisheries-related M/SI are greater than 10% of PBR and less than PBR, and the population is stable or increasing, fisheries may be permitted subject to individual review and certainty of data. Although the PBR level has been set up as a conservative standard that will allow recovery of a stock, there are reasons for individually reviewing fisheries if serious injuries and mortalities are above the threshold level. First, increases in permitted serious injuries and mortalities should be carefully considered. Second, as serious injuries and mortalities approach the PBR level, uncertainties in elements such as population size, reproductive rates, and fisheries-related mortalities become more important.

4. If the population abundance of a stock is declining, the threshold level of 10% of PBR will continue to be used. If a population is declining despite limitations on human-related serious injuries and mortalities below the PBR level, a more conservative criterion is warranted.

5. If total fisheries-related M/SI are greater than PBR, permits may not be issued.

This set of criteria maintained 10% of PBR (from 1995) as the starting point in negligible impact determinations and explicitly noted ways in which determinations could deviate from the default. Criterion 3 notes that NMFS may give special consideration if the affected stock of marine mammals is stable or increasing and may permit take incidental to fishing even if incidental removals exceed 10% of PBR but are below PBR.

1.2 Previous Negligible Impact Analyses and Permit Issuances

On September 4, 2013, NMFS issued a 3-year permit for the CA thresher shark/swordfish drift gillnet fishery (≥14 inch (in) mesh), which was determined to have a negligible impact on the California (CA)/Oregon (OR)/Washington (WA) stocks of fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*), and sperm whales (*Physeter macrocephalus*), and the WA/OR/CA sablefish pot fishery, which was determine to have a negligible impact on the CA/OR/WA humpback whale stock (78 FR 54553).

The September 2013 permit stated that during the 3-year time period authorized, the supporting negligible impact determination (NID) could be re-evaluated pursuant to sections 101(a)(5)(E)(iii), (iv), and (v) of the MMPA (16 U.S.C. 1371 (a)(5)(E)(iii), (iv), and (v)) if a mortality or serious injury of a CA/OR/WA stock sperm whale occurred in any fishery. Significant new information became available after issuance of the permit such that NMFS reevaluated the NID and proposed and then issued an amended permit, following evaluation of public comment (80 FR 22709; April 8, 2015). This modification did not extend the expiration date and therefore remained effective until September 4, 2016.

The 2015 amended permit and supporting NID did not include the CA/OR/WA stock of fin whales because there were no observed takes of a fin whale in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) fishery for the past 15 years, since 1999. Going forward, if there is take of a fin whale from any Category I or II fishery during the 3-year period of this new permit being considered here, we will re-evaluate pursuant to section 101(a)(5)(E)(iii), (iv), and (v) of the MMPA (16 U.S.C. 1371 (a)(5)(E)(iii), (iv), and (v)).

2.0 Action Area-California, Oregon, and Washington

The action area is the U.S. EEZ off the coasts of California, Oregon, and Washington where fishing vessels are managed under a fishery management plan (FMP) (See Figure 1). The most current information on the Highly Migratory Species (HMS) FMP and amendments (which cover the CA thresher shark/swordfish drift gillnet fishery) and the groundfish fishery FMP and amendments (which cover the WA/OR/CA sablefish pot fishery) can be found at: http://www.pcouncil.org/highly-migratory-species/fishery-management-plan-and-amendments/ and http://www.pcouncil.org/groundfish/fishery-management-plan/.

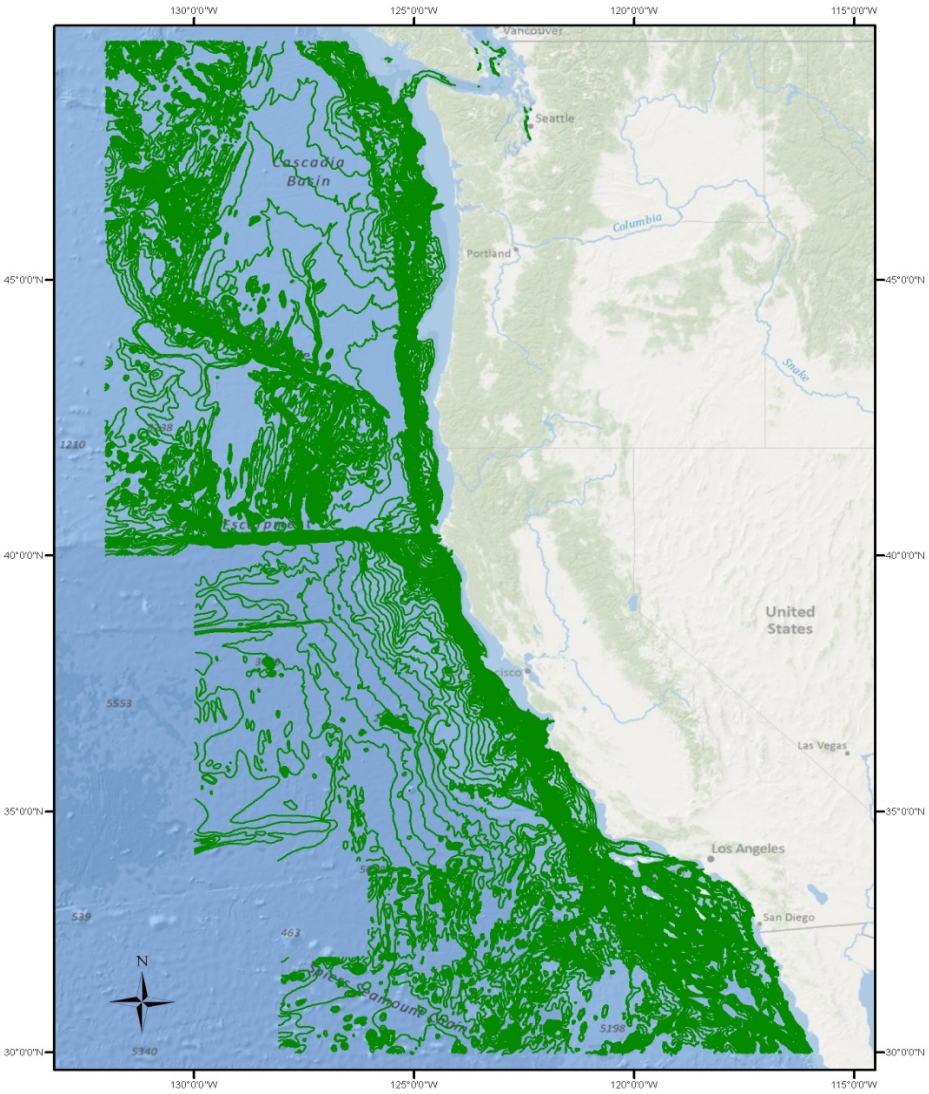

Figure 1. Action area off the coasts of California, Oregon, and Washington. Green lines delineate bathymetry within the U.S. Exclusive Economic Zone.

3.0 Fisheries in the Action Area that Interact with ESA-listed Marine Mammals

Under the MMPA, fisheries are classified according to their incidental M/SI of marine mammals. Each fishery is evaluated on a per-stock basis; thus a fishery may qualify as one category for one marine mammal stock and another for a different marine mammal stock. A fishery is categorized on the MMPA LOF at its highest classification (*e.g.*, a fishery qualifying for Category III for one marine mammal stock and for Category II for another marine mammal stock will be listed under Category II). Category I fisheries have frequent incidental mortality and serious injury of marine mammals and Category II fisheries have occasional incidental mortality and serious injury of marine mammals. Category III fisheries have a remote likelihood of, or no

known incidental mortality and serious injury of, marine mammals. Additional details are provided in the preamble to the proposed rule implementing section 118 of the MMPA (60 FR 45086; August 30, 1995).

The U.S. West Coast commercial fisheries that have been documented as incidentally killing or injuring ESA-listed marine mammals, as identified in the most recent LOF (81 FR 20550, April 8, 2016) are included in Table 1. Only the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) and WA/OR/CA sablefish pot fishery are considered in this analysis because they are the only two federally-managed Category I or II fisheries in Table 1. All other Category II fisheries in the action area are state-managed. NMFS can authorize incidental take of endangered or threatened marine mammals in state fisheries, but is not doing so through this action, as these fisheries are not currently authorized to take marine mammals under the ESA. Category III fisheries are not subject to the permitting requirements of MMPA section 101(a)(5)(E). However, M/SI incidental to all fisheries, regardless of LOF category or management authority, are included in our analysis of total human-caused M/SI, so those fisheries are listed in Table 1.

NMFS described each Category I and II fishery in detail in the final 2008 LOF (72 FR 66048; November 27, 2007). These descriptions can also be found at http://www.nmfs.noaa.gov/pr.interactions/lof/ or in the 2015 Pacific marine mammal stock assessment reports (SAR) (Carretta *et al.* 2016a). We provide a brief description of the CA thresher shark/swordfish drift gillnet fishery (≥14 inch mesh) and the WA/OR/CA sablefish pot fishery below.

Table 1. Commercial fisheries off the coasts of California, Oregon, and Washington with M/SI of ESA-listed marine mammals. (Sources: 2016 List of Fisheries and a self-report from an owner/operator of a commercial fishing vessel). The two fisheries considered for MMPA 101(a)(5)(E) permitting are in bold.

Fishery Description	**ESA-Listed Marine Mammals Incidentally Killed/ Seriously Injured**
Category I	
CA thresher shark/swordfish drift gillnet (>14 inch mesh)	**Humpback whale - CA/OR/WA stock** **Sperm whale-CA/OR/WA stock**
Category II	
CA halibut/white sea bass and other species set gillnet (≤3.5 in mesh)	Humpback whale-CA/OR/WA Sea otter – CA*
CA spot prawn pot	Humpback whale - CA/OR/WA stock
CA Dungeness crab pot	Humpback whale - CA/OR/WA stock
OR Dungeness crab pot	Humpback whale - CA/OR/WA stock
WA/OR/CA sablefish pot	**Humpback whale - CA/OR/WA stock**
WA coastal Dungeness crab pot	Humpback whale - CA/OR/WA stock
Category III	
CA halibut bottom trawl	Steller sea lion, unknown**
CA spiny lobster	Humpback whale – CA/OR/WA stock***

*The CA stock of southern sea otter (*Enhydra lutris*) is listed as threatened under the ESA. Management of sea otters is under the jurisdiction of the U.S. Fish and Wildlife Service and is therefore not considered further in this analysis.

**There are two distinct population segments of Steller sea lion (*Eumetopias jubatus*), the Western DPS, which is listed as endangered, and the Eastern DPS, which was de-listed in 2013 (78 FR 66140). Given the location of the fishery's effort off central California (primarily), the M/SI with a Steller sea lion was very likely with the non-listed Eastern DPS, although it is not identified as such in the LOF.

***In the proposed 2010 LOF (74 FR 27739; June 11, 2009), due to a 2007 M/SI report of a CA/OR/WA humpback in the CA spiny lobster fishery. However, during public comment on the proposed LOF, NMFS received information from the CA Department of Fish And Game that the report of the gear type and fishery was not considered reliable. Based on the public comments, NMFS did not add humpback whales to the species or stock incidentally killed or injured in the CA spiny lobster fishery and did not recategorize it in the final 2010 LOF. The original 2007 entanglement was report was used in the 2013 SAR and therefore, the proposed 2017 LOF should not include humpback whales as interacting (M/SI) with the CA spiny lobster fishery.

3.1 Category I Federally-managed fisheries

CA thresher shark/swordfish drift gillnet fishery (>14 inch mesh)

The CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) targets swordfish and thresher shark. The fishery is managed under regulations implementing the HMS FMP developed by the Pacific Fishery Management Council. This fishery is a limited entry fishery

with seasonal closures and gear restrictions. The CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) operates outside of state waters to about 150 miles offshore ranging from the U.S./Mexico border in the south to the Oregon border in the north, depending on sea temperature conditions (Figure 2). Regulations restrict the fishery to waters outside 200 nautical miles (nm) from February 1 through April 30, outside 75 nm from May 1 through August 14, and outside 12 nm from August 15 through January 31 (Figure 2). CA thresher shark/swordfish drift gillnet vessels targeting swordfish tend to set on warm ocean water temperature breaks, which do not appear along the California coast until late summer; therefore, vessels are not active during February, March, and April, and very little fishing effort occurs during the months of May, June, and July.

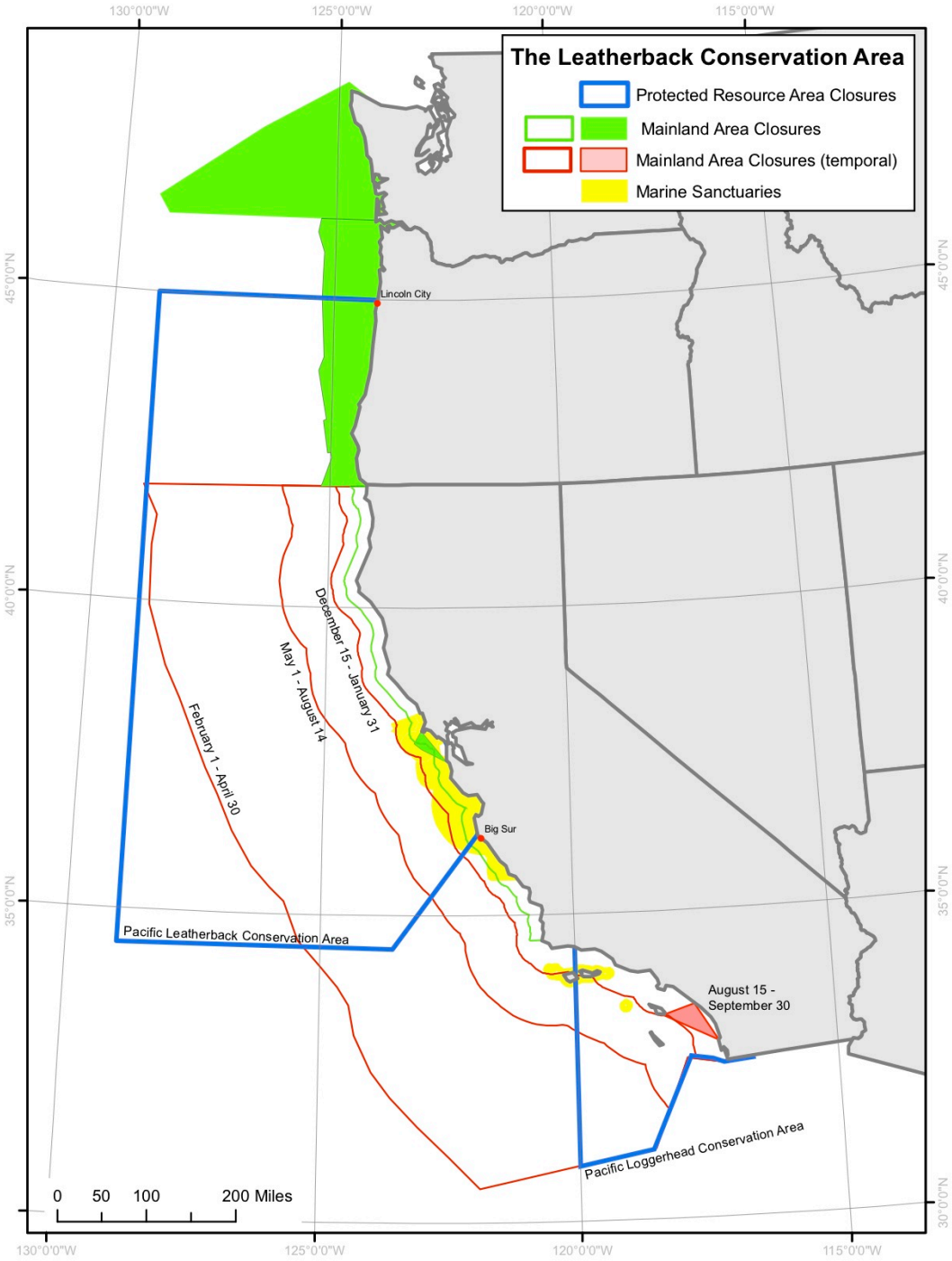

Figure 2. CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) area, with areas designating the sea turtle conservation areas and time area closures. Regulations restrict the fishery to waters outside 200 nm from February 1 through April 30, outside 75 nm from May 1 through August 14, and outside 12 nm from August 15 through January 31.

In 2001, a seasonal (15 August-15 November) area closure was implemented in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) north of Point Conception, to protect leatherback turtles that feed in the area and were observed entangled in previous fishing seasons. An additional seasonal/area closure in southern California was established in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) in 2003 to protect loggerhead turtles during a forecast or occurring El Niño event during the months of June, July, and/or August (Figure 3). Since these regulations have been in place, effort in this fishery has shifted to areas off southern California and primarily in the southern California Bight (Figure 4).

Figure 3. CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) area. The dotted area indicates the leatherback sea turtle conservation area, in effect from August 15-November 15 annually, and the hatched area delineates the loggerhead time/area closure (June 1-August 31) during a forecast or occurring El Niño event.

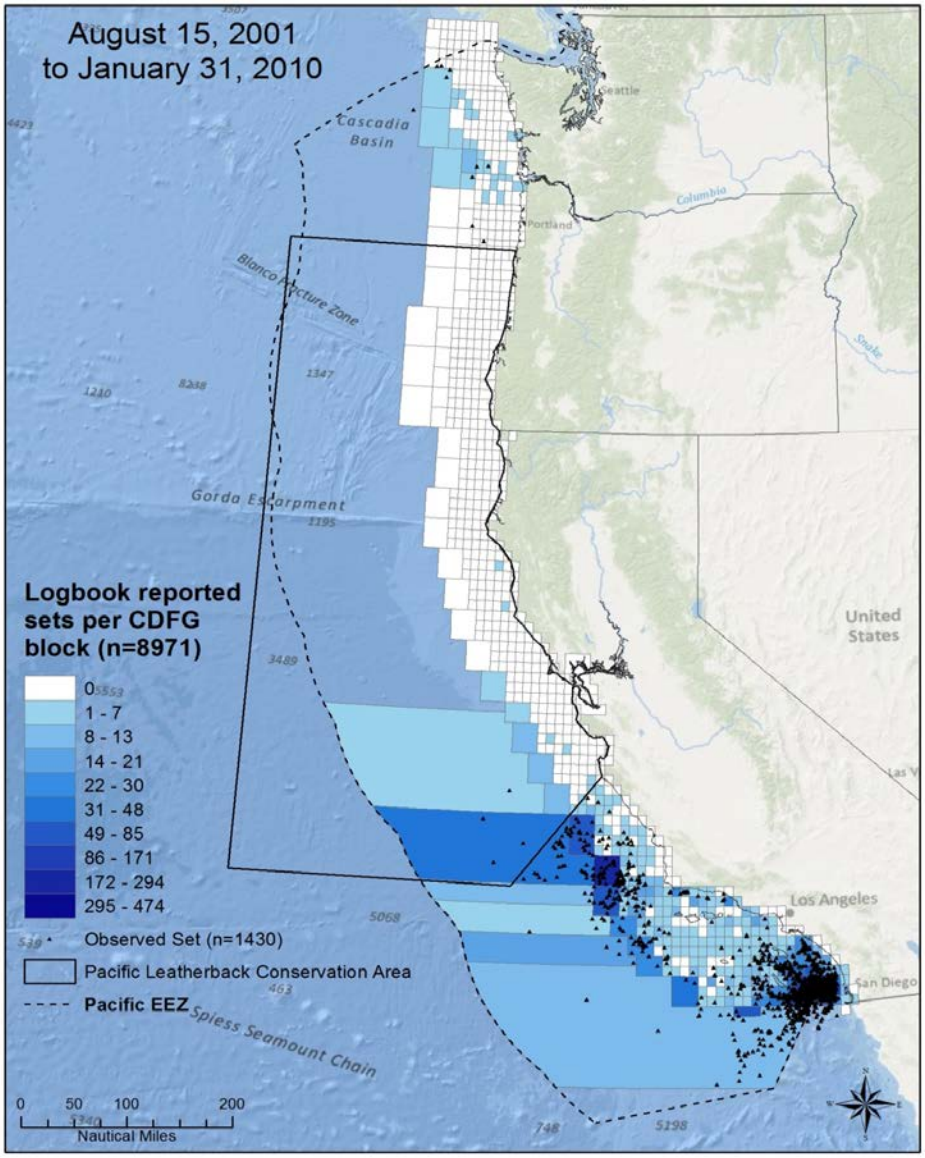

Figure 4. CA thresher shark/swordfish drift gillnet (≥14 in mesh) logbook-reported fishing effort and observed sets from August 15, 2001, to January 31, 2010. Although the fishing season runs a full year (August 15-August 14), no reported effort occurred during this time period outside of the August 15-January 31 timeframe. The solid line shows the leatherback sea turtle conservation area.

The 2016 LOF (81 FR 20550, April 8, 2016) lists the CA thresher shark/swordfish drift gillnet fishery (≥ 14 in mesh) as a Category I fishery. The 2012 LOF (76 FR 73912) elevated the fishery from Category III to Category II, due to a self-report from the owner of a vessel fishing in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh), reporting an incidental entanglement with a humpback whale off of San Diego, California, in January 2009. The fishery was again elevated, from Category II to Category I, on the 2013 LOF (78 FR 53336, August 29, 2013), based on sperm whale interactions observed in the fishery in 2010. On December 5, 2010, NMFS Southwest Region's (now the West Coast Region) Observer Program recorded two sperm whales entangled in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh). One animal was found dead and the other was released alive, but was seriously injured as gear

remained attached to the animal. The self-reported humpback whale and observed sperm whale takes are considered to be from the CA/OR/WA stocks, given their locations.

At this time, no other known fishery has documented takes of individuals from the CA/OR/WA stock of sperm whales. In 2013, the level of sperm whale M/SI from the CA thresher shark/swordfish drift gillnet fishery (≥ 14 in mesh) exceeded the stock's PBR (which was 1.5 at the time) (Carretta *et al.* 2012), and a NID under the MMPA could not be made for sperm whales. NMFS convened the Pacific Offshore Cetacean Take Reduction Team (Team) on July 31 and August 7, 2013. The Team was charged with developing recommendations to reduce the sperm whale M/SI rate in the CA thresher shark/swordfish drift gillnet fishery (≥14 inch mesh) to below PBR (1.5). NMFS considered the Team's recommendations and published an emergency rule on September 4, 2013 (78 FR 54547), valid only for the 2013-2014 fishing season, that modified the CA thresher shark/swordfish drift gillnet fishery (≥14 inch mesh) to reduce the risk of incidental M/SI of sperm whales in the fishery. Modifications included a hard cap on sperm whales and 100% observer coverage for vessels intending to fish in deep water, where evidence showed a high likelihood of an interaction with a sperm whale. Based on these modifications, NMFS concluded that the NID conditions of the MMPA section 101(a)(5)(E) could be met, so NMFS was able to authorize incidental take under the ESA and MMPA (78 FR 54553; NMFS 2013).

On February 4-6, 2014, NMFS reconvened the Team to consider short-term and long-term measures to reduce sperm whale M/SI in the CA thresher shark/swordfish drift gillnet fishery (≥14 inch mesh) in subsequent fishing seasons. The Team reached consensus and, among their recommendations, asked that NMFS consider alternative methods to improve abundance and bycatch estimates when fishery interactions are rare or infrequent. Shortly after the Team met in February 2014, NMFS did consider a more accurate method to evaluate population abundance estimates for sperm whales. That method, described in detail in Moore and Barlow (2014), used data from 1991-2008 to estimate a minimum population abundance and consequently a revised PBR for sperm whales of 2.7 whales per year. In addition, NMFS developed recommendations for pooling annual bycatch estimates when events are rare (Carretta and Moore 2014) and subsequently used a longer time frame (2001-2012) to estimate the annual average M/SI of sperm whales in the CA thresher shark/swordfish drift gillnet fishery (≥14 inch mesh) (Carretta *et al.* 2016a). NMFS reconvened the Team on April 15, 2014, to discuss the methods described in Carretta and Moore (2014) and Moore and Barlow (2014) and the resulting revised PBR and bycatch estimates. NMFS again convened the Team from March 17-19, 2015, and in light of new information, the Team revisited their previous consensus recommendations.

Based on the revised bycatch estimates and the new minimum population abundance for sperm whales, the Team recommended that the provisions of the emergency rule were unnecessary and that NMFS not move forward with a permanent rule for sperm whales. Therefore, NMFS prepared and finalized an amended MMPA 101(a)(5)(E) permit to the CA thresher shark/swordfish drift gillnet fishery to incidentally take CA/OR/WA humpback whales and CA/OR/WA sperm whales (and to the WA/OR/CA sablefish pot fishery to incidentally take CA/OR/WA humpback whales) (80 FR 22709, April 23, 2015).

The number of vessels active in this fishery from 2001-2015 are shown in Table 2. Effort has declined in this fishery primarily due to the 2001 time/area to protect leatherbacks off central and northern California as well as fewer fishermen transferring/recruiting into the fishery.

Table 2. Annual drift gillnet permits issued and number of active vessels, 2001–2015.

Year	Active Vessels*	Permits Issued**
2001	69	114
2002	50	106
2003	43	100
2004	40	96
2005	42	90
2006	45	88
2007	46	86
2008	46	85
2009	46	84
2010	27	82
2011	19	82
2012	15	78
2013	19	72
2014	19	70
2015	17	69

* Source: *Status of the U.S. West Coast Fisheries for Highly Migratory Species through 2004; Stock Assessment and Fishery Evaluation* report, available from the Pacific Fishery Management Council website (www.pcouncil.org).
**Source: California Department of Fish and Wildlife License and Revenue Branch and C. Villafana (NMFS-West Coast Regional Office Observer Program, 2016)

Observer Information

The NMFS' West Coast Region has operated an at-sea federal observer program in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) since July 1990, and the California Department of Fish and Wildlife operated a drift gillnet 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. Observer coverage of the CA thresher shark/swordfish drift gillnet (≥14 in mesh) fleet typically targets 20% of the annual sets made in the fishery, with close to 100% of net retrievals monitored on observed trips for, among other things, species identification and enumeration. Table 3 provides a summary of the estimated total fishing effort and the associated observer coverage from 2001-2015. Effort has decreased in recent years in part due to less productive oceanographic conditions for targeting swordfish/thresher shark and a likely pattern of switching gear and concentrating effort towards more lucrative fisheries.

Table 3. Summary of CA thresher shark/swordfish drift gillnet (>14 in mesh) Observer Program from 2001-2015 (January to December; C. Villafana, NMFS-Observer Program, pers. comm., 2016).

Calendar Season	Estimated Total Fishing Effort (Sets)	Total Number of Observed Sets	Percent Observer Coverage
2001	1,665	339	20.4%
2002	1,630	360	22.1%
2003	1,467	298	20.3%
2004	1,084	223	20.6%
2005	1,075	225	20.9%
2006	1,433	266	18.6%
2007	1,241	204	16.4%
2008	1,103	149	13.5%
2009	761	101	13.3%
2010	492	59	12.0%
2011	435	85	19.5%
2012	445	83	18.7%
2013	470	176	37.4%
2014	409	97	23.7%
2015	361	74	20.5%

3.2 Category II Federally-managed fisheries

WA/OR/CA sablefish pot fishery

The WA/OR/CA sablefish pot fishery targets sablefish using trapezoid, conical, or rectangular steel frame traps, wrapped with ≥ 2 inch nylon webbing (NMFS 2011). The fishery generally sets gear at depths between 80 and 300 fathoms (480-1800 ft; 146.30-548.64 m) off the west coast of the U.S. (NMFS 2016b). The fishery is managed under regulations implementing the Pacific Coast Groundfish FMP developed by the Pacific Fishery Management Council. There are four distinct segments of the Pacific coast groundfish fishery where sablefish may be harvested, by some or all of the participants, with pot gear: the limited entry fixed gear sablefish primary fishery; the limited entry fixed gear sablefish daily trip limit fishery; the limited entry trawl individual fishing quota (IFQ) fishery when vessels are "gear switching" (allowed since 2011); and the open access sablefish daily trip limit fishery (NMFS 2016b; Figure 5). Further information about each of these segments of the groundfish fishery that may harvest sablefish with pot gear is provided below.

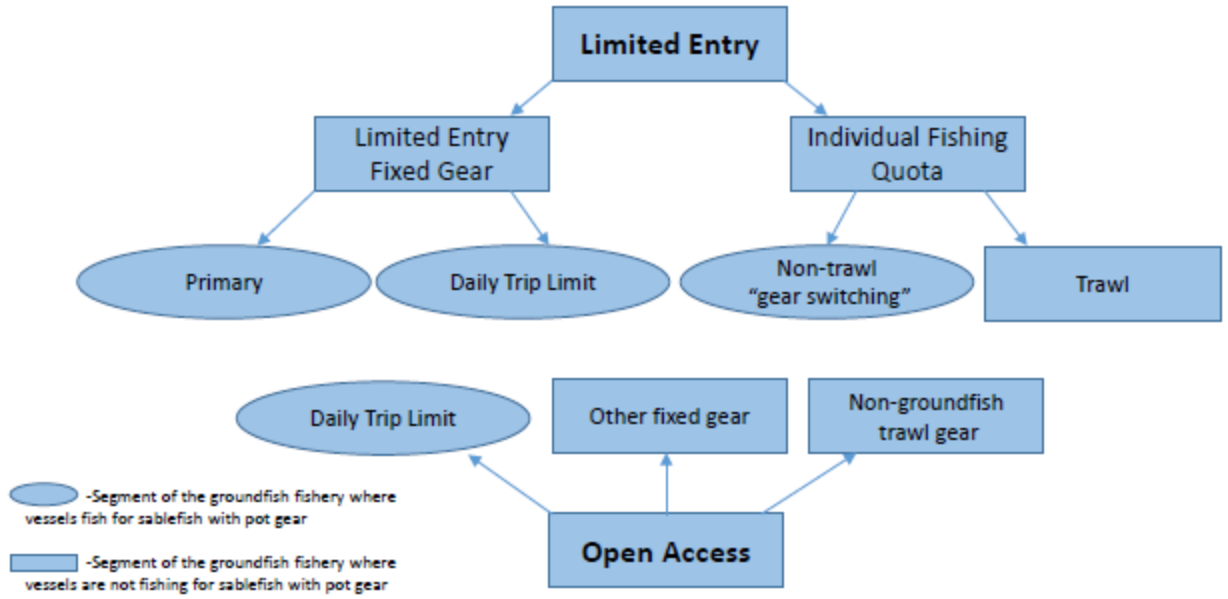

Figure 5. Diagram of the various sectors of the Pacific coast groundfish fishery, showing which segments of the fishery may harvest sablefish with pot gear.

The limited entry fixed gear sablefish primary fishery occurs between 36° N. lat. and the U.S. – Canada border and requires at least one limited entry permit, with both a fixed gear endorsement and a sablefish endorsement, be registered to a vessel. The primary fishery is composed of a three-tier system of cumulative landing quotas within a restricted season, from April 1 to October 31 (NMFS 2016b). Permits were assigned to a tier based on landing history when the system originally began in 1998. There are 32 Limited Entry Permits issued for the sablefish trap fishery on the West Coast (NWFSC 2010). Fishing outside of the primary season or after fulfillment of tier quota is allowed, subject to limited entry fixed gear weekly and two-month cumulative limits (NMFS 2016b). The limited entry permits are currently associated with vessels spread throughout the Pacific Northwest from Northern California through Washington, and some vessels registered to limited entry permits also fish in waters off Alaska. Up to three sablefish-endorsed permits may be stacked for cumulative landings on one vessel and may include both trap and longline gear endorsements (NMFS 2016b).

The limited entry fixed gear daily trip limit fishery occurs coastwide, year-round. Vessels registered to limited entry permits with pot/trap gear endorsements may harvest sablefish with pot/trap gear year round, according to the applicable weekly and two-month cumulative limits, applicable to their time/area. For example, July-August 2016 trip limits for the area north of 36°00' N. lat. were 1,125 lb per week, not to exceed 3,375 pounds (lb) for two months; and south of 36°00' N. lat. trip limits are not to exceed 2,000 lb per week. Accounting for stacking of permits, there were 41 vessels using traps only and five using a combination of traps and longline to harvest sablefish in 2014.

The vessels participating in the limited entry trawl Shorebased IFQ Program may choose to harvest their sablefish quota with non-trawl gear, including pot gear, under provisions of the Program that allow for an activity called "gear switching." Vessels fishing in the Shorebased

IFQ Program under gear switching provisions are subject to most of the same requirements as those vessels fishing trawl gear to harvest their groundfish quota, including 100% observer coverage, fishing on their own individual quota, etc. However, regulations that apply specifically to non-trawl gears, like gear-specific area and depth restrictions, apply to vessels gear switching.

The open access fishery is composed of vessels not registered to limited entry permits, is available to fishermen year round, and managed throughout the year with daily, weekly, and two-month trip limits. For example, July-August 2016 trip limits for the area north of 36°00' N. lat. are 300 lb/day, or 1 landing per week of up to 850 lb, not to exceed 1,700 lb over 2 months. Sablefish trip limits are also implemented for south of 36°00' N. lat. For example, July-August 2016 trip limits are 300 lb/day, or 1 landing per week of up to 1,600 lb, not to exceed 3,200 lb over 2 months. NOAA's Northwest Fisheries Science Center estimates 204 fishermen (number of state-issued permits, not reflective of number of active fishermen) participating in the open access sector in 2014, based on June 17, 2014 query of the NMFS Pacific Coast Fisheries Permit System (https://www.webapps.nwfsc.noaa.gov/apex_ifq/f?p=112:23).

Participants in the sablefish fishery are required to keep daily logs of fishing activities (CDFW 2015; ODFW 2016). Depending on the area of the coast, fishing for sablefish with non-trawl gear (*e.g.*, pot gear) is prohibited in certain depths by the Groundfish Non-Trawl Rockfish Conservation Area. Specific depth restrictions vary, and may be modified during the year, but generally prohibit setting sablefish pots between 30 fathoms and 100 fathoms (from Washington to central California) and between 60 fathoms and 150 fathoms (southern California). Federal regulations pertaining to depth-based closures for limited entry fixed gear can be found in Table 2 (North and South) of 50 Code of Federal Regulations (CFR) Part 660 Subpart E, and open access closures can be found in Table 3 of 50 CFR Part 660 Subpart F. The state management agencies may close additional areas. For example, south of Point Arguello, near Santa Barbara, the minimum depth for setting traps targeting sablefish is 200 fathoms.

Multiple traps are connected to a common ground line made of nylon or nylon blend and 5/16th or 3/8th inch wide. Limited entry permit holders commonly fish 20 to 50 traps per string, while open access fishermen generally fish several smaller strings, up to eight strings with one to four traps per string, each with a float line and buoy stick (NMFS 2011). Figure 6 depicts the general area fished by participants in the sablefish pot fishery, based on depth restrictions/requirements.

Figure 6. Map of the WA/OR/CA sablefish pot fishery (NMFS 2011).

4.0 Marine Mammal Species Listed under the ESA in the Action Area

According to the final *U.S. Pacific Marine Mammal Stock Assessments: 2015* (Carretta *et al.* 2016a) there are nine ESA-listed species of marine mammals under NMFS' jurisdiction that occur within the area of operation of Category I and II fisheries off the coasts of California, Oregon, and Washington. These species, including their ESA listing status, are listed in Table 4.

Table 4. ESA-Listed Marine Mammal Species off the coasts of California, Oregon, and Washington.

Species	Stock	ESA Listing Status
Blue whale (*Balaenoptera musculus*)	Eastern North Pacific stock	Endangered
Fin whale	California/Oregon/Washington stock	Endangered
Humpback whale	California/Oregon/Washington stock	Threatened Mexico DPS Endangered Central America DPS
Gray whale (*Eschrictius robustus*)	Western North Pacific stock	Endangered Western North Pacific DPS
North Pacific right whale (*Eubalaena japonica*)	Eastern North Pacific stock	Endangered
Sei whale (*Balaenoptera borealis*)	Eastern North Pacific stock	Endangered
Sperm whale	California/Oregon/Washington stock	Endangered
Killer whale (*Orcinus orca*)	Eastern North Pacific Southern Resident stock	Endangered Southern Resident DPS
Guadalupe fur seal (*Arctocephalus townsendii*)	Mexico	Threatened

Except for the humpback whale and sperm whale, none of the species are considered likely to be taken in the federally-managed Category I and II fisheries off the coasts of California, Oregon, and Washington, as described below.

Blue whale, North Pacific right whale, sei whale, and Guadalupe fur seal
NMFS issued an MMPA 101(a)(5)(E) permit on October 30, 2000 (65 FR 64670) for the currently named CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) to incidentally take, during the course of commercial fishing operations, sperm whales, humpback whales, fin whales, and Steller sea lions from the eastern DPS (which was later delisted under the ESA on November 4, 2013; 78 FR 66140), based on documented takes in the fishery. At the time, the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) operated over a broader area than it currently operates, including fishing in the now-closed area north of Point Conception during August 15 through November 15. Blue whales, North Pacific right whales, and sei whales were not included in the October 2000 permit because they had never been observed to interact with the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) or the WA/OR/CA sablefish pot fishery. Interactions with fishing gear have been recorded in stranded Guadalupe fur seals; however, we are not able to identify the gear to a fishery at this time. Since NMFS began

observing the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) in 1990, fishery interactions have not been observed for blue whales, North Pacific right whales, sei whales, or Guadalupe fur seals. Given 25 years of observer data, logbook information, self-reports, and stranding information (whale entanglement reports) indicating no interactions between these species and any of the federally-managed Category I and II fisheries off the coasts of California, Oregon, and Washington, and no anticipation of future interactions, these species are not considered further in this analysis.

Killer whale

In 2005, the Southern Resident Killer Whale DPS was listed as endangered under the ESA (70 FR 69903; November 18, 2005). Most sightings of this stock of killer whales have occurred in the summer in the inland waters of Washington state and southern British Columbia. Pods belonging to this stock have also been sighted in coastal waters off southern Vancouver Island and Washington (Bigg *et al.* 1990; Ford *et al.* 2000). Of the three pods comprising this stock, one pod (J) is commonly sighted in inshore waters in winter, while the other two pods (K and L) apparently spend more time offshore (Ford *et al.* 2000). These latter two pods have been observed in recent years in Monterey Bay, California, near the Farallon Islands, and off Point Reyes. Thus, the entire range for the Southern Resident killer whale extends as far south as Monterey, CA and, based on a recent review by the Department of Fisheries and Oceans (Canada) of photographs taken in 2007, as far north as Chatham Strait, Southeast, Alaska. One killer whale from the non-ESA listed eastern North Pacific Transient Stock was observed taken in 1995 in the CA thresher shark/swordfish drift gillnet (≥14 in mesh) (Carretta *et al*. 2006), but no serious injuries or mortalities of killer whales from the endangered Eastern North Pacific Southern Resident stock have been observed or attributed to any of the federally-managed Category I and II fisheries off the coasts of California, Oregon, and Washington. NMFS does not anticipate the incidental take (M/SI) of the Eastern North Pacific Southern Resident killer whale by the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) or the WA/OR/CA sablefish pot fishery, and therefore, this stock is not considered further in this analysis.

Fin whale

Fin whales, listed globally as endangered, are widely distributed in the world's oceans; however, there is insufficient information to accurately determine population structure of the fin whale (Carretta *et al.* 2016a). For more detailed information on fin whales, refer to the Fin Whale Recovery Plan (NMFS 2010a) and the most recent SAR (Carretta *et al.* 2016a). Observations show aggregations of fin whales year-round off southern and central California (Dohl *et al*. 1983; Barlow 1997; Forney *et al.* 1995), in summer off the coast of Oregon (Green *et al.* 1992; McDonald *et al.* 1995), and in the summer and fall in the Gulf of Alaska. Acoustic signals from fin whales are detected year-round off northern California, Oregon, and Washington, with a concentration of vocal activities between September and February (Moore *et al*. 1998). Since fin whale abundance appears lower in winter/spring in California (Dohl *et al*. 1983; Forney *et al*. 1995) and in Oregon (Green *et al*. 1992), it is likely that the distribution of this stock extends seasonally outside these coastal waters.

The 2013 NID (78 FR 54553; September 4, 2013) provides a detailed description of entanglements and ship strikes impacting the CA/OR/WA stock of fin whales from 1998-2011 and will not be discussed in detail here. The CA thresher shark/swordfish drift gillnet fishery

(≥14 in mesh) is the only identified fishery that has interacted with fin whales from this stock, and only one fin whale death has been observed since 1990 when NMFS began observing the fishery (*i.e.,* over 8,000 observed sets *in* Carretta *et al.* 2016a). During the past 25 years (1990-2015), five CA/OR/WA fin whales have been recorded as having interacted with fishing gear. Only one of these interactions was able to be attributed to a specific fishery, a fin whale death observed in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) in 1999 (Carretta *et al.* 2016a). NMFS concludes the risk of a fin whale entanglement in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) is very low. Although fin whales and the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) are known to co-occur in areas off the California coast, there is a remote likelihood that the fishery will take fin whales. NMFS does not anticipate incidental take (M/SI) of the CA/OR/WA fin whale stock by the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) or the WA/OR/CA sablefish pot fishery, and therefore, this stock is not considered further in this analysis.

Gray whale

Gray whales are presently recognized as two populations in the North Pacific Ocean. Recent genetic studies using both mitochondrial 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; Brownell *et al.* 2009; LeDuc *et al.* 2002; Lang 2010; Lang *et al.* 2010; Lang *et al.* 2011). In 1994, ENP gray whales were removed from the ESA list of endangered and threatened species (59 FR 31094), and the WNP gray whales continue to be listed as endangered. ENP and WNP gray whales were once considered geographically separated along either side of the ocean basin, but recent photo-identification (Urban *et al.* 2012; Weller *et al.* 2012), genetic (Lang 2010; Lang *et al.* 2011), and satellite tracking data (Mate *et al.* 2011) have documented spatial and temporal overlap between WNP and ENP gray whales.

The timing of the majority of effort in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) 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 limit the overlap between migrating gray whales and drift gillnet fishing. Northbound gray whales, which include all age classes, migrate from February to June, and therefore, are not expected to overlap with any drift gillnet fishing.

From 2001 to 2014, two gray whales were observed killed in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) by the NMFS fishery observer program (C. Villafana, NMFS-Observer Program, pers. comm., 2016). The assumption has been that these were ENP gray whales. Historically, records suggest that gray whale strandings have been commonly associated with gillnet gear, although no positive identification of drift gillnet gear can be made from those records outside the observer program (Saez *et al. in prep*). With the exception of the Southern California Bight, the area where the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) operates is outside of the majority of the traditional gray whale southbound migratory route. Both of the observed interactions between gray whales and the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) occurred in the Southern California Bight, which coincides with a large proportion of the non-listed ENP population migrating through the area at that time. 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% of the population is expected to have made the migration by the end of December. Based on tagging data, it is assumed that when endangered 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). Thus, it is possible that a WNP gray whale's migratory route could overlap with the drift gillnet 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 drift gillnet 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 CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh). Therefore, similar to ENP gray whales, the likelihood that a WNP gray whale would interact with the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) is low and made lower by the very small numbers of WNP gray whales as compared to the ENP population.

The current minimum population estimate for ENP gray whales is 20,125 whales (Carretta *et al*. 2016a). The most recent estimate (for 2015) for WNP gray whales, using photo-identification data collected between 1994 and 2011 on the summer feeding grounds off Sakhalin Island, was 140 whales, with a minimum population estimate of 135 whales. 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 CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh), and the already low probability of a gray whale entanglement occurring, the likelihood that a WNP gray would be entangled in CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) gear is extremely low. In addition, no gray whales have been observed to interact with the WA/OR/CA sablefish pot fishery.

Given this, NMFS does not anticipate the incidental take (M/SI) of the WNP gray whale by the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) or the WA/OR/CA sablefish pot fishery; therefore, this stock is not considered further in this analysis.

5.0 Marine Mammals Considered in This Analysis

For this analysis, NMFS will consider the impact of M/SI of the CA/OR/WA sperm whale and humpback whale stocks incidental to the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) and the WA/OR/CA sablefish pot fishery. Detailed information on each of these species can be found in the recovery plans for the sperm whale and humpback whale;[3] SARs;[4] and the Pacific Offshore Cetacean Take Reduction Plan (POCTRP)[5]. Information from these sources that is relevant to this analysis and the best available science is summarized below.

[3] http://www.nmfs.noaa.gov/pr/recovery/plans.htm#mammals
[4] http://www.nmfs.noaa.gov/pr/sars/
[5] http://www.nmfs.noaa.gov/pr/interactions/trt/poctrp.htm

5.1 CA/OR/WA Stock of Humpback Whales

Humpback whales are 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 IWC first protected humpback whales from commercial harvest in the North Pacific in 1966. They are also protected under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). In the U.S., humpback whales were listed as "endangered" under the ESA of 1973 and were classified as depleted and strategic under the MMPA.

NMFS recently conducted a global status review of humpback whales (Bettridge *et al.* 2015), and revised the ESA listing by identifying 14 distinct population segments (DPSs) and listing four as endangered and one as threatened (81 FR 62259; September 8, 2016). The MMPA stocks of humpback whales do not necessarily equate with DPSs under the ESA. NMFS is currently conducting a review of humpback whale stock delineations in waters under U.S. jurisdiction to determine whether any stocks should be realigned in light of the ESA DPSs. Until such time as the MMPA stock delineations are reviewed and potentially revised, NMFS is treating existing MMPA stocks that fully or partially coincide with a listed DPS as depleted, and stocks that do not fully or partially coincide with a listed DPS as not depleted for management purposes. Therefore, in the interim, we are treating the CA/OR/WA stock as depleted because it partially coincides with the ESA-listed Mexico (threatened) and Central America (endangered) DPSs, as well as the non-listed Hawaii DPS. Based on photo-identification records, humpback whales that breed off Central America (the Central America DPS) and off Mexico (the Mexico DPS) feed off Oregon and California. Whales from those DPSs, as well as from the Hawaii DPS, also feed off Washington and Southern British Columbia (Wade *et al.* 2016).

5.1.1 Stock Status

Humpback whales of the North Pacific were estimated to be reduced to 13% of carrying capacity by commercial whaling (Braham 1991). The initial abundance estimate has never been estimated separately for the CA/OR/WA stock, but shore-based whaling apparently depleted the humpback whale stock off California twice: once prior to 1925 (Clapham *et al.* 1997) and again between 1956 and 1965 (Rice 1974). Since then, abundance estimates for humpback whales in the entire North Pacific have increased substantially.

A photo-identification study in 2004-2006 estimated the abundance of humpback whales in the entire Pacific Basin to be approximately 21,808 (CV=0.04) (Calambokidis *et al.* 2008; Barlow *et al.* 2011). Barlow (2010) estimated 1,090 (CV=0.41) humpback whales from a 2008 summer/fall ship line-transect survey of California, Oregon, and Washington waters. Abundance estimates from photographic mark-recapture surveys conducted in California and Oregon waters every year from 1991 through 2011 represent the most current estimates (Calambokidis 2013). These estimates include only animals photographed in California and Oregon waters and not animals that are part of the separate feeding group found off Washington state and southern British Columbia (Calambokidis *et al.* 2009). California and Oregon estimates range from

approximately 1,100 to 2,600 animals, depending on the choice of recapture model and sampling period (Carretta *et al.* 2014). The best estimate of abundance for California and Oregon waters is taken as the 2008-2011 Darroch estimate of 1,729 (CV = 0.03) whales, which is also the most precise estimate (Calambokidis 2013). Calambokidis *et al.* (2008) reported a range of photographic mark-recapture abundance estimates (145–469) for the northern Washington and southern British Columbia feeding group, most recently in 2005. The best model estimate from that paper (lowest AIC_c score) was reported as 189 (CV not reported) animals. This estimate is approximately 8 years old and will soon be outdated for use in stock assessments. Combining abundance estimates from both the California/Oregon and Washington/southern British Columbia feeding groups (1,729 + 189), yields an estimate of 1,918 (CV≈0.03) animals for the California/Oregon/Washington stock. The approximate CV of 0.03 for the combined estimate reflects that a vast majority of the variance is derived from the California and Oregon estimate (CV=0.03) and that no CV was provided for the Washington state and southern British Columbia estimate. The minimum population estimate for this stock is 1,876 animals (Carretta *et al.* 2016a). We note that these animals, particularly off CA and OR, represent the combined presence of the Mexico DPS and the Central America DPS. Therefore, even though the CA/OR/WA stock, as currently defined under the MMPA, is not aligned with the new DPSs, we are evaluating impacts to the same whales that are listed.

The proportion of calves in the CA/OR/WA stock from 1986 to 1994 appeared much lower than previously measured for humpback whales in other areas (Calambokidis and Steiger 1994), but in 1995-97 a greater proportion of calves were identified. The 1997 reproductive rates for this population are closer to those reported for humpback whale populations in other regions. Despite the apparently low proportion of calves, two independent lines of evidence (Petersen mark-recapture estimates and summer/fall ship line-transect surveys) indicate that this stock was growing in the 1980s and early 1990s (Barlow 1994; Calambokidis *et al.* 2003) with a best estimate of 8% growth per year (Calambokidis *et al.* 1999). The current net productivity rate is unknown.

Under the MMPA, PBR is defined as the product of the minimum population estimate, one half the maximum theoretical net productivity rate (R_{max}), and a recovery factor (F_r): $PBR = N_{min} \times 0.5R_{max} \times F_r$. The PBR level for this stock is calculated as the minimum population size (1,876) times one half the estimated population growth rate for this stock of humpback whales (½ of 8%) times a recovery factor of 0.3 (for an endangered species, with $N_{min} > 1,500$ and $CV(_{Nmin}) < 0.50$), resulting in a PBR of 22. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11 whales per year (Carretta *et al.* 2016a).

5.1.2 Threats

Here we provide a brief summary of the threats to humpback whales as they are applicable to the NID, but more detailed information can be found in the humpback whale global status review (Bettridge *et al.* 2015) and the most recent SAR (Carretta *et al*. 2016a). Threats to humpback whales include entanglement in fishing gear, vessel strikes and disturbance, climate change, illegal whaling or resumed legal whaling, reduced prey abundance due to overfishing or other factors (including climate change), habitat degradation, disturbance from low-frequency noise, disease, impacts related to research, and natural causes. Information on all sources of human-

caused M/SI, including fishery entanglements and ship strikes, is summarized in Table 5 in Section 7.0.

Entanglement in Commercial Fisheries

Entanglement in commercial fishing gear poses a threat to individual humpback whales throughout the Pacific. The impact of fisheries on this humpback whale stock is likely underestimated, since the M/SI 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. Pot and trap fisheries are the most commonly documented source of mortality and serious injury of humpback whales in U.S. west coast waters (Carretta *et al.* 2016a). According to the West Coast Region's Stranding Database (NMFS 2016c), fishery observer records (Jannot *et al.* 2016), and a self-report from the Marine Mammal Authorization Program, 57 humpback whales off the West Coast were entangled (M/SI) in fishing gear from 2001-2014. From 2010-2014, 28 humpback whales were observed or reported to be entangled in fishing gear (M/SI) (Carretta *et al.* 2016b). Not all of these interactions have been confirmed to be from commercial fisheries; in cases where the specific fishery that caused the M/SI cannot be definitively identified, the M/SI has been attributed to "unknown fishery." These interactions are conservatively included in the estimate of commercial fishery-related M/SI for this analysis. In addition to these M/SI, there were additional entanglements that resulted in non-serious injuries. This stock is currently driving the Category II classification of the following fisheries: the CA halibut/white seabass and other species set gillnet (≤3.5 in mesh); CA spot prawn pot fishery; CA Dungeness crab pot fishery; OR Dungeness crab pot fishery; WA/OR/CA sablefish pot fishery; and the WA coastal Dungeness crab pot/trap fishery (81 FR 20550; April 8, 2016).

From 2001 through 2014, there have been a number of unidentified whales observed entangled in known or unknown pot/trap gear, unknown gillnet gear, or unidentified fishing gear (NMFS 2016c). Some of these animals may represent re-sightings of entangled humpback whales described above. It is likely that some of the unidentified pot/trap or gillnet fishery entanglements involved humpback whales. However, without a positive identification of the whale species reportedly entangled (M/SI), NMFS cannot attribute such entanglements (M/SI) to the CA/OR/WA stock of humpback whales.

Ship Strikes and Non-commercial Fishery Interactions

Ship strikes were implicated in the deaths of at least 13 humpback whales off the U.S. west coast from 2001-2014 (NMFS 2016c; Carretta *et al.* 2016b). In addition, one humpback whale was found entangled (M/SI) in Dungeness crab recreational fishing gear. The 14-year (2001-2014) average number of humpback whale M/SI from ship strikes and non-commercial fisheries off the U.S. west coast is 1.0 humpback whale per year (14 whales/14 years), while the 5-year (2010-2014) average is 1.2 humpback whales per year (5 ship-struck and 1 commercial fishing (M/SI)/5 years) (also see Table 5).

These are considered minimums; additional mortality from ship strikes probably goes unreported or undetected 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.* 2012).

Habitat Concerns
The increasing levels of anthropogenic noise in the world's oceans have been suggested to be a habitat concern for whales, particularly baleen whales who may communicate using low-frequency sound.

5.2 CA/OR/WA Stock of Sperm Whales

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 enacted in 1973. Because of this, they are considered depleted, and the CA/OR/WA stock is strategic under the MMPA.

5.2.1 Status of the Stock

Sperm whales are found year-round in California waters (Dohl *et al*. 1983; Barlow 1995; Forney *et al*. 1995). They reach peak abundance there 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 (December through February) in Washington and Oregon (Green *et al.* 1992). A 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). However, there is no evidence of sperm whale movements into U.S. waters off the west coast from either the west or south, and genetic data suggest that mixing to the west is 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.

The abundance of sperm whales in the North Pacific was reported to be 1,260,000 prior to exploitation from commercial whaling. By the late 1970s, abundance was estimated to have been reduced to 930,000 whales (Rice 1989). These estimates include whales from the CA/OR/WA stock. The overall population abundance of sperm whales has increased worldwide since the cessation of whaling.

With respect to CA/OR/WA sperm whales, previous estimates of abundance from 2005 (3,140, CV=0.40, Forney 2007) and 2008 (300, CV=0.51, Barlow 2010) show a tenfold difference that cannot be attributed to human causes or natural population declines, and likely reflect a combination of estimation error and movement of animals into and out of the study area. New estimates of sperm whale abundance in California, Oregon, and Washington waters out to 300 nm are available from a trend-model analysis of line-transect data collected from 1991 through 2008 (Moore and Barlow 2014). Abundance trend models incorporate information from the entire 1991-2008 time series to obtain each annual abundance estimate and provide more precise estimates with less inter-annual variability. The new estimates are from methods similar to those previously used to estimate abundance trends for fin whales (Moore and Barlow 2011) and

beaked whales in the California Current (Moore and Barlow 2013). Sperm whale abundance estimates based on the trend-model ranged between 2,000 and 3,000 animals for the 1991-2008 time series (Moore and Barlow 2014). The best estimate of sperm whale abundance in the California Current is the trend-based estimate corresponding to the most recent survey (2008), which is 2,142 animals (CV=0.58). Generally, the models provide more precise estimates of abundance than methods used more commonly to generate a stock's abundance estimate. In the case of the CA/OR/WA sperm whale stock, the new analysis includes improved estimates of trackline detection probability, g(0) (Barlow 2015), because it includes corrections for low-biased group size estimates related to field methods used prior to the 2001 California Current survey cruise.

Although populations are expected to have increased due to the cessation of whaling, determining population trends has been difficult. 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. Moore and Barlow (2014) report that the abundance of sperm whales in the eastern North Pacific appeared stable from 1991 to 2008, but that any reliable conclusions on trends could not be made for the whole population because the precision of estimated growth rates was poor. However, they also reported that trends in the detection of single animals (presumably large, solitary males) apparently doubled over this time period. The authors could not determine if the apparent increase in sightings of single animals reflected an increase in the number of adult male sperm whales in the population or merely increased use of the U.S. west coast by adult males in recent years.

The minimum population estimate for sperm whales is taken as the lower 20th percentile of the posterior distribution of abundance estimated from 2008 or 1,332 whales (Moore and Barlow 2014). The PBR level for this stock is calculated as the minimum population size (1,332) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (for an endangered stock with N_{min} <1,500), resulting in a PBR of 2.7 sperm whales per year.

5.2.2 Threats

Here we provide a brief summary of the threats to sperm whales as they are applicable to the negligible impact determination, but more detailed information can be found in the Sperm Whale Recovery Plan (NMFS 2010b) and the most recent SAR (Carretta *et al*. 2016a). Threats to sperm whales include fishery interactions, vessel disturbance, illegal whaling or resumed legal whaling, reduced prey abundance due to overfishing or other factors (including climate change), habitat degradation, disturbance from noise, disease, pollution, impacts related to research, and natural causes.

Entanglement in Commercial Fisheries
Entanglement in fishing gear poses a threat to individual sperm whales and overall to the CA/OR/WA sperm whale stock. From 1990 (when NMFS first began observing the fishery) and prior to the implementation of the POCTRP on October 30, 1997, the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) was observed to incidentally take seven sperm

whales; of these whales, three were dead (43%), three were released alive and uninjured (43%), and one was released injured and was not expected to survive (14%).

After the implementation of the Plan (NMFS 1997), which required, among other things, use of acoustic pingers, overall cetacean entanglement rates in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) dropped considerably (Barlow and Cameron 2003). Between 1998 and 2009, only one sperm whale was observed incidentally taken in the fishery. This animal died in a net off central California that did not have the full complement of pingers. Because sperm whale entanglements are rare and because the net that killed the sperm whale did not use the full mandated complement of pingers, it is difficult to evaluate whether pingers are having an effect on sperm whale entanglement. Pingers emit pulsed tones with source levels of 135 decibels root mean square re: 1 microPascal @ 1 m, fundamental operating frequencies of 10-12 kilohertz (kHz) (with harmonics to (80 kHz)), a pulse duration of 300 milliseconds (ms), and a pulse interval of 4 seconds, which is within the hearing range of sperm whales. In late 2010, an observer recorded two sperm whales entangled in one net (with a full complement of pingers) in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh). One animal was found dead, and the other was released alive but seriously injured with gear attached. The whales were likely taken from the CA/OR/WA stock of sperm whales. Because those sperm whales were observed by NMFS' federal observers, the numbers of animals that interacted with the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) was extrapolated by the percent observer coverage for that year (11.9%), resulting in an extrapolated value of 16 M/SI for 2010 (Carretta *et al* 2016a). In Section 7.1, we describe a more recently developed method using random forest regression tree models to produce more stable annual estimates with better precision for the CA thresher shark/swordfish drift gillnet fishery (≥ 14 in mesh).

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 (NMFS 2016c). 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 was caused by interactions with fishing gear, or whether the fishing gear involved was from a commercial fishery, but conservatively, these interactions are included in the estimate of commercial fishery-related M/SI for this analysis.

Ship Strikes

Ship strikes were implicated in the deaths of at least four sperm whales from 2001-2014 (NMFS 2016c; Carretta *et al*. 2016b). The 14-year (2001-2014) average number of sperm whale deaths from ship strikes off the U.S. west coast is 0.3 sperm whales per year (4 ship-struck whales/14 years), while the 5-year (2010-2014) average is 0.2 sperm whales per year (1 ship-struck whale/5 years) (also see Table 5). These are considered minimums; additional mortality from ship strikes probably goes unreported or undetected because the whales do not strand or, if they do, they do not have obvious signs of trauma.

6.0 Interaction with Category I and II Fisheries in the Action Area

For the purposes of this analysis, both Andersen *et al.* (2008) and NMFS (2012) guidelines and directives were used to evaluate human-caused injuries and distinguish an injury as either "serious" or "non-serious." The NMFS (2012) guidelines went into effect in 2012 and were first applied to the 2013 SARs. Some of the large whale injury criteria in the NMFS guidelines lead to prorated determinations (*e.g.*, a particular category of injury to a large whale may be recorded as 0.75 serious injury [and 0.25 non-serious injury], rather than 1.0). Conservatively, for the purposes of this NID analysis, if an injury was determined to be a serious injury for the CA/OR/WA humpback whale or sperm whale stocks, it was recorded as a whole number (*i.e.*, 1.0 M/SI) and not prorated (*e.g.*, 0.75).

This section evaluates the available information to determine the impact of humpback or sperm whale interactions with commercial fisheries off California, Oregon, and Washington. Information available for this analysis includes reports of interactions between the fisheries and humpback and sperm whales, derived from observer programs, logbooks, and reports (*e.g.*, reported entanglements, fisher self-reports). Additional M/SI has been documented through stranding reports. As noted in the sections above, in cases where the specific fishery that caused the M/SI cannot be definitively identified, the M/SI has been attributed to "unknown fishery" but is conservatively included in the estimate of commercial fishery-related M/SI for this analysis. All human interactions recorded in the stranding database involving humpback or sperm whales were reviewed by James Carretta from the NMFS SWFSC (J.V. Carretta, pers. comm., 2014 and Carretta *et al.* 2016b) using the NMFS policy directive for injury determinations (NMFS 2012). Only those that were determined to be either a serious injury or mortality were included in Table 5.

Impacts of CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh)
In the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh), a wide variety of marine mammals are seriously injured or killed, which is most likely attributable to the non-selectivity of gear and location of fishing effort. The probability that a marine mammal will initially survive an entanglement in fishing gear depends largely on the nature of the interaction (*e.g.*, location of entanglement on body, amount of gear, whether feeding or locomotion is impaired, etc.), species, size, age, and health of the marine mammal involved. For instance, larger animals such as humpback whales may become entangled in gillnet but often survive the initial contact with the gear. Such entanglement may cause considerable damage to the gear, as the large whales may "punch" through and continue swimming. The degree of gear damage may be related to the type of net used, however, as fishermen do report that large whales usually break through drift gillnets without entangling and that very little damage is done to the net.

Marine mammals that die as a result of entanglement in drift gillnets usually drown. If entangled in a net with a typical soak time of 12-14 hours and suspended at least 36 feet from the surface, the animal is unable to survive without oxygen, especially if it is entangled at the beginning of the set, or in a deep section of the net. Marine mammals may also be affected as a result of being captured in a drift gillnet, such as a sustained stress response caused by repeated or prolonged entanglement in gear, which may reduce fitness and make marine mammals more vulnerable to infection, disease, and predation (Angliss and DeMaster 1998).

In the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh), 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 completely release themselves or are completely released from the net by fishermen and can swim normally are recorded as "alive." Based on the recent disentanglement efforts, the condition of the animal at the time of disentanglement likely predicts its future (*e.g.*, a skinny, weak animal is more likely to perish than an animal with less gear and swimming strongly). Seriousness of injuries was then formally assessed under the MMPA serious injury guidelines (Angliss and DeMaster 1998; Andersen *et al*. 2008; NMFS 2012).

Because long-term stress studies have not been conducted on the impacts of capture by a fishery on marine mammals, NMFS is only able to make assumptions on the condition of marine mammals that have been released "unharmed" from a drift gillnet. Although marine mammals released "unharmed" do not have visible injuries, they may have been stressed from being caught or entangled in a net. This stress may cause an interruption in essential feeding behaviors or migration patterns; however, NMFS considers this effect, if experienced, is likely to be temporary and short-term, unless there are indications that the animal is or has been compromised. For these reasons, without long-term studies on a whale's behavior following an entanglement, NMFS assumes that most of the marine mammals released and reported as "unharmed," or "uninjured," recover fully and survive following their capture in a drift gillnet, and that latent effects are limited to short-term physiological stress or short-term interruption of normal behavioral patterns.

Survival rate likely varies among marine mammal species incidentally taken by the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh). This is due in part to variations in size and diving and foraging behavior, as well as location in the net and time of entanglement. With few observed large whale entanglements in the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh), it is difficult to speculate as to the survival rate of the two listed species observed taken in the fishery. However, because baleen whales (humpbacks) and sperm whales differ so greatly in the nature of their preferred prey and foraging behavior, as well as their physiology (*e.g.*, the sperm whale is capable of diving to much greater depths than the baleen whales in order to find their preferred prey of squid, depending largely on oxygen storage and metabolism, while the baleen whales rely less on diving, if possible, and tend to skim and gulp for euphausiids at the surface or below), survival rates following gillnet entanglement most likely vary greatly as well.

Since 2001, of the two species of whale analyzed, one humpback (self-report in 2009) and two sperm whales (observed in 2010) were observed/reported as M/SI in CA thresher shark/swordfish drift gillnet gear. Based on all known observed and/or reported entanglements of humpback whales in the CA thresher shark/swordfish drift gillnet fishery (≥ 14 in mesh) (four animals from 1990-2014), only one was seriously injured or killed (the 2009 self-report), indicating a 25% serious injury and mortality rate (also reported in Martin *et al.* 2015). Of all the observed sperm whale interactions in the CA thresher shark/swordfish drift gillnet fishery (ten animals from 1990-2014), seven were seriously injured or killed. Based on these data, 70% of sperm whale interactions resulted in mortality or serious injury in this fishery.

Impacts of WA/OR/CA sablefish pot fishery
Since 2001, two humpback whales have been confirmed interacting with the WA/OR/CA sablefish pot fishery, one in 2006 and one in 2014. One was disentangled from all gear (2006) (Carretta *et al.* 2011), and the other died while entangled in a portion of the groundline between pots (2014) (Hanson *et al*. 2015). This fishery was observed at 31% in 2014 (Jannot *et al.* 2016); however, an extrapolated estimate of total bycatch is not anticipated to be available until 2017, as part of a required two-year report to the Pacific Fishery Management Council for the U.S. west coast groundfish fisheries.

Other Fishery Interactions
From 2001-2014, 12 humpback whales were observed/reported entangled (M/SI) in the Dungeness crab commercial fishery, two in the spot prawn pot commercial fishery, 20 in unidentified pot gear, six in unidentified gillnet gear, and 14 in unidentified or unknown fishing gear. Additionally, from 2001-2014, four dead sperm whales were reported to have monofilament or other net in their stomach (following necropsies) and/or had entanglement scars (NMFS 2016c; Carretta *et al.* 2016b).

7.0 Negligible Impact Analysis

A conservative approach is taken in this NID analysis, so in certain cases, the maximum number of M/SI was used for the calculations. For example, if a ship strike occurred, but serious injury or mortality was not observed on scene or confirmed by necropsy of the stranded animal, and if further review of reports and other sources confirmed serious injury or mortality, it was assumed for purposes of this analysis that serious injury or mortality occurred. Also, as noted in Section 6.0, conservatively and for the purposes of this NID analysis, if an injury was determined to be a serious injury, it was recorded as a whole number (*i.e.*, 1.0 M/SI) and not prorated (*e.g.*, 0.75 M/SI).

7.1 Incidental Takes in Commercial Fisheries

Data sources for M/SI incidental to fishing operations include observer data, fisher self-reports and stranded or entangled whales reported to NMFS through various sources. Seriousness of injuries was assessed using guidelines developed for marine mammal stock assessments under the MMPA (Angliss and DeMaster 1998; Andersen *et al.* 2008; NMFS 2012). These estimates are considered a minimum because not all entangled animals die immediately and not all dead animals are found, reported, or cause of death determined.

We considered two time frames for this analysis: the most recent 5-year period (2010-2014) for which data are available and have been analyzed, and a 14-year period (2001-2014). The most recent five-year period (here, January 1, 2010 through December 31, 2014), as noted above, is typically used in stock assessments and for negligible impact determination analyses because it provides enough data to adequately capture year-to-year variations in take levels while reflecting current environmental and fishing conditions as they may change over time. However, NMFS' GAMMS (NMFS 2016a) suggest that M/SI estimates could be averaged over as many years as necessary to achieve a CV of less than or equal to 0.3, so we also considered a longer timeframe, as described below.

Carretta and Moore (2014) recommend pooling longer time series of data particularly when bycatch is a rare event. Rare bycatch events typically involve smaller populations paired with low observer coverage for that fishery. If true bycatch mortality is low, but near PBR, then estimation bias needs to be reduced to allow reliable evaluation of the bycatch estimate against a low removal threshold. Pooling 10 years of fishery data, for example, results in bycatch estimates within 25% of the true bycatch rate over 50% of the time (*i.e.*, estimates were within 25% of the true value more often than not) (Carretta and Moore 2014). When pooling data, it is important that the data reflect a fishery with relatively constant characteristics (effort, gear, locations, etc.).

The CA/OR/WA stocks of sperm whale and humpback whale have relatively low minimum population estimates (N_{min}) and rarely reported or observed M/SI in either the CA thresher shark/swordfish drift gillnet fishery ($\geq$ 14 in mesh). Pooling post-2000 data for the fishery is appropriate given the establishment of the Pacific Leatherback Conservation Area in 2001, which altered patterns in fishing effort by prohibiting drift gillnet fishing within the area at certain times of the year. The 2001-2014 time period is used to calculate the mean annual bycatch estimate for sperm whales in this fishery. For consistency, estimates of total known human-caused M/SI are also assessed for 2001-2014.

The M/SI of sperm and humpback whales incidental to state and federal commercial fisheries is summarized by source and year. The M/SI from fisheries is described as:

(1) "Observed commercial fishery M/SI (% observer coverage rate)," which indicates interactions in a commercial fishery observed by a NMFS federal observer that were subsequently determined to be a mortality or serious injury, and the corresponding observer coverage rate provided in the parentheses;
(2) "Prorated[6] commercial fishery M/SI (from observed takes) which are based on random forest regression tree estimates of total *takes* of humpback whales and sperm whales, multiplied by their respective M/SI rates calculated in Section 6.0 (25% and 70%), to reach an estimate of M/SI in the CA thresher shark/swordfish drift gillnet fishery ($\geq$ 14 in mesh)[7];
(3) "Other reported commercial fishery M/SI" represents any other commercial[8] fishery-related M/SI that was not observed or reported by a NMFS federal observer (and is therefore not prorated or extrapolated);[9] or
(4) "Other human-caused M/SI (source)" indicates any record of human-caused serious injury or mortality from a source other than a commercial fishery, with the source of that serious injury or mortality included in parentheses.

[6] Extrapolation is only possible when a mortality or serious injury is observed by a NMFS federal observer and the mortality or serious injury is either multiplied by the observer coverage rate for that year (*i.e.*, ratio estimates) or by prorating using the most recent regression tree estimates, as described in Carretta *et al* (2016c).
[7] An estimate of the annual M/SI for the humpback reported in the WA/OR/CA sablefish pot fishery has not been calculated, based on the observer coverage for that year. Therefore, a prorated (or extrapolated value if the ratio estimator is used), is not included in this column.
[8] This column also includes M/SI from unidentified or unknown fisheries, which are conservatively considered to be commercial for this analysis.
[9] Other fishery-related M/SI is reported as "non-extrapolated" because there is no corresponding observer coverage.

Regarding the prorated M/SI values (in (2) above), staff from the NMFS SWFSC presented PSRG-2016-08, "Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery: 1990-2014" at the February 2016 PSRG meeting. The paper explains how estimates of marine mammal bycatch, including those of the CA/OR/WA stocks of humpbacks and sperm whales, were generated using random forest regression trees and were compared to the traditional intra-annual ratio estimates generated from the same data. As described in the abstract:

> "in the case of rare-event bycatch, small-sample bias usually results in annual estimates that are either too low or too high, because low observer coverage prevents the detection of rare events, or conversely, observed bycatch rates are positively-biased due to few observations. For rare species, which often pose the greatest management concerns, annual ratio estimates are volatile. In contrast, random forest regression tree models result in more stable annual estimates with better precision, because estimates are informed by all available data. Even in years with zero observed bycatch, estimates from regression trees are usually positive (sometimes fractions of animals), where corresponding ratio estimates would be zero."

The PSRG agreed with this approach. We consider this to be the best available science, and therefore, use the regression tree estimates for the bycatch events ("takes," not just M/SI) of CA/OR/WA humpback whales and sperm whales estimated in the CA thresher shark/swordfish drift gillnet fishery.

Commercial Fishery-Related Mortality and Serious Injury

CA/OR/WA humpback whale stock

From 2001 through 2014, the total of all known commercial fisheries-related incidental M/SI is 57.1 humpback whales, resulting in an annual average M/SI of 4.1 animals/year. The overall PBR calculated for this stock is 11.0 animals. Therefore, the 14-year (2001-2014) average annual commercial fisheries-related incidental M/SI is 37.3% of the current PBR.

From 2010 through 2014, the total of all known commercial fisheries-related incidental M/SI is 28.1 humpback whales, resulting in an annual average M/SI of 5.6 animals/year. The current PBR calculated for this stock is 11.0 animals. Therefore, the 5-year (2010-2014) average annual commercial fisheries-related incidental M/SI is 51% of the current PBR.

CA/OR/WA sperm whale stock

From 2001 through 2014, the total of all known commercial fisheries-related incidental M/SI is 8.6 sperm whales, resulting in an annual average M/SI of 0.6 animals/year. The overall PBR calculated for this stock is 2.7 animals. Therefore, the 14-year (2001-2014) average annual commercial fisheries-related incidental M/SI is 22.2% of the current PBR.

From 2010 through 2014, the total of all known commercial fisheries-related incidental M/SI is 1.8 sperm whales, resulting in an annual average M/SI of 0.4 animals/year. The current PBR calculated for this stock is 2.7 animals. Therefore, the 5-year (2010-2014) average annual fisheries-related incidental M/SI is 14.8% of the current PBR.

7.2 Other human-caused mortality and serious injury

The same 5-year and 14-year time frames used above for commercial fisheries were also used to analyze other human-caused M/SI. For ship strikes, either: (1) the ship strike was the confirmed cause of serious injury and/or mortality from direct observation from the ship or from the necropsy; or (2) the ship strike is assumed to be the cause of serious injury and/or mortality based on the report that accompanied the event (*e.g.*, ship captain observed blood in the water).

CA/OR/WA humpback whale stock
From 2001-2014, the total number of observed or assumed M/SI attributed to ship strikes and a recreational fishery is 14, resulting in an annual average of 1 animal per year, or 9.1% of PBR.

From 2010-2014, the total number of observed or assumed M/SI attributed to ship strikes and a recreational fishery is 6, resulting in an annual average of 1.2 animals per year, or 11.0% of PBR.

No other sources of direct human-caused M/SI are known to affect the CA/OR/WA stock of humpback whales.

CA/OR/WA sperm whale stock
From 2001-2014, the total number of observed or assumed M/SI attributed to ship strikes is 4, resulting in an annual average of 0.3 animals per year, or 11.1% of PBR.

From 2010-2014, the total number of observed or assumed M/SI attributed to ship strikes is 1, resulting in an annual average of 0.2 animals per year, or 7.4% of PBR.

No other sources of direct human-caused M/SI are known to affect the CA/OR/WA stock of sperm whales.

7.3 Total Human-Caused Mortality and Serious Injury

CA/OR/WA humpback whale stock
The 14-year (2001-2014) average annual human-caused M/SI, including ship strikes and incidental to all commercial and recreational fishing, is 5.1 (71.1 humpback whales/14 years), or 46.4% of PBR.

The 5-year (2010-2014) average annual human-caused M/SI, including ship strikes and incidental to all commercial and recreational fishing, is 6.8 (34.1 humpback whales/5 years), or 62.0% of PBR.

CA/OR/WA sperm whale stock
The 14-year (2001-2014) average annual human-caused M/SI, including ship strikes and incidental to all commercial and recreational fishing, is 0.9 (12.6 sperm whales/14 years), or 33.3% of PBR.

The 5-year (2010-2014) average annual human-caused M/SI, including ship strikes and incidental to all commercial and recreational fishing, is 0.6 (2.8 sperm whales/5 years), or 22.2% of PBR.

Table 5. Mortality and serious injury incidental to commercial fisheries (including unknown/unidentified fisheries) and other human-caused sources (i.e., ship strikes and recreational fisheries) for humpback and sperm whales (2001-2014). UNK is for when the gear type is not known, POT is for when gear is pot/trap gear, NET is for when gear includes netting.

Humpback Whale

Year	Gear Type	Fishery Type, if known	Observed commercial fishery M/SI (% observer coverage rate)	Prorated[10] commercial fishery M/SI (from observed takes multiplied by M/SI rate (25%))	Other reported commercial fishery M/SI (not prorated or extrapolated)	Other human caused M/SI (source)	Minimum commercial fishery M/SI (includes extrapolated values)	Minimum total M/SI (includes extrapolated values)	PBR for that year
2001	NET	CA DGN	0 (20.4%)	0.1			1.1	1.1	1.9
	POT	Dungeness crab			1				
2002	NET	CA DGN	0 (22.1%)	0.1			0.1	0.1	1.6
2003	NET	CA DGN	0 (20.3%)	0.1			5.1	5.1	1.35
	POT	Dungeness crab			1				
		Unid pot			2				
	UNK				2				
2004	NET	CA DGN	0 (20.6%)	0.4		1 (ship strike)	1.4	2.4	1.6
	UNK				1				
2005	NET	CA DGN	0 (20.9%)	0.0		1 (ship strike)	3	4	2.3
	POT	Dungeness crab			2				
		Spot prawn			1				
2006	NET	CA DGN	0 (18.6%)	0.1		1 (ship strike)	4.1	5.1	
		Unid gillnet			2				
	POT	Dungeness crab			1				
		Unid pot			1				

[10] Estimates of bycatch in the CA drift gillnet fishery were derived from Carretta *et al*. 2016c: "Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery, 1990-2014." Draft document PSRG-2016-08 reviewed by the Pacific Scientific Review Group, Feb 2016, Seattle WA. Mortality and serious injury estimates (25%) for humpbacks were derived from observer records and a self-report, reviewed by J. Carretta, SWFSC, 2016, and cited in Martin et al. 2015.

2007	NET	CA DGN	0 (16.4%)	0.1		2 (ship strike)	5.1	7.1	
		Unid gillnet			1				
	POT	Dungeness crab			1				
		Unid pot			1				
	UNK				2				
2008	POT	Dungeness crab			3	3 (ship strike)	6	9	
		Unid pot			1				
	NET	CA DGN	0 (13.5%)	0.0					
		Unid gillnet			1				
	UNK				1				
2009	NET	CA DGN	0 (13.3%)	0.1	1 (self-report)		3.1	3.1	2.5
		Unid gillnet			1				
	UNK				1				
2010	POT	Dungeness crab			1	1 (ship strike)	8.1	9.1	11.3
		Unid pot			4				
	NET	CA DGN	0 (12%)	0.1					
		Unid gillnet			1				
	UNK				2				
2011	POT	Unid pot			5	1 (ship strike) 1 (Dungeness crab recreational fishery)	5	7	
	NET	CA DGN	0 (19.5%)	0.0					
2012	UNK				1		3	3	
	NET	CA DGN	0 (18.7%)	0.0					
	POT	Dungeness crab			1				
		Unid pot			1				
2013	NET	CA DGN	0 (37.2%)	0.0		1 (ship strike)		1	11.0

2014	NET	CA DGN	0 (23.7%)	0.0		2 (ship strike)	12	14	11.0
	POT	Dungeness crab			1				
		Sablefish pot (limited entry)			1*				
		Spot prawn			1				
		Unid pot			5				
	UNK				4				
Total 2001-2014						14	57.1	71.1	
Average 2001-2014						1	4.1	5.1	
Ratio of 14-year Average Annual to Most Recent PBR (PBR=11.0)						9.1%	37.3%	46.4%	
Total 2010-2014						6	28.1	34.1	
Average 2010-2014						1.2	5.6	6.8	
Ratio of 5-year Average Annual to Most Recent PBR (PBR=11.0)						11.0%	51.0%	62.0%	

*This was based on 31% observer coverage in this fishery (Jannot *et al.* 2016) yet no extrapolation has been made (anticipated in 2017).

Sperm Whale

Year	Gear Type	Fishery, if known	Observed commercial fishery M/SI (% observer coverage rate)	Prorated commercial fishery M/SI (from observed takes multiplied by M/SI rate (70%))[11]	Other reported commercial fishery M/SI (not prorated or extrapolated)	Other human caused M/SI (source)	Minimum commercial fishery M/SI (includes extrapolated values)	Minimum total M/SI (includes extrapolated values)	PBR for that year
2001	NET	CA DGN	0 (20%)	1.0			1	1	2.1
2002	NET	CA DGN	0 (22%)	0.5		1(ship strike)	0.5	1.5	
2003	NET	CA DGN	0 (20%)	0.2			0.2	0.2	1.8
2004	NET	CA DGN	0 (21%)	0.0			0	0	
	UNK				1*		1	1	
2005	NET	CA DGN	0 (21%)	0.0			0	0	
2006	NET	CA DGN	0 (19%)	0.3			0.3	0.3	
2007	NET	CA DGN	0 (16%	0.3		1(ship strike)	0.3	1.3	3.4
2008	NET	CA DGN	0 (14%)	0.4			3.4	3.4	9.3
	UNK				3**				
2009	NET	CA DGN	0 (13%)	0.1		1(ship strike)	0.1	1.1	
2010	NET	CA DGN	2 (12.0%)	1.4			1.4	1.4	1.5
2011	NET	CA DGN	0 (20%)	0.1			0.1	0.1	
2012	NET	CA DGN	0 (19%)	0.1		1 (ship strike)	0.1	1.1	
2013	NET	CA DGN	0 (37%)	0.2			0.2	0.2	2.7
2014	NET	CA DGN	0 (24%)	0.0			0	0	
Total 2001-2014						4	8.6	12.6	
Average 2001-2014						0.3	0.6	0.9	
Ratio of 14-year Average to Most Recent PBR (PBR=2.7)						11.1%	22.2%	33.3%	

[11] Estimates of bycatch in the CA drift gillnet fishery were derived from Carretta *et al*. 2016c: "Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery, 1990-2014". Draft document PSRG-2016-08 reviewed by the Pacific Scientific Review Group, Feb 2016, Seattle WA. Mortality and serious injury estimates (70%) for sperm whales were derived from observer records reviewed by J. Carretta, SWFSC, 2016.

Total 2010-2014						1	1.8	2.8	
Average 2010-2014						0.2	0.4	0.6	
Ratio of 5-year Average to Most Recent PBR (PBR=2.7)						7.4%	14.8%	22.2%	

* Monofilament netting found in stomach during necropsy of dead sperm whale.

** Two dead sperm whales found with a variety of netting in their stomachs. One dead sperm whale found with entanglement scars.

8.0 Application of Negligible Impact Determination Criteria

Below, we apply the 1999 NID criteria (see Section 1.1 for a description of these criteria) to determine whether M/SI incidental to commercial fisheries will have a negligible impact on a listed marine mammal stock. We used both a 5-year annual average M/SI and a 14-year annual average M/SI for the both the CA/OR/WA sperm whale and humpback whale stocks (see Section 7.0) for the negligible impact determination analysis and the application of the appropriate criterion. A summary of the M/SI data from Table 5 is presented below in Table 6 for convenience.

Table 6. Summary of M/SI data for use in application of negligible impact determination criteria.

Estimate		**CA/OR/WA humpback whale**	**CA/OR/WA sperm whale**
PBR		11.0	2.7
5-year period (2010-2014)	Avg. annual total human-caused M/SI	6.8	0.6
	% of PBR	62%	22.2%
	Avg. annual fishery-related M/SI	5.6	0.4
	% of PBR	51%	14.8%
14-year period (2001-2014)	Avg. annual total human-caused M/SI	5.1	0.9
	% of PBR	46.4%	33.3%
	Avg. annual fishery-related M/SI	4.1	0.6
	% of PBR	37.3%	22.2%

Criterion 1

Criterion 1 was not satisfied for either stock in either time period because the total *human-caused* M/SI for each stock is *not less than* 10% of the stock's PBR. For the CA/OR/WA stock of humpback whale, the average annual human-caused M/SI is **46.4%** (2001-2014) or **62%** (2010-2014) of the current PBR. For the CA/OR/WA stock of sperm whale, the average annual human-caused M/SI is **33.3%** (2001-2014) or **22.2%** (2010-2014) of the current PBR. As a result, the other criteria must be examined.

Criterion 2

Criterion 2 was not satisfied for either stock in either time period because human-caused M/SI is *not greater than* (i.e., is less than 100% of) PBR, and fisheries-related mortality is *not less than* 10% of PBR. As noted above, average annual human-caused M/SI is less than 100% of each stock's PBR. For the CA/OR/WA stock of humpback whale, the average annual *fishery-related* M/SI is **37.3%** (2001-2014) or **51%** (2010-2014) of the current PBR. For the CA/OR/WA stock of sperm whale, the average annual *fishery-related* M/SI is **33.3%** (2001-2014) or **22.2%** (2010-2014) of the current PBR. As a result, the other criteria must be examined.

Criterion 3

Criterion 3 was satisfied for both stocks in both time periods because the total *fishery-related* M/SI is *greater than* 10% and *less than* 100% of each stock's PBR, and the stocks are considered to be stable or increasing (see Sections 5.1.1 and 5.2.1 regarding abundance trends).

9.0 Negligible Impact Determination

Based on the review of the available data and applying the 1999 criteria for making a negligible impact determination under MMPA Section 101(a)(5)(E), all conditions of Criterion 3 are met by the available data for the CA/OR/WA stocks of humpback and sperm whales. For the following stocks, NMFS has determined that the M/SI incidental to the Category I CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) will have a negligible impact for purposes of issuing a permit under section 101(a)(5)(E) of the MMPA:

Humpback whale, CA/OR/WA stock
Sperm whale, CA/OR/WA stock

For the following stocks, NMFS has determined that the M/SI incidental to the Category II WA/OR/CA sablefish pot fishery will have a negligible impact for purposes of issuing a permit under section 101(a)(5)(E) of the MMPA:

Humpback whale, CA/OR/WA stock

For the following species of marine mammal stocks considered depleted under the MMPA because of their listing under the ESA, there is no documented evidence of M/SI having occurred with the CA thresher shark/swordfish drift gillnet fishery (≥14 in mesh) or WA/OR/CA sablefish pot fishery:

Blue whale, Eastern North Pacific stock
Fin whale, CA/OR/WA stock
Sei whale, Eastern North Pacific stock
Guadalupe fur seal, Mexico stock
North Pacific Right whale, Eastern North Pacific stock
Killer whale, Eastern North Pacific Southern Resident stock
Gray whale, Western North Pacific stock

10.0 References

Andersen, M. S., K. A. Forney, T. V. N. Cole, T. Eagle, R. Angliss, K. Long, L. Barre, L. Van Atta, D. Borggaard, T. Rowles, B. Norberg, J. Whaley, and L. Engleby. 2008. Differentiating Serious and Non-Serious Injury of Marine Mammals: Report of the Serious Injury Technical Workshop, 10-13 September 2007, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-39. 94 p.

Angliss, R. P., and D. P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. U.S. Dep. Commer., NOAA Tech Memo. NMFS-OPR-13, 48 p.

Barlow, J. 1994. Abundance of large whales in California coastal waters: a comparison of ship surveys in 1979/80 and in 1991. Rept. Int. Whal. Commn. 44:399-406.

Barlow, J. 1995. The abundance of large whales in California coastal waters: a comparison of ship surveys in 1979/80 and in 1991. Rept. Int. Whal. Commn. 44:399-406.

Barlow, J. 1997. Preliminary estimates of cetacean abundance off California, Oregon and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Administrative Report LJ-97-11, Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 25 p.

Barlow, J. 2010. Cetacean abundance in the California Current from a 2008 ship-based line-transect survey. NOAA Technical Memorandum, NMFS, NOAA-TM-NMFS-SWFSC-456.19 p.

Barlow, J. 2015. Inferring trackline detection probabilities, g(0), for cetaceans from apparent densities in different survey conditions. Marine Mammal Science, published online 4 January, 2015.

Barlow, J. and G.A. Cameron. 2003. Field experiments show that acoustic pingers reduce marine mammals bycatch in the California drift gillnet fishery. Mar. Mamm. Sci., 19:265-283. pp. 265-283.

Barlow, J. and B.L. Taylor. 2005. Estimates of sperm whale abundance in the northeastern temperate Pacific from a combined acoustic and visual survey. Marine Mammal Science 21(3):429-445.

Barlow, Jay, J. Calambokidis, E.A. Falcone, C.S. Baker, A.M. Burdin, P.J. Clapham and J.K.B. Ford 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. *Marine Mammal Science* 27:793-818.

Bettridge, S., C.S. Baker, J. Barlow, P.J. Clapham, M. Ford, D. Gouveia, D.K. Mattila, R.M. Pace, III, P.E. Rosel, G.K. Silber, and P.R. Wade. 2015. Status Review of the Humpback Whale

(*Megaptera novaeangliae*) under the Endangered Species Act. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-540, 240 p.

Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford, and K. C. Balcomb, III. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Rep. Int. Whal. Commn. (Spec. Iss. 12):383-405.

Braham, H.W. 1991. Endangered whales: status update. A Report on the 5-year status of the stocks review under the 1978 amendments to the U.S. Endangered Species Act. NMFS Unpublished Report.

Brownell R. L., Jr., A. R. Lang, A. M. Burdin, A. B. Bradford, and D. W. Weller. 2009. The western gray whale population is distinct: a response to SC/61/BRG22. Rep. Int. Whal. Commn. SC/61/BRG30.

Calambokidis, J. 2013. Updated abundance estimates of blue and humpback whales off the US west coast incorporating photo-identifications from 2010 and 2011. Document PSRG-2013-13 presented to the Pacific Scientific Review Group, April 2013. 7 p.

Calambokidis, J., and G. H. Steiger. 1994. Population assessment of humpback and blue whales using photo-identification from 1993 surveys off California. Final Contract Report to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 31pp.

Calambokidis, J., T. Chandler, K. Rasmussen, G. H. Steiger, and L. Schlender. 1999. Humpback and blue whale photo-identification research off California, Oregon and Washington in 1998. Final Contract Report to Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 35 p.

Calambokidis, J., T. Chandler, L. Schlender, G.H. Steiger, and A. Douglas. 2003. Research on humpback and blue whales off California, Oregon, and Washington in 2002. Final Contract Report to Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 47 p.

Calambokidis, J., E.A. Falcone, T.J. Quinn, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. LeDuc, D. Mattila, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, J. Urban, D. Weller, B.H. Witteveen, M. Yamaguchi, A. Bendlin, D. Camacho, K. Flynn, A. Havron, J. Huggins, and N. Maloney. 2008. SPLASH: Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific. Final report for Contract AB133F-03-RP-00078. 58 p. Available from Cascadia Research (www.cascadiaresearch.org) and NMFS, Southwest Fisheries Science Center (http://swfsc.noaa.gov).

Calambokidis, J., E. Falcone, A. Douglas, L. Schlender, and J. Huggins. 2009. Photographic identification of humpback and blue whales off the U.S. West Coast: results and updated abundance estimates from 2008 field season. Final Report for Contract AB133F08SE2786 from Southwest Fisheries Science Center. 18 p.

California Department of Fish and Wildlife (CDFW). 2015. Commercial Digest California fishing regulations. Sacramento, CA. April 2015. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=94111&inline

Carretta, J.V. and J.E. Moore. 2014. Recommendations for pooling annual bycatch estimates when events are rare. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-528, available from Southwest Fisheries Science Center, 8901 La Jolla Shores Drive, La Jolla, CA 92037, 15 p.

Carretta, J.V., K.A. Forney, M.M. Muto, J. Barlow, J. Baker, B. Hanson, and M.S. Lowry. 2006. U.S. Pacific Marine Mammal Stock Assessments: 2005. U.S. Department of Commerce Technical Memorandum, NOAA-TM-NMFS-SWFSC-388, 317 p.

Carretta, J.V., K.A. Forney, E. Oleson, K. Martien, M.M. Muto, M.S. Lowry, J. Barlow, J. Baker, B. Hanson, D. Lynch, L. Carswell, R.L. Brownell, J. Robbins, D.K. Mattila, K. Ralls, and M.C. Hill. 2011. U.S. Pacific Marine Mammal Stock Assessments: 2010. U.S. Department of Commerce Technical Memorandum, NOAA-TM-NMFS-SWFSC-476, 352 p.

Carretta, J.V., K.A. Forney, E. Oleson, K. Martien, M.M. Muto, M.S. Lowry, J. Barlow, J. Baker, B. Hanson, D. Lynch, L. Carswell, R. L. Brownell Jr., J. Robbins, D. K. Mattila, K. Ralls, and M. C. Hill. 2012. U.S. Pacific Marine Mammal Stock Assessment Report: 2011. U.S. Department of Commerce Technical Memorandum, NOAA-TM-NMFS-SWFSC-488, 360 p.

Carretta, J.V., K.A. Forney, E. Oleson, K. Martien, M.M. Muto, M.S. Lowry, J. Barlow, J. Baker, B. Hanson, D. Lynch, L. Carswell, R. L. Brownell Jr., J. Robbins, D. K. Mattila, K. Ralls, and M. C. Hill. 2014. U.S. Pacific Marine Mammal Stock Assessment Report: 2013. NOAA Technical Memorandum NMFS-SWFSC-532. August 2014.

Carretta, J.V., E.M. Oleson, J. Baker, D.W. Weller, A.R. Lang, K.A. Forney, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.I. Brownell. 2016a. U.S. Pacific Marine Mammal Stock Assessments: 2015. NOAA-TM-NMFS-SWFWC-561.

Carretta, J.V., M.M. Muto, J. Greenman, K. Wilkinson, J. Viezbicke, and J. Jannot. 2016b. Sources of human-related injury and mortality for U.S. Pacific west coast marine mammal stock assessments, 2010-2014. U.S. Department of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-554. 102 p.

Carretta, J.V., J.E. Moore, and K.A. Forney. 2016c. Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery, 1990-2014. Draft document PSRG-2016-08 reviewed by the Pacific Scientific Review Group, Feb 2016, Seattle WA.

Clapham, P.J., S. Leatherwood, I. Szczepaniak, and R.L. Brownell, Jr. 1997. Catches of humpback and other whales from shore stations at Moss Landing and Trinidad, California, 1919B1926. Mar. Mamm. Sci. 13:368B394.

Clapham, P.J. and Y. Ivashchenko. 2009. A Whale of Deception. Marine Fisheries Review. 71:44-52.

Dohl, T. P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-83: Status, abundance, and distribution. Final Report to the Minerals Management Service, Contract No. 14-12-0001-29090. 284 p.

Ford, J.K.B., G.M. Ellis, and K.C. Balcomb. 2000. Killer whales: The natural history and genealogy of *Orcinus killer whale* in British Columbia and Washington State (2nd ed.). UBC Press, Vancouver.

Forney, K.A. 2007. Preliminary estimates of cetacean abundance along the U.S. west coast and within four National Marine Sanctuaries during 2005. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-406. 27 p.

Forney, K. A., J. Barlow, and J. V. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. Fish. Bull. 93:15-26.

Green, G. A., J. J. Brueggenman, R. A. Grotefendt, C. E. Bowlby, M. L. Bonnell, K. C. Balcom, III. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Ch. 1 *in* J. J. Brueggeman (ed.). *Oregon and Washington Marine Mammal and Seabird Surveys*. Minerals Management Service Contract Report 14-12-0001-30426.

Hanson, B., T.P. Good, J.Jannot, and J. McVeigh. 2015. Humpback whale bycatch in the 2010-2013 U.S. west coast groundfish fisheries. Agenda Item D.F., Supplemental Attachment 6., June 2015 (provided to the Pacific Fishery Management Council).

Jannot, J.E., V. Tuttle, K. Somers, Y-W., Lee, and J. McVeigh. 2016. Marine mammal, seabird and sea turtle summary of observed interactions. March 8, 2016.

Lang, A.R., Weller, D.W., Leduc, R.G., Burdin, A.M., Hyde, J. and Brownell, R.L., Jr. 2004. Genetic differentiation between western and eastern gray whale populations using microsatellite markers Paper SC/56/BRG38 of the IWC Scientific Committee. 15 p.

Lang, A. R., Weller, D. W., Leduc, R. G., Burdin, A. M., & Brownell Jr, R. L. 2005. Genetic assessment of the western gray whale population: current research and future directions. Unpublished paper to the IWC Scientific Committee.

Lang A.R. 2010. The population genetics of gray whales *(Eschrichtius robustus)* in the North Pacific. PhD dissertation, University of California, San Diego, CA.

Lang, A.R., D.W. Weller, R.G. LeDuc, A.M. Burdin, and R.L. Brownell, Jr. 2010. Genetic differentiation between western and eastern (*Eschrichtius robustus*) gray whale populations using microsatellite markers. Paper SC/62/BRG11 presented to the International Whaling Commission Scientific Committee (Unpublished). 18 p. Available at http://www.iwcoffice.org.

Lang A.R.,D.W. Weller, R. LeDuc, A.M. Burdin, V.L. Pease, D. Litovka, V. Burkanov, R.L. Brownell, Jr. 2011. Genetic analysis of stock structure and movements of gray whales in the eastern and western North Pacific. Paper SC/63/BRG10 presented to the International Whaling Commission**.**

LeDuc, R. G., D. W. Weller, J. Hyde, A. M. Burdin, P. E. Rosel, R. L. Brownell, Jr., B. Wursig, and A. E. Dizon. 2002. Genetic differences between western and eastern gray whales (*Eschrichtius robustus*). Journal of Cetacean Research and Management.

Martin, S.L., S.M. Stohs and J.E. Moore. 2015. Bayesian inference and assessment for rare-event bycatch in marine fisheries: a drift gillnet fishery case study. Ecological Applications, 25(2), pp. 416-429.

Mate, B., A.L. Bradford, G. Tsidulko, V. Vertyankin,V. IlyashenkoV.2011. Late-feeding season movements of a western North Pacific gray whale off Sakhalin Island, Russia and subsequent migration into the Eastern North Pacific.Paper SC/63/BRG23 presented to the International Whaling Commission Scientific Committee. Available at www.iwcoffice.org.

McDonald, M.A., J.A. Hildebrand, and S.C. Webb. 1995. Blue and fin whales observed on a seafloor array in the Northeast Pacific. *Journal of the Acoustical Society of America* 98 (2), pp. 712–721. Available at: http://repositories.cdlib.org/postprints/2320.

Moore, J.E., and J. Barlow. 2011. Bayesian hierarchical estimation of fin whale abundance trends from a 1991-2008 time series of line-transect surveys in the California Current. *Journal of Applied Ecology* 48:1195-1205.

Moore JE, and J. P. Barlow. 2013. Declining Abundance of Beaked Whales (Family Ziphiidae) in the California Current Large Marine Ecosystem. PLoS ONE 8(1): e52770. doi:10.1371/journal.pone.0052770.

Moore, J.E. and J. Barlow. 2014. Improved abundance and trend estimates for sperm whales in the eastern North Pacific from Bayesian hierarchical modeling. *Endangered Species Research* 25:141-150.

Moore, S.E., K.M. Stafford, M.E. Breiwick, C.G. Fox, H.W. Braham, J.J. Polovina, and D.E. Bain. 1998. Seasonal variation in reception of fin whale calls at five geographic areas in the North Pacific. Mar. Mamm. Sci. 14(3):617-627.

NMFS. 1991. Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*). Prepared for the National Marine Fisheries Service, Silver Spring, Maryland. 105 p.

NMFS. 1997. Final Pacific Offshore Cetacean Take Reduction Plan. 501 West Ocean Boulevard, Suite 4200, Long Beach, CA 90802.

NMFS. 2010a. Final Recovery Plan for the Fin Whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD. 121 p.

NMFS. 2010b. Recovery Plan for the Sperm Whale (*Physeter macrocephalus*). National Marine Fisheries Service, Silver Spring, MD. 165 p.

NMFS. 2011. Fixed Gear Guide: CA, OR, WA Commercial Fisheries. This guide can be found at **www.westcoast.fisheries.noaa.gov/**.

NMFS. 2012. NMFS Policy Directive PD 02-238, Process for Distinguishing Serious from Non-Serious Injury of Marine Mammals, Effective Date January 27, 2012. NMFS Instruction 02-238-01, Process for Injury Determinations, Effective Date January 27, 2012.

NMFS. 2013. Biological Opinion on the continued management of the California drift gillnet fishery under the Fishery Management Plan for U.S. West Coast Fisheries under the Highly Migratory Species. May 2, 2013.

NMFS. 2016a. Guidelines for Preparing Stock Assessment Reports Pursuant to the 1994 Amendments to the MMPA**.** NMFS Instruction 02-204-01, February 22, 2016.

NMFS. 2016b. Action to Modify the Fixed Gear Sablefish Fishery Managed under the Pacific Coast Groundfish Fishery Management Plan Including an Environmental Assessment and Regulatory Impact Review. Seattle, WA. August 2016.

NMFS. 2016c. California, Oregon, and Washington Marine Mammal Stranding Database, January 1, 2001-December 31, 2014.

Northwest Fisheries Science Center (NWFSC). 2010. Data report and summary analyses of the U.S. west coast non-nearshore fixed gear groundfish fishery. West Coast Groundfish Observer Program. National Marine Fisheries Service, NWFSC, 2725 Montlake Blvd E., Seattle, WA 98112.

Oregon Department of Fish and Wildlife (ODFW). 2016. Synopsis Oregon Commercial Fishing Regulations. Salem, OR.
http://www.dfw.state.or.us/fish/commercial/docs/2016_Commercial_Synopsis.pdf

Reeves, R.R., and H. Whitehead. 1997. Status of the sperm whale, *Physeter macrocephalus*, in Canada. Can. Field-Nat. 111:293-307.

Rice, D. W. 1974. Whales and whale research in the eastern North Pacific. Pp. 170-195 In: W. E. Schevill (ed.). *The Whale Problem: A Status Report*. Harvard Press, Cambridge, MA.

Rice, D.W. 1989. Sperm whale *Physeter macrocephalus* Linnaeus, 1758. Pp. 177-233 in S.H. Ridgway and R. Harrison (eds.), Handbook of marine mammals, vol. 4. Academic Press, London.

Saez L., D. Lawson, M. DeAngelis, S. Wilkin, J. Viezbike, E. Petras, C. Fahy, and B. Norberg. (In prep). Large whale entanglements off the west coast of the United States.

Swartz, S. L., B. L. Taylor, and D. J. Rugh. 2006. Gray whale *Eschrichtius robustus* population and stock identity. Mammal Review 36:66-84.

Urbán R., J., Weller, D., Tyurneva, O., Swartz, S., Bradford, A., Yakovlev,Y., Sychenko, O., Rosales N., H.,Martínez A., S., Burdin, A. and Gómez-Gallardo U., A. 2012. Report on the photographic comparison of the western and Mexican gray whale catalogues. Paper SC/64/BRG13 presented to the Scientific Committee of the International Whaling Commission. Available at http://www.iwcoffice.org/.

Wade, P.R., T.J. Quinn, J. Barlow, C.S. Baker, A.M. Burden, J. Calambokidis, P.J. Clapham, E.A. Falcone, J.K.B. Ford, C.M. Gabriele, D.K. Mattila, L. Rojas-Bracho, J.M. Straley, B. Taylor, J. Urbán, D. Weller, B.H. Witteveen, and M. Yamaguchi. 2016. Estimates of abundance and migratory destination for north Pacific humpback whales in both summer feeding areas and winter mating and calving areas. Paper SC/66b/IA/21 presented to the International Whaling Commission Scientific Committee. Available at www.iwcoffice.org.

Weller, D. W., Burdin, A.M., Bradford, A.L., Ivashchenko, Y.I., Tsidulko, G.A., Lang, A.R. and Brownell, R.L., Jr. 2004. Status of western gray whales off northeastern Sakhalin Island, Russia, in 2003. Paper SC/56/BRG40 presented to the IWC Scientific Committee (unpublished). 18 p.

Weller, D. W., Bradford, A. L., Tsidulko, G. A., Ivashchenko, Y. V., Lang, A. R., Kim, H. W., Burdin, A.M., and Brownell Jr, R. L. 2006. A catalog of photo-identified western gray whales from Sakhalin Island, Russia. Paper SC/58/BRG2 presented to the IWC Scientific Committee.

Weller D.W., Klimek A., Bradford A.L., Calambokidis J., Lang A.R., Gisborne B., Burdin A.M., Szaniszlo W.,Urban J., Gomez-Gallardo Unzueta A., Swartz S. and Brownell R.L., Jr. 2012. Movements of gray whales between the western and eastern North Pacific. Endangered Species Research 18:193-199.