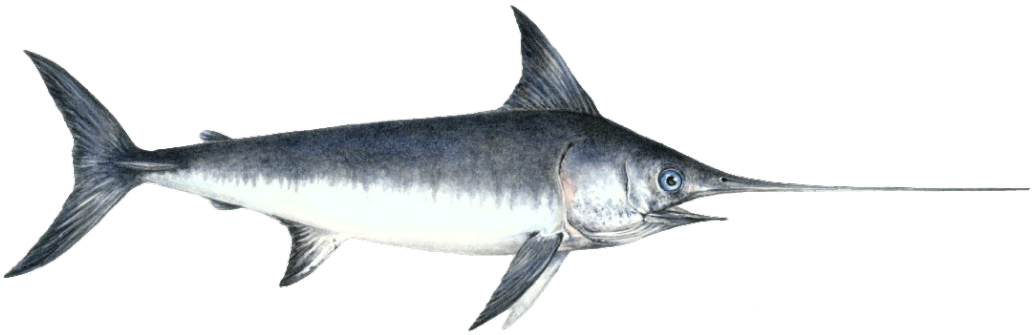
Monterey Bay Aquarium Seafood Watch®

Swordfish *(Xiphias gladius)*
Shortfin mako shark *(Isurus oxyrinchus)*
Common thresher shark *(Alopias vulpinus)X*
Opah *(Lampris guttatus)*
Pacific bluefin tuna *(Thunnus orientalis)X*
Albacore tuna *(Thunnus alalunga)*



California
Drift gillnets (driftnets)

Fisheries Standard Version F2

April 3, 2017

Seafood Watch Consulting Researcher

Table of Contents

About Seafood Watch 3
Guiding Principles 4
Summary 5
Final Seafood Recommendations 6
Introduction 8
Assessment 10
Criterion 1: Impacts on the species under assessment 10
Criterion 2: Impacts on other species 19
Criterion 3: Management Effectiveness 26
Criterion 4: Impacts on the habitat and ecosystem 34
Acknowledgements 37
References 38
Appendix A: Extra By Catch Species 43
Appendix B: Discard rate 48

About Seafood Watch

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch®'s sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Based on this principle, Seafood Watch had developed four sustainability **criteria** for evaluating wildcatch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and **rating**

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

Avoid/Red Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report focuses on swordfish *(Xiphias gladius)*, common thresher shark *(Alopias vulpinus)*, opah *(Lampris guttatus)*, albacore tuna *(Thunnus alalunga)*, shortfin mako shark *(Isurus oxyrinchus),* and Pacific bluefin tuna *(Thunnus orientalis)* caught in the California drift gillnet fishery that operates off the U.S. West Coast.

The primary target in this fishery is swordfish, although common thresher shark is a secondary target species. Opah is also caught and sold for human consumption. Swordfish populations in this region are healthy, being above the biomass needed to produce the maximum sustainable yield (MSY) and sustainably fished (i.e., fishing mortality rates are below those that produce MSY). The status of opah is unknown, but common thresher shark populations appear to be healthy. There are several additional species included in this report. The status of these species varies from overfished, as for Pacific bluefin tuna, to unknown, as for ocean sunfish. Although sea turtle interactions used to be an issue in this fishery, management measures put into place in 2001 have greatly reduced these incidental encounters. In recent years, several sperm whale interactions have occurred; managers implemented emergency measures to address these interactions, but these measures have since expired and are no longer in effect.

Drift gillnet gear does not come into contact with bottom habitats, and the U.S. West Coast management councils have been proactive in taking the lead to formulate and implement ecosystem-based fishery management plans.

Final Seafood Recommendations

SPECIES/FISHERY	CRITERION 1: IMPACTS ON THE SPECIES	CRITERION 2: IMPACTS ON OTHER SPECIES	CRITERION 3: MANAGEMENT EFFECTIVENESS	CRITERION 4: HABITAT AND ECOSYSTEM	OVERALL RECOMMENDATION
Swordfish California East Pacific, Drift gillnets (driftnets)	Green (5.000)	Red (0.950)	Yellow (3.000)	Green (3.873)	**Good Alternative (2.725)**
Shortfin mako shark California East Pacific, Drift gillnets (driftnets)	Red (2.159)	Red (0.950)	Yellow (3.000)	Green (3.873)	**Avoid (2.209)**
Common thresher shark California East Pacific, Drift gillnets (driftnets)	Green (5.000)	Red (0.950)	Yellow (3.000)	Green (3.873)	**Good Alternative (2.725)**
Opah California East Pacific, Drift gillnets (driftnets)	Yellow (2.644)	Red (0.950)	Yellow (3.000)	Green (3.873)	**Good Alternative (2.324)**
Pacific bluefin tuna California East Pacific, Drift gillnets (driftnets)	Red (1.414)	Red (0.950)	Yellow (3.000)	Green (3.873)	**Avoid (1.987)**
Albacore tuna California East Pacific, Drift gillnets (driftnets)	Green (3.831)	Red (0.950)	Yellow (3.000)	Green (3.873)	**Good Alternative (2.550)**

Summary

Swordfish, opah, albacore tuna and common thresher shark caught in the California drift gillnet fishery are a Good Alternative. However, shortfin mako shark, due to their unknown status, high vulnerability and the fishery's impact on bycatch species, has an overall recommendation of Avoid.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch

Management Strategy (Factor 3.2) are Very High Concern[2], and no more than one Red Criterion, and no Critical scores

- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report focuses on swordfish *(Xiphias gladius)*, common thresher shark *(Alopias vulpinus)*, opah *(Lampris guttatus)*, albacore tuna *(Thunnus alalunga)*, shortfin mako shark *(Isurus oxyrinchus),* and Pacific bluefin tuna *(Thunnus orientalis)* caught in the California drift gillnet fishery that operates off the U.S. West Coast.

Species Overview

Swordfish is a widely distributed billfish species, found globally from 50°N to 50°S and at all longitudes in the Pacific Ocean (IATTC 2014b). Swordfish is assessed as two populations in the North Pacific (Western and Central Pacific, and Eastern Pacific), in the Southwest and Southeastern Pacific, two populations in the Atlantic (South and North), and a single population in both the Indian Ocean and Mediterranean Sea. This report focuses on the North Pacific population in the Eastern Pacific Ocean.

Common thresher shark is a highly migratory species found in temperate and tropical waters of all oceans. Within the Northeast Pacific Ocean, common thresher sharks are found from Goose Bay, British Columbia, Canada to the Baja Peninsula. Mexico (FR 2015). Common thresher shark is found out to 200 miles from shore, with juveniles remaining in shallow waters of the continental shelf and adults more commonly found in deeper waters (Smith et al. 2008).

Opah is found throughout the world in temperate and tropical waters. In the Eastern Pacific Ocean, it is found from the Gulf of Alaska to Southern California. Opah is found in epipelagic and mesopelagic waters and is thought to be solitary in nature (Froese and Pauly 2014).

In U.S. waters, swordfish and common thresher shark are managed by the Pacific Fishery Management Council (PFMC). Opah is not currently included in any management plan through the PFMC.

Production Statistics

Longline catches of swordfish in the northern region of the Eastern Pacific Ocean (EPO) have varied over time, with peaks occurring during the late 1960s and early 2000s (≈6,000 t). In 2012, catches were around 3,000 t and less than in previous years (approximately 2008–2011) (IATTC 2014b). Landings of swordfish by the California drift gillnet fishery, which operates in the Eastern Pacific Ocean, have decreased over time from a high of 1,413 mt in 1993 to a low of 62 mt in 2010. Swordfish landings by this fishery were 95 mt during 2013. Landings of common thresher shark increased rapidly during the 1970s, reaching a peak of over 1,000 t. Landings declined after regulations were put into place in 1986. Common thresher shark catches have varied between 37 mt and 55 mt since 2011 (PFMC 2015). It is unclear how much opah is landed in this fishery. The Stock Assessment and Fishery Evaluation reports do not report landings of this species, and no landings have been reported in the National Marine Fisheries Service commercial landings database. But observer records indicate that catches have varied between 64 and 189 opah between 2010 and 2015. (http://www.westcoast.fisheries.noaa.gov/fisheries/wc_observer_programs/sw_observer_program_info/data_su

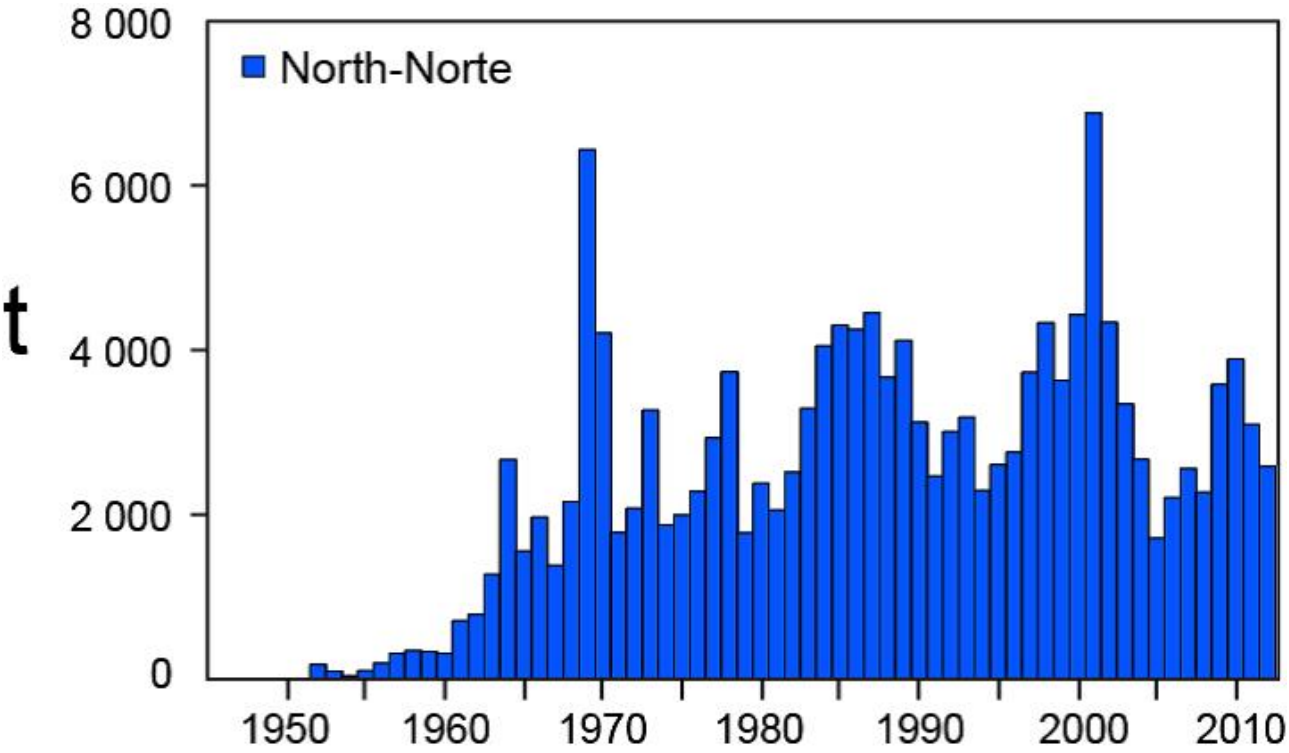


Figure 1 Swordfish catches (t) in the North Pacific Ocean (1945–2012) (IATTC 2014).

Importance to the US/North American market.

Swordfish were primarily imported from Ecuador (51%) during 2013 (NMFS 2014). Information on imports of common thresher shark and opah is not available.

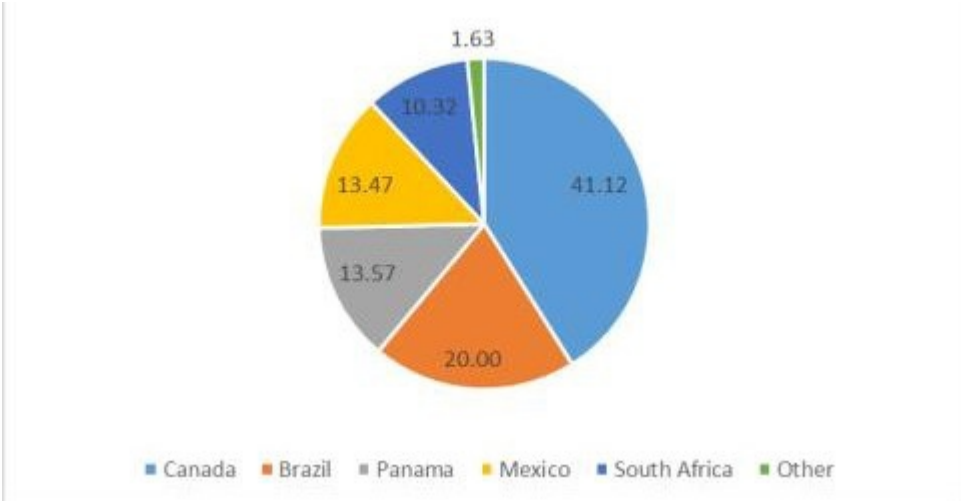


Figure 2 Swordfish imports, IATTC Convention Area, 2013 (country of origin) (NMFS 2014).

Common and market names.

Swordfish is also known broadbilled swordfish, broadbill, espada, and emperado. Common thresher shark is also known as thresher shark, and there are no other common names for opah.

Primary product forms

Swordfish is available as fresh or frozen steaks, fillets, and loins. Fresh whole swordfish that have been headed and gutted are known as "bullets." Frozen sashimi-quality fish are known as "clipper" swordfish (Pacific Seafood Group 2001). Common thresher shark and opah are sold as fresh and frozen steaks.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown.

The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Criterion 1 Summary

ALBACORE TUNA				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
California/East Pacific Drift gillnets (driftnets)	2.00: Medium	4.00: Low Concern	3.67: Low Concern	Green (3.831)

COMMON THRESHER SHARK				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
California/East Pacific Drift gillnets (driftnets)	1.00: High	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.000)

OPAH				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
California/East Pacific Drift gillnets (driftnets)	2.00: Medium	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.644)

PACIFIC BLUEFIN TUNA				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
California/East Pacific Drift gillnets (driftnets)	2.00: Medium	2.00: High Concern	1.00: High Concern	Red (1.414)

SHORTFIN MAKO SHARK				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
California/East Pacific Drift gillnets (driftnets)	1.00: High	2.00: High Concern	2.33: Moderate Concern	Red (2.159)

SWORDFISH				
Region / Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
California/East Pacific Drift gillnets (driftnets)	2.00: Medium	5.00: Very Low Concern	5.00: Very Low Concern	Green (5.000)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Inherent Vulnerability

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing).*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator). Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

Factor 1.2 - Abundance

- *5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.*
- *4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished*
- *3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.*
- *2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

Factor 1.3 - Fishing Mortality

- *5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible (≤ 5% of a sustainable level of fishing mortality).*
- *3.67 (Low Concern)—Probable (>50%) chance that fishing mortality is at or below a sustainable level, but*

some uncertainty exists, OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible, OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught).

- *2.33 (Moderate Concern)—Fishing mortality is fluctuating around sustainable levels, OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery and, if species is depleted, reasonable management is in place.*
- *1 (High Concern)—Overfishing is occurring, but management is in place to curtail overfishing, OR fishing mortality is unknown, species is depleted, and no management is in place.*
- *0 (Critical)—Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.*

ALBACORE TUNA

Factor 1.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Medium

FishBase assigned a high vulnerability score of 58 out of 100 (Froese and Pauly 2013). But the life history characteristics of albacore suggest only a medium vulnerability to fishing. For example, albacore reaches sexual maturity between 5 and 6 years of age and reaches a maximum age of 15 years (ISCAWG 2014). It is a broadcast spawner and top predator (Froese and Pauly 2013). Based on these life history characteristics, we have awarded a medium score.

Rationale:

Life history paramater	Value	Score
Average age at maturity	5–15 years	2
Average size at maturity	40–200 cm	2
Average maximum age	10–25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	> 3.25	1
Average score		2

Factor 1.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Low Concern

The most recent stock assessment for albacore tuna in the North Pacific Ocean was conducted in 2014. According to this assessment, the spawning stock biomass (SSB) in 2012 (last year of data included in the model) was 110,101 t, with stock depletion estimated to be 35.8% of the unfished SSB. No biomass-based reference points are in place, but the assessment concluded that there was little indication that the SSB was below any candidate biomass-based reference points. We have therefore awarded a "low" concern score because it is likely that albacore tuna in the North Pacific is not overfished, but not a very low concern score

because no reference points are currently accepted (ISCAWG 2014).

Factor 1.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Low Concern

The current fishing mortality rate ($F_{2010–2012}$) for albacore tuna in the North Pacific Ocean is around 72% of the interim reference point (see Detailed Rationale for information on reference points). In addition, the current fishing mortality rate ($F_{2010–2012}$) is below other F-based reference points and $F_{50\%}$. Albacore tuna in the North Pacific Ocean is therefore not currently undergoing overfishing according to the Albacore Working Group. But increases in fishing mortality rates will significantly reduce the spawning biomass (ISCAWG 2014). We have awarded a "low" concern and not a very low concern score.

Rationale:

Biomass-based reference point: $F_{SSB–ATHL50\%}$ is the fishing mortality rate that would lead to future minimum spawning stock biomass (SSB) falling below the SSB-ATHL (average of the ten historically lowest amounts) threshold level (average of at least once during a 25-year projection period).

Fishing mortality based reference points: (MSY $F_{0.1}$ and $F_{10\%–40\%}$ [fishing mortality that gives a 10%–40% reduction in the spawning potential ratio]) except F_{MED} (fishing mortality level corresponding to median biomass to recruitment ratio in the long term).

COMMON THRESHER SHARK

Factor 1.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

FishBase assigned a high to very high vulnerability score of 67 out of 100 (Cheung et al. 2005). Common thresher shark reaches sexual maturity around 5–6 years of age in the Pacific Ocean and lives to 25 years of age (Smith et al. 2008). Sexual maturity is reached around 150 cm and it reaches a maximum size of around 500 cm (Smith et al. 2008) (Wegmann 2016). It is a top predator and gives birth to live young (Smith et al. 2008) (Froese and Pauly 2016). According to the Seafood Watch productivity and susceptibility table, common thresher shark has an overall inherent vulnerability score of 1.5 (see Detailed Rationale below) and therefore has a high inherent vulnerability to fishing.

Rationale:

Life history trait	Value	PSA score
Average maximum size	> 300 cm	1
Average maximum age	10–25 years	2
Average age at sexual maturity	5–15 years	2
Average size at sexual maturity	40–200 cm	2
Reproductive strategy	Live young	1
Trophic level	4.5	1
PSA Score		1.5

Factor 1.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very Low Concern

An updated assessment of common thresher shark was conducted during 2016. According to this assessment, the current population in the northeastern Pacific Ocean is at 94% of unfished levels. The estimated mature female biomass is 83,330 and the reference point ($MSST_0$) is 35,700. Therefore, the ratio of the biomass and reference point is above 1, indicating that the population is not overfished (S_{2014}/MSST = 2.33) (Teo 2016). Previously, the National Marine Fisheries Service announced a positive 90-day finding for listing common thresher shark under the Endangered Species Act; however, this was for the population as a whole. The 90-day finding found that management of the West Coast population was precautionary and that the population is rebuilding from historical overfishing (FR 2015). The International Union for Conservation of Nature (IUCN) has listed common thresher shark as "Near Threatened" in the Eastern Pacific Ocean based on a 2007 assessment (Goldman et al. 2009), but this status has been superseded by the more recent and more robust stock assessment conducted in 2016. We have awarded a "very low" concern score because the population is currently at a quite healthy level according to the most recent stock assessment.

Factor 1.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very Low Concern

Common thresher shark is a secondary target species in the California drift gillnet fishery. According to the 2016 stock assessment, current fishing intensity on this species is very low (0.08) and far below the reference point of 0.39. Therefore, overfishing is not currently occurring on this species (Teo et al. 2016). We have awarded a "very low" concern score to account for the low impact of fishing on this species.

OPAH

Factor 1.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Medium

Recent research suggests that two species of opah may be present in the Pacific: Lineages 3 and 5 (Hyde et al. 2014). Around 90% of Hawaiian catch is made up of Lineage 3 (Hyde et al. 2014). FishBase assigned a very high vulnerability of 82 out of 100 (Froese and Pauly 2013). Opah reaches a maximum length of 200 cm and lives at least 11 years (Froese and Kesner-Reyes 2002). There is no information on its age at maturity. It is a broadcast spawner and a top predator (Froese and Pauly 2015). These life history characteristics suggest a moderate level of vulnerability (PSA score = 2). Based on the PSA score and the widespread distribution of this species, and because they are not targeted in many fisheries (C. Sepulveda 2015), we have adjusted the score to medium.

Rationale:

Life history trait	Parameter	Score
Average Maximum size	100–300 cm	2

Average maximum age	10–25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	> 3.25	1

Factor 1.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

Opah populations have not been assessed in the Eastern Pacific Ocean either through a formal assessment or by the International Union for the Conservation of Nature (IUCN). Stock abundance relative to a sustainable level is therefore unknown and is scored as a "moderate" concern (because inherent vulnerability is not high).

Factor 1.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

Fishing mortality rates for opah are not available. But opah makes up a large percentage of the total catch in this fishery—as much as 14% in recent years (PFMC 2015). Opah is not included in any management plan, so there are no management measures in place. We have awarded a "moderate" concern score because fishing mortality rates are unknown and there is no indication that the population is depleted.

PACIFIC BLUEFIN TUNA

Factor 1.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Medium

FishBase assigned a high vulnerability score of 60 out of 100 (Froese and Pauly 2013). Pacific bluefin tuna begins reaching sexual maturity around 160 cm, and reaches sexual maturity around 5 years of age (PBTWG 2016). Maximum size and age of 250 cm and 20 years, respectively, have been reported (PBTWG 2016). Pacific bluefin tuna is a broadcast spawner and has a high trophic level, according to FishBase (Froese and Pauly 2013). According to these life history characteristics, which score a 2 according to the Seafood Watch productivity attribute table, Pacific bluefin tuna has a moderate level of vulnerability and we have therefore adjusted the score to medium.

Rationale:

Life history trait	Parameter (score range)	Value
Average size at maturity	40–200 cm	2
Average age at maturity	5–15	2
Maximum size	100–300	2
Maximum age	10–25 years	2
Reproductive strategy	Broadcast	3
Trophic level	> 3.25	1
Total score		2

Factor 1.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High Concern

The most recent stock assessment for Pacific bluefin tuna was conducted in 2016. The ratio of spawning stock biomass (SSB) in 2014 to virgin levels is low, at only 2.6%. There are no reference points in place for Pacific bluefin tuna but, based on proxy limit reference points ($SSB_{20\%}$), the population of Pacific bluefin tuna would be considered overfished (ISCPBWG 2016). The National Marine Fisheries Service considers this species overfished (NMFS 2016b). The International Union for the Conservation of Nature (IUCN) has assessed this species as "Vulnerable" (Collette et al. 2014). We have therefore awarded a "high" concern score.

Factor 1.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High Concern

There are no target or limit reference points for Pacific bluefin tuna, but the current F (2011–2013 average) is higher than all target and biological reference points commonly used in other fisheries, except for one reference point (F_{MED}). It is currently thought that overfishing is occurring and/or the population is approaching an overfishing status, depending on which potential reference points are examined (ISCPBWG 2016). Although the drift gillnet fishery is not a primary fishery for this species, it does capture this species (NMFS 2016), and this report issues a recommendation for bluefin tuna caught in the drift gillnet fishery. Per Seafood Watch criteria, when providing a recommendation for a secondary catch species, we evaluate the stock status and fishing mortality affecting the stock as a whole. Accordingly, fishing mortality for Pacific bluefin tuna caught in this fishery is rated as a "high" concern because it is probable that overfishing is occurring for the Pacific bluefin tuna population.

SHORTFIN MAKO SHARK

Factor 1.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

FishBase assigned a very high vulnerability of 86 out of 100 (Froese and Pauly 2013). Shortfin mako shark (male) reaches sexual maturity around 160 cm in size and 5 years of age (Smith et al. 2008). The maximum size attained by shortfin mako shark ranges from 221 cm to 247 cm in size and 25 to 40 years of age (Smith et al. 2008) (Froese and Pauly 2015). Shortfin mako shark is a top predator and gives birth to live young (Froese and Pauly 2015). Based on the FishBase score and life history characteristics, we have awarded a high vulnerability score.

Factor 1.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High Concern

There has been some question about the stock structure of shortfin mako shark in the Pacific Ocean. Currently, the consensus is that there is a single population in the North Pacific (PIFSC 2014). A stock-wide assessment was attempted in 2015; the previous assessment of shortfin mako shark was conducted in the

Northwest Pacific in 2009. The 2015 assessment used four indicators (proportion of positive sets, abundance, sex ratio, and size components) to determine the status of shortfin mako shark. Trends for the proportion of positive sets varied by fishery, as did the abundance indices. The Japanese abundance indices, which were considered the best, showed a flat trend through 2004 followed by a sharp increase through 2013. The Hawaii shallow-set and deep-set abundance indices showed contrasting trends. No trends in sex ratio were evident, but the size composition appeared to remain stable across fleets. No determination of stock status could be determined because of an overall lack of data (ISC 2015). The International Union for the Conservation of Nature has assessed this species globally as "Vulnerable" (Cailliet et al. 2009). We have awarded a "high" concern score because the status is unknown and shortfin mako shark has a high inherent vulnerability score.

Factor 1.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

The 2015 assessment was unable to calculate fishing mortality rates because of a lack of data (ISC 2015). The previous 2009 assessment of shortfin mako shark in the Northwest Pacific suggested that fishing mortality should be reduced by 32% from then-current (2007) levels to be sustainable (Chang and Liu 2009). Estimated average annual longline catches between 1992 and 2009 were 71 t. There are no management measures in place and fishing mortality rates are unknown, so we have awarded a "moderate" concern score.

SWORDFISH

Factor 1.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Medium

FishBase assigned a high to very high vulnerability of 72 out of 100 (Froese and Pauly 2013). Swordfish reaches sexual maturity at around 180 cm in size and around 5 years of age. It reaches a maximum length of 455 cm and lives 10–20 years. Swordfish is a broadcast spawner and a top predator (Froese and Pauly 2013). These life history characteristics, considered in the vulnerability assessment detailed below, result in a vulnerability score of 1.83, which is considered "medium" vulnerability to fishing according to Seafood Watch criteria.

Rationale:

Life history trait	Parameter	Score
Average age at maturity	5–15 years	2
Average size at maturity	40–200 cm	2
Average maximum age	10–20 years	2
Average maximum size	> 300 cm	1
Reproductive strategy	Broadcast spawner	3
Trophic level	> 3.25	1

Factor 1.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very Low Concern

In 2014, an assessment ofor swordfish in the North Pacific was conducted. This assessment considered two populations: one in the Western and Central Pacific (WCPO) and one in the Eastern Pacific Ocean (EPO). The WCPO population reaches across the Pacific and includes the U.S. West Coast, while the EPO population covers South America (ISC 2014). The California gillnet fishery only catches swordfish from the WCPO population (PFMC 2016) (PFMC 2016b). According to this model, the exploitable biomass for the population in the WCPO region fluctuated at or above the level needed to produce the maximum sustainable yield (B_{MSY}) for most of the time series (1951–2012), and there is a low probability (14%) of the biomass being below B_{MSY} in 2012 (ISCBWG 2014). We have therefore awarded a "very low" concern score.

Factor 1.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very Low Concern

In 2014, an assessment of swordfish in the North Pacific was conducted. The California gillnet fishery catches swordfish from the Western and Central Pacific Ocean population (ISC 2014) (PFMC 2016) (PFMC 2016b). Exploitation rates in this region peaked in the 1960s and have declined since. The current fishing mortality rate ($H_{2010–2012}$) is 15%, which is lower than the level necessary to produce the maximum sustainable yield (H_{MSY} = 25%). It is very unlikely (< 1%) that fishing mortality rates (H) are unsustainable, so overfishing is not occurring (ISCBWG 2014). We have therefore awarded a "very low" concern score.

Criterion 2: Impacts on other species

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing.

To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix B.

ALBACORE TUNA - CALIFORNIA/EAST PACIFIC - DRIFT GILLNETS (DRIFTNETS)					
Subscore:	**1.000**	**Discard Rate:**	**0.95**	**C2 Rate:**	**0.950**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
sperm whale	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)	
Pacific bluefin tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)	
Leatherback turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)	
Loggerhead turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)	
Shortfin mako shark	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)	
Ocean sunfish	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)	
Opah	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)	
Swordfish	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)	

Common thresher shark	1.00:High	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

COMMON THRESHER SHARK - CALIFORNIA/EAST PACIFIC - DRIFT GILLNETS (DRIFTNETS)					
Subscore:	**1.000**	**Discard Rate:**	**0.95**	**C2 Rate:**	**0.950**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
sperm whale	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)
Pacific bluefin tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Leatherback turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Loggerhead turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Shortfin mako shark	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Ocean sunfish	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Opah	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Albacore tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Swordfish	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

OPAH - CALIFORNIA/EAST PACIFIC - DRIFT GILLNETS (DRIFTNETS)					
Subscore:	**1.000**	**Discard Rate:**	**0.95**	**C2 Rate:**	**0.950**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
sperm whale	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)
Pacific bluefin tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)

Leatherback turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Loggerhead turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Shortfin mako shark	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Ocean sunfish	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Albacore tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Swordfish	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)
Common thresher shark	1.00:High	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

PACIFIC BLUEFIN TUNA - CALIFORNIA/EAST PACIFIC - DRIFT GILLNETS (DRIFTNETS)					
Subscore:	**1.000**	**Discard Rate:**	**0.95**	**C2 Rate:**	**0.950**

Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore
sperm whale	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)
Leatherback turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Loggerhead turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Shortfin mako shark	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Ocean sunfish	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Opah	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Albacore tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)

Swordfish	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)
Common thresher shark	1.00:High	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

SHORTFIN MAKO SHARK - CALIFORNIA/EAST PACIFIC - DRIFT GILLNETS (DRIFTNETS)					
Subscore:	**1.000**	**Discard Rate:**	**0.95**	**C2 Rate:**	**0.950**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
sperm whale	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)	
Pacific bluefin tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)	
Leatherback turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)	
Loggerhead turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)	
Ocean sunfish	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)	
Opah	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)	
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)	
Albacore tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)	
Swordfish	2.00:Medium	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)	
Common thresher shark	1.00:High	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)	

SWORDFISH - CALIFORNIA/EAST PACIFIC - DRIFT GILLNETS (DRIFTNETS)					
Subscore:	**1.000**	**Discard Rate:**	**0.95**	**C2 Rate:**	**0.950**
Species	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Subscore**	
sperm whale	1.00:High	1.00:Very High Concern	1.00:High Concern	Red (1.000)	

Pacific bluefin tuna	2.00:Medium	2.00:High Concern	1.00:High Concern	Red (1.414)
Leatherback turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Loggerhead turtle	1.00:High	1.00:Very High Concern	2.33:Moderate Concern	Red (1.526)
Shortfin mako shark	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Ocean sunfish	1.00:High	2.00:High Concern	2.33:Moderate Concern	Red (2.159)
Opah	2.00:Medium	3.00:Moderate Concern	2.33:Moderate Concern	Yellow (2.644)
Blue shark	1.00:High	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Albacore tuna	2.00:Medium	4.00:Low Concern	3.67:Low Concern	Green (3.831)
Common thresher shark	1.00:High	5.00:Very Low Concern	5.00:Very Low Concern	Green (5.000)

The California drift gillnet fishery targets swordfish and common thresher shark as a secondary target. In addition to these species, several "main species," defined by Seafood Watch criteria as making up at least 5% of the total catch or being a vulnerable species affected by this fishery, are included in these reports {NOAA 2016}. These include opah, Pacific bluefin tuna, albacore tuna, ocean sunfish, shortfin mako shark, blue shark, sperm whale, California sea lion, loggerhead turtle, and leatherback turtle. Marine mammal interactions are considered rare in this fishery, partly because of the use of bycatch mitigation measures. A Take Reduction Plan was put into place in 1997, which included the use of pingers, skipper workshops, and modifications to the gillnet design. Since 1997, cetacean entanglement rates have dropped considerably {Barlow and Cameron 2003}. During the 2014–15 season, three short-beaked common dolphins and one Dall's porpoise were observed caught in this fishery {NMFS 2015}. Historically, northern right whale, long beak dolphin, and common dolphin were also reported as bycatch in this fishery. Interactions have been reported with northern elephant seal and California sea lion, but not at rates necessary to include in this report. Several species of sharks are also incidentally captured in this fishery, although most (except for blue and shortfin mako, which are included in this report) are not commonly captured. This fishery has incidentally captured two megamouth sharks {NMFS 2013}. For this report, we have used observer data to identify the "main species" to be included in this report. Out of these species, the sperm whale, sea turtles, and Pacific bluefin tuna scored the lowest because of their current population sizes and fishing mortality rates.

Bycatch Species	Justification	Source
Thresher shark	target	Observer data
Ocean sunfish	60%	Observer data

Opah	4%	Observer data
Bluefin tuna	2% of total catch and status	Observer data
Shortfin mako shark	4%	Observer data
Blue shark	6%	Observer data
Sperm whale	Status	Observer data
Loggerhead sea turtle	Status	Observer data
Leatherback sea turtle	Status	Observer data

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Inherent Vulnerability
(same as Factor 1.1 above)

Factor 2.2 - Abundance
(same as Factor 1.2 above)

Factor 2.3 - Fishing Mortality
(same as Factor 1.3 above)

SPERM WHALE

Factor 2.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

Marine mammals have a high level of vulnerability (Seafood Watch 2013) due to their life history characteristics. These include a late age at maturity, producing a small number of young, and a long life span.

Factor 2.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very High Concern

There are an estimated 2,106 sperm whales in the waters of California, Oregon, and Washington. Estimates for the entire Eastern Pacific Ocean are 22,700 but it is unknown if these animals enter the U.S. Exclusive Economic Zone (EEZ) waters. The 2008 declines in sperm whale abundance likely are the result of normal inter-annual changes rather than declining populations (Carettea et al. 2013) (Moore and Barlow 2014). The International Union for the Conservation of Nature (IUCN) has classified sperm whale as "Vulnerable." Sperm whale is listed on Appendix I of CITES (Taylor et al. 2008). The United States has listed sperm whale as

"Endangered" throughout its range (OPF 2013). We have awarded a "very high" concern score based on these various classifications.

Factor 2.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High Concern

In 2010, two sperm whales were incidentally captured in this fishery (PFMC 2015). This amount exceeded the potential biological removal for this species at that time. But interim emergency management measures were not put into place until 2013, and these measures expired during 2014 (see the Criterion 3 Bycatch Strategy section) (FR 2013). Emergency management measures included closure of the fishery after a single sperm whale interaction, and 100% observer coverage in a specific Zone region (FR 2013a). The National Marine Fisheries Service has a proposed rule for a rolling, 2-year cap on sperm whale entanglements (two individuals) (FR 2016). The 2013 Biological Opinion indicates that the continued management of the fishery, combined with these new emergency management measures, was not likely to jeopardize the continued existence of sperm whale (among other species) (NOAA 2013) (NMFS 2013b). The most recent assessment (2014) supported this by indicating that the potential biological removal of 2.7 animals was not exceeded, and that this fishery only has an estimated removal of 1.3 animals per year (Carretta et al. 2014). Between 1990 and 2014, over 8,500 fishing sets were observed, representing approximately 15% of overall fishing effort. During these ≈8,500 observed sets, there were 6 fishing sets documented to entangle sperm whales, totaling 10 whales. The true number of sperm whale entanglements over the history of the observer program is unknown, but certainly greater than the number of observations. Six of these occurred before the required use of acoustic pingers (Carretta and Enriquez 2010). We have awarded a "high" concern and not critical concern score to take into account previous assessments that estimated the PBR was exceeded, while accounting for management measures.

Rationale:

According to the 2014 assessment, differences in abundance estimates from 2005 and 2008 could not be attributed to human-caused or natural population declines, and were more likely a factor of inter-annual variability in movement patterns. New information based on line-transect studies was included in this assessment, along with a longer time series (1991–2008), which was thought to provide annual abundance estimates with less inter-annual variability. Similar techniques have been used for fin and beaked whales in the California Current. The stock assessment indicated that sperm whale abundance ranged between 2,000 and 3,000 animals between 1991 and 2008 (CV = 0.58). An updated Potential Biological Removal (PBR) of 2.7 was calculated in this assessment (Carretta et al. 2014).

Factor 2.4 - Discard Rate

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

20-40%

The overall discard rate (number) in the drift gillnet fishery between 2010 and 2015 was 25% (http://www.pcouncil.org/wp-content/uploads/H3a_Att5_ACSF_MAR2015BB.pdf). Discard rates vary greatly by species. For example, less than 1% of swordfish were discarded, but 100% of ocean sunfish and blue sharks were returned to sea, with the majority being alive (PFMC 2015). We have awarded a 20%–40% discard rate to account for the overall discard rate of 25% between 2010 and 2015 (see Appendix for data) (PFMC 2015).

Criterion 3: Management Effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region / Method	Harvest Strategy	Bycatch Strategy	Score
California / East Pacific / Drift gillnets (driftnets)	3.000	3.000	Yellow (3.000)

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1: Harvest Strategy

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.'

- 5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered
- 4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'
- 3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'
- 2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective.'
- 1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective.'
- 0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.

Factor 3.1 Summary

FACTOR 3.1: MANAGEMENT OF FISHING IMPACTS ON RETAINED SPECIES							
Region / Method	**Strategy**	**Recovery**	**Research**	**Advice**	**Enforce**	**Track**	**Inclusion**
California / East Pacific / Drift gillnets (driftnets)	Moderately Effective	Moderately Effective	Moderately Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective

The Pacific Fishery Management Council manages highly migratory species (HMS), including swordfish and common thresher shark, in the U.S. Exclusive Economic Zone (EEZ) waters. Swordfish is currently managed under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species.

Subfactor 3.1.1 – Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderately Effective

Swordfish, tuna, sharks (including common thresher), and other pelagic species caught in the California drift gillnet fishery are managed by the Pacific Fishery Management Council (PFMC) under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species (PFMC 2016a). The National Marine Fisheries Service (NMFS) has approved this management plan. The only "main species" included in this report that are not managed under this plan are opah and ocean sunfish. Management measures specific to this fishery include a limited-entry permit system, mandatory gear standards, and time/area closures (see Detailed Rationale). Additional permits are required for fishing outside of state waters and within federal EEZ waters. The PFMC is working toward a federal limited-entry permit for this fishery (PFMC 2016). There are no U.S. domestic quotas in place for any species in this fishery, but there are harvest guidelines (an amount of harvest that is a general objective and, if exceeded, requires NMFS to take additional actions) for common thresher and shortfin mako sharks. There is also a tri-state management plan in place for thresher shark (California, Oregon, and Washington) (PFMC 2016a). International regulations, which include quotas, are in place for some species (PFMC 2011). The PFMC considers swordfish to be an "international exception" and has therefore not developed independent stock status reference points; instead, it relies on those used in assessments conducted by the Inter-American Tropical Tuna Commission (IATTC) (OPC 2013). The PFMC suggests that the drift gillnet fishery does not catch swordfish from the Eastern Pacific Ocean stock, which is undergoing overfishing, so no domestic management measures are currently needed (PFMC 2016b). Reference points and/or harvest control rules are not in place for other main species in this fishery (common thresher shark, shortfin mako shark, opah, and Pacific bluefin tuna). The Inter-American Tropical Tuna Commission (a Regional Fishery Management Organization) implemented a catch limit for Pacific bluefin tuna of 10,000 t between 2012 and 2013 (5,600 t in 2012 and 4,400 t in 2013), 5,000 t for 2014, and 6,600 t for 2015 and 2016 combined, for Pacific bluefin tuna caught in the Convention Area (IATTC 2012) (IATTC 2014). In addition, countries are to take measures to reduce the catch of Pacific bluefin tuna weighing less than 30 kg to under 50% of the total catch (IATTC 2014). The quota is not divided between individual countries, but the United States is a contracting party to IATTC and therefore must take measures to comply with this catch limit. In terms of Pacific bluefin tuna, management measures have so far failed to allow populations to recover, though there are recovery plans in progress with a greater than 50% chance of eventual success.

We have awarded a "moderately effective" score because harvest control rules are not in place for all species.

Rationale:

The following time/area restrictions are in place for the drift gillnet fishery to protect both target and bycatch species (PFMC 20111).

EEZ off California from February 1 to April 30
Portion of EEZ off California within 75 nm of coastline May 1 to August 14
Portion of EEZ off California within 25 nm of coastline from December 15 to January 31
In the portion of the EEZ bounded by a direct line connecting Dana Point, Church Rock on Catalina Island, and Point La Jolla in San Diego County, and the inner boundary of the EEZ from August 15 through September 30 each year.
In the portion of the EEZ within 12 nm of the nearest point on the mainland shore north to the Oregon border from a line extending due west from Point Arguello.
East of a line running from Point Reyes to Noonday Rock to the westernmost point of Southeast Farallon Island to Pillar Point. In the portion of the EEZ within 75 nm of the Oregon shoreline from May 1 through August 14, and within 1,000 nm the remainder of the year.
Off Washington
Channel Islands

Subfactor 3.1.2 – Recovery of Species of Concern

Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderately Effective

Pacific bluefin tuna is overfished. Fishing effort and catch limits were adopted after the 2012 assessment by the Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission (WCPFC) (IATTC 2012)(IATTC 2014) (ISCPBWG 2016) (WCPFC 2012a) (WCPFC 2015). According to projections conducted during the 2016 updated assessment, there is at least a 60% probability of achieving the initial target of SSB_{MED} by 2024 if all measures are continued in force and fully implemented. The probability of achieving this goal would be increased if additional management measures were adopted (ISCPBWG 2016). The California swordfish fishery does not have measures in place specifically to reduce bycatch of Pacific bluefin tuna, but catches are negligible in this fishery. No other target species are overfished and in need of a recovery plan. We have therefore awarded a "moderately effective" score.

Subfactor 3.1.3 – Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderately Effective

Stock assessments are conducted every 5 years for swordfish in this region and include information on catch and effort along with biological information. Common thresher shark was most recently assessed in 2016 (Teo 2016). Shortfin mako shark was assessed during 2015, but a comprehensive assessment could not be conducted because of a lack of data (ISC 2015). North Pacific blue shark has also been assessed (ISCSWG 2014). Albacore tuna is assessed every few years, as is Pacific bluefin tuna (ISCAWG 2014) (ISCPBWG 2014). Other species from the fishery included in this report have not been assessed; therefore, because of a lack of

information, we have only awarded a "moderately effective" and not highly effective score.

Subfactor 3.1.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Highly Effective

The Pacific Fishery Management Council produces annual Stock Assessment and Fishery Evaluation (SAFE) reports that are used to develop future catch limits for managed species (OPC 2013). In addition, the United States is a contracting party to the Inter-American Tropical Tuna Commission (IATTC), a Regional Fisheries Management Organization (RFMO) that provides scientific advice for international management measures. The United States generally abides by the accepted advice provided through the IATTC. For example, in 2013 and 2014, IATTC took into account scientific advice by setting a catch limit for Pacific bluefin tuna (ISCPBWG 2014) (IATTC 2013) (IATTC2014). We have awarded a "highly effective" score because the U.S. is proactive in committing to and complying with scientific advice.

Subfactor 3.1.5 – Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Highly Effective

State and federal agencies help with compliance and enforcement of management measures in U.S. waters (PFMC 2015). In state waters, the California Department of Fish and Wildlife is in charge; in federal waters, NOAA's Office of Law Enforcement is in charge. Logbooks are required in this fishery to record information on catch, effort, and catch disposition (PFMC 2015). Compliance with required permits is checked on an annual basis, with compliance being 90% (for all permits) during 2011. In addition, the U.S., as a contracting party to the Inter-American Tropical Tuna Commission, must report information on Pacific bluefin tuna catches weekly (IATTC 2013) and must provide catch and effort data for all tuna and tuna-like species to IATTC on a annual basis as well. We have awarded a "highly effective" score because management measures are enforced and compliance is high.

Subfactor 3.1.6 – Management Track Record

Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderately Effective

The Pacific Fishery Management Council produces annual Stock Assessment and Fishery Evaluation (SAFE) reports that are used to assess the effectiveness of previous management measures (OPC 2013). The

statuses of several species in this report are unknown, and Pacific bluefin tuna populations have failed to recover, although this fishery has little impact on the total stock (ISCPBWG 2014). We have therefore awarded a "moderately effective" score.

Subfactor 3.1.7 – Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent and includes stakeholder input.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Highly Effective

The Pacific Fishery Management Council is made up of federal and state organizations and representatives of stakeholders. The entire council process is open to the public and encourages public participation (OPC 2013). Stakeholder inclusion is rated "highly effective."

Factor 3.2: Bycatch Strategy

SCORING GUIDELINES

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.' Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these rating are the same as in 3.1.

- 5 (Very Low Concern)—Rated as 'highly effective' for all four subfactors considered
- 4 (Low Concern)—Management Strategy rated 'highly effective' and all other subfactors rated at least 'moderately effective.'
- 3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'
- 2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy but some other factors rated 'ineffective.'
- 1 (Very High Concern)—Management exists, but Management Strategy rated 'ineffective.'
- 0 (Critical)—No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substatntially impacted by the fishery

FACTOR 3.2: BYCATCH STRATEGY

Region / Method	All Kept	Critical	Strategy	Research	Advice	Enforce
California / East Pacific / Drift gillnets (driftnets)	No	No	Moderately Effective	Highly Effective	Highly Effective	Highly Effective

A number of management measures have been put into place to reduce bycatch interactions in this fishery. The target species also appear to be managed adequately.

Subfactor 3.2.2 – Management Strategy and Implementation

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery

on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderately Effective

The main bycatch taxa are sea turtles, ocean sunfish, opah, Pacific bluefin tuna, blue shark, and sperm whale (see Criterion 2). Specific measures in place to mitigate mortality of these species are discussed below. Overall, we have awarded a "moderately effective" score because this fishery has implemented management plans to reduce the interaction of vulnerable species such as sea turtles, but the plans have not been proved to be 100% effective, and a number of species (sharks, marine mammals, and sea turtles) are incidentally captured in this fishery.

Turtles
Sea turtles have additional protection through the U.S. Endangered Species Act (PFMC 2015b). Because of the incidental capture of leatherback and loggerhead sea turtles in this fishery, two Pacific sea turtle conservation areas were created in 2001 and include seasonal restrictions for the drift gillnet fishery. Drift gillnet fishing is prohibited in EEZ waters north of Point Conception, California to mid-Oregon from August 15 to November 15. In addition, there is a small closure south of Point Conception from June through August that is for protection of sea turtles during El Nino events (PFMC 2015). Since these closures have been put into place, there has been a 90% reduction in leatherback interactions and an 85% reduction in loggerhead interactions (NOAA 2015). Beginning in the 2016–17 fishing season, 2-year hard-cap limits (when observer coverage is under 75%) will be put into place for high-priority species including leatherback, loggerhead, olive ridley and green sea turtles (PFMC 2015b).

Sharks and other finfish
There are several species prohibited from capture off the U.S. West Coast, including great white shark, that could be incidentally captured in this fishery. Shark finning is prohibited. In addition, starting in 2016–17, there will be annual performance objectives in place for billfish (other than swordfish), prohibited sharks, hammerhead sharks, and manta rays—with an aim toward a 70% finfish retention rate (PFMC 2015b).

Marine Mammals
Bycatch mitigation measures, acoustic pingers, and net extenders are required to reduce incidental interactions with marine mammals (Carretta and Enriquez 2007). Cetacean bycatch is 50% lower in sets in which pingers are used (at least 30 pingers) (NOAA 2015). Historically (1990–1995), this fishery had interactions with several species of beaked whales but zero interactions have been observed since 1996 (NOAA 2015). In 2010, two sperm whales, an endangered species, were incidentally captured in this fishery, resulting in one death and one serious injury. This resulted in the implementation of several emergency management measures that were put into effect from August 15, 2013 through August 6, 2014. These measures included the closure of the fishery if a single sperm whale was killed or seriously injured and required all drift gillnet vessels to carry an observer in a region termed the "Zone," which encompasses the majority of areas in the U.S. EEZ with waters deeper than 1,100 fm (FR 2013a). These emergency measures expired and have yet to be extended; however, the most recent estimates indicate that bycatch is below potential biological removal (PBR). In addition, marine mammals are protected through the U.S. Marine Mammal Protection Act, including a marine mammal stock assessment program (PFMC 2015b). Marine mammals in this fishery have been protected by regulations specified in the Pacific Offshore Cetaceans Take Reduction Plan. This plan was one of the most successful in the country at reducing marine mammal bycatch to below PBR (McDonald et al. 2016b) (McDonald and Gallagher 2015).

Subfactor 3.2.3 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Highly Effective

Fisheries observers have been deployed on drift gillnet vessels in this fishery since 1990. The current observer coverage rate is 20% (PFMC 2015); however, the historical average is around 15% (Caretta and Barlow 2011), which may be too low to fully capture and understand the effects on rare species, such as sea turtles and marine mammals, caught as bycatch. New management measures will commence in this fishery during the 2016–17 fishing season. Included in these is a requirement to maintain 30% observer coverage at a minimum or to use electronic monitoring. The goal of the management measure is to have 100% monitoring by 2018. Exemptions for unobservable vessels (i.e., too small) will be removed under these new measures as well (PFMC 2015b). We have awarded a "highly effective" score because the fishery is taking action to improve monitoring of this fishery.

Subfactor 3.2.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Highly Effective

Marine mammals in this fishery have been protected by regulations specified in the Pacific Offshore Cetaceans Take Reduction Plan (POCTRP). This plan was created through consensus-based, multi-stakeholder negotiation (by the POC Take Reduction Team) that includes marine mammal researchers. The regulations created by these plans are based on the best and most recent scientific data about the marine mammals and the fishery. Prior to all Take Reduction Team meetings, the NMFS supplies members with dossiers of materials with the most recent scientific information about marine mammal stocks (abundance and distribution), fisheries interactions, compliance with and enforcement of the regulations, and results of gear testing experiments (McDonald et al. 2016a). Moreover, approximately one-third of the TRT in-person meetings is devoted to educating and informing members about the most up-to-date information and answering questions about the latest research (McDonald et al. 2016a). Between meetings, the NMFS hosts webinars to keep team members current on the effectiveness of the plan and the most recent data. The POCTRP is one of the most successful in the country at reducing marine mammal bycatch to below PBR (McDonald et al. 2016b) (McDonald and Gallagher 2015). Much of its success can be attributed to high compliance with the requirement to implement acoustic deterrence devices, or pingers, as well as other gear modifications and area closures (Carretta and Barlow 2011) (McDonald et al. 2016b). By adhering to the POCTRP, this fishery is adhering to the best available scientific advice. Thus, Seafood Watch rates adherence to scientific advice as "highly effective."

Subfactor 3.2.5 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management

regulations and what is the level of fishermen's compliance with regulations? To achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Highly Effective

The National Marine Fisheries Service enforced the loggerhead closure in 2015 based on an El Nino event (FR 2015b). A closure was also put into place during 2014 after the working group determined that El Nino conditions were present off the coast of southern California and that loggerhead sea turtles were present in the closure area (FR 2014). The loggerhead closure is mandated to occur during El Nino years (PFMC 2011). During 2013, vessel monitoring systems (VMS) were required to monitor the fishery in response to sperm whale interactions, and observer coverage was increased (FR 2013). Marine mammal and sea turtle species that may be encountered in this fishery are federally protected through the Endangered Species Act and the Marine Mammal Protection Act (PFMC 2013b).

Criterion 4: Impacts on the habitat and ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
California / East Pacific / Drift gillnets (driftnets)	5.00: None	0.00: Not Applicable	3.00: Moderate Concern	Green (3.873)

Drift gillnet fishing gear does not come into contact with the ocean bottom, and management councils on the U.S. West Coast have been proactive in developing and implementing ecosystem-based fishery management plans.

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

- 5 (None) - Fishing gear does not contact the bottom
- 4 (Very Low) - Vertical line gear
- 3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (
- 2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand
- 1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)
- 0 (Very High)—Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)
  Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Mitigation of Gear Impacts

- +1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.
- +0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.
- +0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced
- 0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats

Factor 4.3 - Ecosystem-Based Fisheries Management

- 5 (Very Low Concern)—Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators)
- 4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.
- 3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not place to mitigate these impacts
- 2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.
- 1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

None

The drift gillnet fishing gear used in this fishery is fished at the ocean surface, or slightly below (fishery requires 6 fathom suspender lines), so it does not come into contact with bottom habitats (PFMC 2015). But lost fishing gear could lead to ghost fishing (NOAA 2015b). Drift gillnets may be lost at sea because of storms or other events and may eventually reach bottom habitats; the impact of this potential concern is not known for this fishery, but ghost fishing from gillnets lost in this fishery are not suggested to be a major mortality issue for any species. But Seafood Watch considers ghost fishing mortality (when it is a concern) under Criterion 2 (bycatch mortality). This fishery is rated as having no concern with gear impacts on the substrate because the gear does not contact bottom habitats.

Factor 4.2 - Mitigation of Gear Impacts

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Not Applicable

Factor 4.3 - Ecosystem-Based Fisheries Management

CALIFORNIA / EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

This fishery catches shark and tuna species that are considered exceptional species because they are top level predators. The Pacific Fishery Management Council has developed a Pacific Coast Fishery Ecosystem Plan to enhance their current species-specific management with broader ecosystem components. The Council identified a number of issues that this plan will aid with, including improvements in management decisions, developing safeguards to buffer against uncertainties, informing fishery management measures, coordinating information, and setting priorities for research needs. The specific objectives of the plan include describing key oceanographic features, identifying ways to inform reference points, addressing gaps in the current ecosystem knowledge, and evaluating spatial management of populations within the management framework. The draft was adopted in April of 2013 and will be reviewed again in 2015 (PFMC 2013). The Pacific Fishery Management Council and NMFS have made efforts to better understand the California Current (Kaplan et al. 2012) (Field et al. 2001) (NMFS 2014b). We have awarded a "moderate" concern score because an ecosystem plan has just been put into place but its success is yet unknown. In addition, it has not yet resulted in different measures affecting the fishery, which captures a number of top predators.

Acknowledgements

Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

Seafood Watch would like to the consulting researcher and author of this report, Alexia Morgan, as well as Elizabeth Babcock from University of Miami, Emiliano Garcia from CICESE - Ecología y Pesquerías de la Zona Costera Carretera Ensenada, Stephen Stohs from NMFS's Southwest Fishereies Science Center, and eight anonymous reviewers for graciously reviewing this report for scientific accuracy.

References

Aurioles, D. & Trillmich, F. (IUCN SSC Pinniped Specialist Group) 2008. Zalophus californianus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1. <www.iucnredlist.org>.

Barlow, J. and Cameron, G.A. 2003. Field experiments show that acoustic pingers reduce marine mammal bycatch in the California drift gillnet fishery. Marine Mammal Science 19:265-283.

Brodziak, J. and Ishimura, G. 2010. Stock assessment of North Pacific swordfish (Xiphias gladius) in 2009. Pacific Islands Fisheries Science Center Administrative Report H-10-01. 43 p.

C. Sepulveda. 2015. Personnel Communication.

Long-term effectiveness, failure rates, and "dinner bell" properties of acoustic pingers in a gillnet fishery. Marine Technology Society Journal 45:7–19.

Carretta, J.V. and Barlow, J. 2011. Long-term effectiveness, failure rates and "dinner bell" properties of acoustic pingers in a gillnet fishery. Marine Technology Society Journal. Volume 45.

Carretta, J.V. and Enriquez, L. 2007. Marine mammal and sea turtle bycatch in the California/Oregon thresher shark and swordfish drift gillnet fishery in 2006. Southwest Fisheries Science Center Administrative Report LJ-07-06.

Carretta, J.V., Oleson, E., Weller, D.W. Lang, A.R. et al. (2013. US Pacific marine mammal stock assessments: 2012. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-504.

Carretta, J.V., Oleson, E., Weller, D.W., Lang, A.R. Forney, K.A. et al. 2014. US Pacific marine mammal draft stock assessments: 2014. NOAA-TM-NMFS-SWFSC-XXX.

Cheung, W.W.L., T.J. Pitcher and D. Pauly, 2005. A fuzzy logic expert system to estimate intrinsic extinction vulnerabilities of marine fishes to fishing. Biol. Conserv. 124:97-111.

A status snapshot of key shark species in the Western and Central Pacific and potential management options. Scientific Committee Seventh Regular Session, 9-17 August 2011, Pohnpei, Federated States of Micronesia. WCPFC-SC7-EB-WP-04. 37 p.

Collette, B., Fox, W., Juan Jorda, M., Nelson, R., Pollard, D., Suzuki, N. & Teo, S. 2014. Thunnus orientalis. The IUCN Red List of Threatened Species 2014: e.T170341A65166749

Estimating limit reference points for Western Pacific Leatherback Turtles (Dermochelys coriacea) in the U.S. West Coast EEZ. PLOS One 10(9): e0136452.

Field, J.C., Francis, R.T.C. and Strom, A. 2001. Toward a fisheries ecosystem plan for the Northern California Current. ColCOFI Report.

Fr. 2013b. List of Fisheries for 2013. 50 CFR Part 229. Federal Register Vol. 78 No. 168.

FR. 2013. Fisheries off west coast states; highly migratory fisheries; California drift gillnet fishery; sperm whale interaction restrictions. Federal Register 78 FR 54547.

FR. 2014. Fisheries off west coast states; the Highly Migratory Species Fishery; closure. Federal Register 79 FR

43268

FR. 2015. Endangered and threatened wildlife; 90-day finding on a petition to list the common thresher shark as Threatened or Endangered under the Endangered Species Act. Federal Register 80 FR 11379.

FR. 2015b. Fisheries off west coast states: the Highly Migratory Species Fishery; closure. 50 CFR 660.

FR. 2016. Fisheries off west coast states; highly migratory fisheries; California drfit gillnet fishery; protected species hard caps for the California/Oregon large-mesh drift gllnet fishery. 50 CRF 660:2016-24780.

FR. 2013a. Fisheries off west coast states: highly migratory fisheries: California drift gillnet fishery; sperm whale interaction restrictions. 50 CFR Part 660. Federal Register Vol. 78, No. 171.

Goldman, K.J., Baum, J., Cailliet, G.M., Cortés, E., Kohin, S., Macías, D., Megalofonou, P., Perez, M., Soldo, A. & Trejo, T. 2009. Alopias vulpinus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1

Hyde, J.R., Underkoffler, K.W. and Sundberg, M.A. 2014. DNA barcoding provides support for a cryptic species complex within the globablly distributed and fishery important opah (Lampris guttatus). Molecular Ecology 14:1239-1247.

Inter-American Tropical Tuna Commission (IATTC). 2012. Conservation and Management Measures for bluefin tuna in the eastern Pacific Ocean. Resolution C-12-09, 83rd Meeting, La Jolla, CA, 25-29 June 2012.

Inter-American Tropical Tuna Commission (IATTC). 2013. Resolution C-13-02 measures for the conservation and management of bluefin tuna in the Eastern Pacific Ocean. 85th Meeting, Veracruz, Veracruz Mexico, 10-14 June 2013.

IATTC. 2014b. Tunas and billfishes in the eastern Pacific Ocean in 2013. Fishery status report No. 12. Inter-American Tropical Tuna Commission.

IATTC. 2014. Measures for the conservation and management of Pacific bluefin tuna in the eastern Pacific Ocean, 2015-2016. Resolution C-14-06.

ISC. 2014. North Pacific swordfish (Xiphias gladius) stock assessment in 2014. Report of the Billfish Working Group.

ISC. 2015. Indicator-based analysis of the status of shortfin mako sharks in the north Pacific Ocean WCPFC-SC11-2015/SA-WP-08.

ISCAWG. 2014. Stock assessment of albacore tuna in the North Pacific Ocean in 2014. International Scientific Committee for Tuna and Tuna-like species in the North Pacific Ocean. 16-21 July 2014 Taipei, Taiwan.

ISCPBWG. 2016. 2016 Pacific bluefin tuna stock assessment. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. Sapporo, Hokkaido, Japan 13-18, July 2016.

ISCSWG. 2014. Stock assessment and future projections of blue shark in the north Pacific Ocean; report of the shark working group. International Scientific Committee for Tuna Shark Working Group.

Kaplan, I.C., Holland, D.S., Taylor, I.G., Fresh, K.L and Levin, P.S. 2012. Management testing and scenarios in the California Current. CCIEA Phase II Report 2012: Management Testing and Scenarios (summary).

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

Evaluating the efficacy of environmental legislation: A case study from the US marine mammal Take Reduction Planning process. Global Ecology and Conservation 5: 1–11.

Participant perceptions of consensus-based, marine mammal take reduction planning. Marine Policy 61:216–226.

Comparing stakeholder perceptions with empirical outcomes from negotiated rulemaking policies: Is participant satisfaction a proxy for policy success? Marine Policy 73:224-230.

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

National Marine Fisheries Service (NMFS). 2010. Highly migratory species management team report on Fishery Management Plan Amendment 2, annual catch limits and accountability measures. Supplement HMSMT Report June 2010.

NMFS. 2011. NMFS California/Oregon drift gillnet fishery observer program observed catch 2014/15 fishing season. National Marine Fisheries Service.

NMFS. 2012. NMFS California/Oregon drift gillnet observer program observed catch - 2011/2012 fishing season. National Marine Fisheries Service.

NMFS. 2013a. NMFS California/Oregon drift gillnet observer program. Observed catch -2012/13 fishing season. National Marine Fisheries Service.

NMFS. 2013b. Leatherback sea turtle (Dermochelys coriacea) 5-year review: summary and evaluation. National Marine Fisheries Service.

NMFS. 2013c. Biological report on the designation of marine critical habitat for the loggerhead sea turtle, Caretta caretta. National Marine Fisheries Service.

NMFS. 2013d. Draft Marine Mammal Protection Act l01(a)(5)(E) Negligible Impact Determination. National Marine Fisheries Service, Southwest Regional Office. Long Beach, CA. March, 2013

NMFS. 2014. Commercial fisheries statistics: annual trade data by product, country/association. National Marine Fisheries Service.

NMFS. 2014b. Atlantic model for the California Current; Report of methodology review panel meeting. National Marine Fisheries Service.

NMFS. 2015. NMFS California/Oregon drift gillnet observer program. Observed catch - 2014/15 fishing season. National Marine Fisheries Service.

NMFS. 2015b. National Marine Fisheries Service 2nd quater 2015 update: summary of stock status for FSSI stocks. National Marine Fisheries Service.

NMFS. 2015c. NMFS California/Oregon drift gillnet observer program observed catch - 2014/2015 fishing season. National Marine Fisheries Service.

NMFS. 2015d. Common thresher shark (Alopias vulpinus) Fact Sheet. NOAA Fisheries Service, Southwest Fisheries Science Center.

NMFS. 2016. NMFS California/Oregon drift gillnet observer program observed catch 2015-2016 fishing season. National Marine Fisheries Service.

NMFS. 2016b. 3rd Quarter 2016 update summary of stock status for FSSi stocks. National Marine Fisheries Service.

NOAA. 2013. Biological Opinion on the continued management of the drift gillnet fishery under the Fishery Management Plan for US West Coast Fisheries for Highly Migratory Species. NOAA Fisheries 2012/03020:DDL.

NOAA. 2015. California drift gillnet fishery management success with implications for seafood imports. National Oceanic and Atmospheric Administration.

NOAA. 2015b. Impact of "ghost fishing" via derelict fishing gear. National Oceanic and Atmospheric Administration.

NOAA. 2016. Observer program data summaries and reports. NOAA West Coast Region.

OPR. 2013. Sperm whales (Physeter macrocephalus). NOAA Fisheries Office of Protected Resources.

California Ocean Science Trust (OST). 2013. Rapid assessments for selected California fisheries. California Ocean Science Trust, Oakland, CA.

PFMC (2010) Status of the U.S. West Coast Fisheries for Highly Migratory Species Through 2009. www.pcouncil.org/wp-content/uploads/10_HMS_SAFE_FINAL_100831.pdf

PFMC. 2011. Fishery management plan for US west coast fisheries for highly migratory species. Pacific Fishery Management Council.

PFMC. 2015b. California large mesh drift gillnet fishery management final preferred alternatives. Pacific Fishery Management Council.

PFMC. 2016a. Fishery Management plan for US West Coast Fisheries for Highly Migratory Species. Pacific Fisheries Management Council, March 2016.

PFMC. 2016. Decision summary document. Pacific Fishery Management Council, November 16-21, 2016.

PFMC. 2016b. Decision summary document. Pacific Fisher Management Council, June 23-28, 2016.

Pacific Fishery Management Council (PFMC). 2013. Pacific coast Fishery Ecosystem Plan for the US portion of the California current large marine ecosystem public review draft. Pacific Fishery Management Council, Portland, OR.

Pacific Fishery Management Council (PFMC). 2013b. Stock Assessment and Fishery Evaluation (SAFE) documents: current HMS SAFE report. Pacific Fishery Management Council, Portland, OR.

Pacific Fishery Management Council (PFMC). 2014. Status of the US west coast fisheries for highly migratory species through 2014. Pacific Fishery Management Council.

PIFSC. 2014. International team launches research on pelagic sharks in the North Pacific Ocean. NOAA Pacific Islands Fisheries Science Center Quarterly Research Bulletin, June 2011.

Seafood Watch. 2013. Seafood Watch criteria for fisheries. Monterey Bay Aquarium Seafood Watch Version January 18, 2013. 82 p.

Smith, S.E., Au, D.W. and Show, C. 2008. intrinsic rates of increase in pelagic elasmobranchs. In: Sharks of the open ocean: biology, fisheries and conservation (eds. Camhi, M., Pikitch, E.K. and Babcok, S.A.). Pg.s 288-297.

Tapilatu, R.F., P.H. Dutton, M.Tiwari, T. Wibbels, H.V. Ferdinandus, W.G. Iwanggin, and B.H. Nugroho. 2013. Long-term decline of the western Pacific leatherback, Dermochelys coriacea, a globally important sea turtle population. Ecosphere 4(2):Article 25.

Taylor, B.L., Baird, R., Barlow, J., Dawson, S.M., Ford, J., Mead, J.G., Notarbartolo di Sciara, G., Wade, P. & Pitman, R.L. 2008. Physeter macrocephalus. The IUCN Red List of Threatened Species. Version 2014.1.

Teo, S.L.H., Rodriguez, E.G. and Sosa-Nishizaki, O. 2016. Status of common thresher sharks, Alopias vulpinus, along the west coat of North America. NOAA Technical Memorandum 557. Available at: https://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-557.pdf

Teo, S.L.H. 2016. Status of common thresher sharks, Alopias vulpinus, along the west coast of North America. NOAA Technical Memorandum 557. Available at: https://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-557.pdf

Teo, S.L.H., 2016. Status of common thresher sharks, Alopias bulpinus, along the west coast of North America. NOAA-TM-NMFS-SWFSC-557.

Thys, T.M., Ryan, J.P., Dewar, H., Perle, C.R., Lyons, K. et al. 2015. Ecology of the ocean sunfish, Mola mola, in the southern California Current System. Journal of Experimental Marine Biology and Ecology 471:64-76.

Western and Central Pacific Fisheries Commission (WCPFC). 2008. Conservation and management of sea turtles. Conservation and Management Measure 2008-03. Fifth Regular Session, 8-12 December 2008, Busan, Korea.

Weigmann, S., 2016. Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity. Journal of Fish Biology (2016):1-201.

Appendix A: Extra By Catch Species

OCEAN SUNFISH

Factor 2.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

FishBase assigned a very high vulnerability of 82 (Cheung et al. 2005). Ocean sunfish reaches sexual maturity around 155 cm in length. It attains a maximum length of 330 cm, but the maximum age is unknown. It is a broadcast spawner and high level predator (Froese and Pauly 2013). These life history characteristics also suggest a high vulnerability to fishing based on the productivity and susceptibility table (1.75).

Rationale:

Life history characteristic	Value	Score
Average size at sexual maturity	155	2
Maximum length	330	1
Reproductive strategy	Broadcast spawner	3
Trophic level	> 3.25	1

Factor 2.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High Concern

Ocean sunfish populations have not been assessed in the Eastern Pacific Ocean, either through a formal assessment or by the International Union for the Conservation of Nature. We have awarded a "high" concern score because of the lack of information and the high vulnerability score.

Factor 2.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

Fishing mortality rates for ocean sunfish are not available. There are no targeted fisheries for this species in the Eastern Pacific Ocean, but it does make up a large percentage of the total catch in this fishery—as much as 30% in recent years (PFMC 2015). The majority are released alive, but the post-release mortality rates are unknown in this fishery (PFMC 2013b)(Thys et al. 2015). Under the current management plan, ocean sunfish is not considered to be "in the fishery" but managers are to consider ways to reduce bycatch of them. Currently, there are no management measures in place for ocean sunfish. We have awarded a "moderate" concern score because information on fishing mortality rates is unknown.

Factor 2.4 - Discard Rate

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

20-40%

The overall discard rate (number) in the drift gillnet fishery between 2010 and 2015 was 25%

(http://www.pcouncil.org/wp-content/uploads/H3a_Att5_ACSF_MAR2015BB.pdf). Discard rates vary greatly by species. For example, less than 1% of swordfish were discarded, but 100% of ocean sunfish and blue sharks were returned to sea, with the majority being alive (PFMC 2015). We have awarded a 20%–40% discard rate to account for the overall discard rate of 25% between 2010 and 2015 (see Appendix for data) (PFMC 2015).

LEATHERBACK TURTLE

Factor 2.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

Sea turtles have a high level of vulnerability due to their life history characteristics that include a long life, late age at maturity, and low reproductive output (Seafood Watch 2013).

Factor 2.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very High Concern

Leatherback sea turtle has been listed as Endangered under the U.S. Endangered Species Act (ESA) since 1970 (NMFS 2012). The International Union for the Conservation of Nature (IUCN) classified leatherback turtles as "Critically Endangered" with a decreasing population trend in 2000 (Martinez 2000). Leatherback turtle has been listed on CITES since 1975 and is currently listed on Appendix I, meaning that it is threatened with extinction and that international trade is prohibited. Over the past 25 years, the population of leatherbacks in the Pacific Ocean has decreased significantly (Spotila et al. 1996). Recent estimates from the Pacific Ocean suggest a population size of 294,068 turtles, and out of these, 6,199 are adults (Jones et al. 2012). Tapilatu et al. (2013) found a decline in nesting at the primary western Pacific beaches of 5.9% per year since 1984 (Tapilatu et al. 2013). We have awarded a score of "very high" concern based on the ESA, IUCN, and CITES listings.

Factor 2.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

Fishing mortality is thought to be a major threat to leatherback turtles, especially for juveniles and adults that can be incidentally captured in fisheries along their migration routes (Martinez 2000) (Zug and Parham 1996). But since 2001, interactions between the California drift gillnet fishery and leatherback turtles have been significantly reduced by the implementation of a large time/area closure (NMFS 2013b). Since 2010, only one observed interaction with a leatherback turtle occurred, and this was during the 2012–13 fishing season (NMFS 2013a). But observer coverage rates are 10%–40%, so actual interactions are higher than observed and may exceed one turtle per year. Although this seems like a low number, a quantitative analysis of the limit reference point (LRP) that would allow Pacific leatherback turtle to rebuild to maximum net productivity levels calculated that LRP to be less than one turtle per year (Curtis et al. 2015). Thus, it is possible that even the low levels of mortality caused by this fishery could be a contributing factor to preventing full rebuilding of the species. Beginning in the 2016–17 fishing season, 2-year hard cap limits (when observer coverage is under 75%) will be put into place for high-priority species, including leatherback, loggerhead, olive ridley, and green sea turtles (PFMC 2015b). In addition, the Pacific Leatherback Conservation Area, in place since 2001, has reduced leatherback interactions by about 90% (Martin et al. 2015). We have awarded a "moderate" concern

score because there is conflicting analysis on the risk that the fishery poses to leatherback sea turtle.

Factor 2.4 - Discard Rate

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

20-40%

The overall discard rate (number) in the drift gillnet fishery between 2010 and 2015 was 25% (http://www.pcouncil.org/wp-content/uploads/H3a_Att5_ACSF_MAR2015BB.pdf). Discard rates vary greatly by species. For example, less than 1% of swordfish were discarded, but 100% of ocean sunfish and blue sharks were returned to sea, with the majority being alive (PFMC 2015). We have awarded a 20%–40% discard rate to account for the overall discard rate of 25% between 2010 and 2015 (see Appendix for data) (PFMC 2015).

LOGGERHEAD TURTLE

Factor 2.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

Sea turtles have a high level of vulnerability due to their life history characteristics that include a long life, late age at maturity, and low reproductive output (Seafood Watch 2013).

Factor 2.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Very High Concern

The International Union for the Conservation of Nature (IUCN) classified loggerhead turtle as "Endangered" in 1996, although it has been suggested that this assessment needs to be updated (MTSG 2006). Loggerhead is listed on Appendix I of CITES. In the North Pacific Ocean, loggerhead has been listed as "Endangered" under the U.S. Endangered Species Act since 1978 (NMFS 2012). We have awarded a score of "very high" concern based on the IUCN, CITES, and ESA listings.

Factor 2.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Moderate Concern

The incidental capture of loggerhead turtle is considered a primary threat to its populations (MTSG 2006). Research has suggested that 67,000 loggerhead sea turtles were incidentally captured throughout the Pacific Ocean during 2000. Of these, 2,600 to 6,000 were killed by this incidental capture, and it is possible that its mortality threshold was exceeded (Lewison et al. 2004). But after management measures were put into place in 2001, these interactions within the Eastern Pacific Ocean and specifically along the U.S. West Coast have decreased and are now considered uncommon (PFMC 2012) (PFMC 2013b). Only one interaction with loggerhead has been observed in the California drift gillnet fishery since these regulations were put into place (NMFS 2013c). Because observer coverage is relatively high compared to other fisheries, we have awarded a "moderate" concern score, but there is still uncertainty in the actual number of sea turtle takes because they are rare events and because the population is depleted and continuing to decline.

Factor 2.4 - Discard Rate

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

20-40%

The overall discard rate (number) in the drift gillnet fishery between 2010 and 2015 was 25% (http://www.pcouncil.org/wp-content/uploads/H3a_Att5_ACSF_MAR2015BB.pdf). Discard rates vary greatly by species. For example, less than 1% of swordfish were discarded, but 100% of ocean sunfish and blue sharks were returned to sea, with the majority being alive (PFMC 2015). We have awarded a 20%–40% discard rate to account for the overall discard rate of 25% between 2010 and 2015 (see Appendix for data) (PFMC 2015).

BLUE SHARK

Factor 2.1 - Inherent Vulnerability

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

High

FishBase assigned a high to very high vulnerability score of 67 out of 100 (Froese and Pauly 2013). Blue shark reaches sexual maturity around 4–7 years of age, and reaches a maximum size and age of 380 cm and 16 years, respectively. Blue shark gives birth to live pups every 1–2 years (ISCSWG 2014). Although the life history characteristics of this species may lend more to a medium ranking, because the stock status is known and the inherent vulnerability does not affect the overall score as a result, we have left it as "high" vulnerability.

Factor 2.2 - Abundance

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Low Concern

There are two populations of blue shark in the Pacific: North and South Pacific. An updated assessment of blue shark in the North Pacific was completed during 2014. Two different models were used in the assessment. The base case results of the two models indicated that the population (biomass (B) and spawning stock biomass (SSB)) of blue shark is not overfished (B/B = 1.65 and SSB/SSB = 1.621) and that the population will remain above the level necessary to maintain the maximum sustainable yield (B) in the future (ISCSWG 2014). Other evidence, including declines in median size and catch rates, suggests declines in abundance of blue shark in recent years (Clarke 2011), and there is uncertainty in the assessment of blue shark. We have therefore awarded a “low” concern rather than very low concern score.

Factor 2.3 - Fishing Mortality

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

Low Concern

Blue shark is widely distributed throughout the North Pacific (a single population in the North Pacific) and dominates shark catches in that region. According to the 2014 updated assessment, the fishing mortality rate estimated in 2011 (F_{2011}) was around 34% of that needed to produce the maximum sustainable yield (F_{MSY}) (ISCSWG 2014). Therefore, overfishing is not occurring. But there is uncertainty surrounding these results, and previous assessments have indicated some issues with the data (e.g., unreported and underreported catch and effort data, along with size information). We have therefore awarded a “low” concern instead of

very low concern score.

Factor 2.4 - Discard Rate

CALIFORNIA/EAST PACIFIC, DRIFT GILLNETS (DRIFTNETS)

20-40%

The overall discard rate (number) in the drift gillnet fishery between 2010 and 2015 was 25% (http://www.pcouncil.org/wp-content/uploads/H3a_Att5_ACSF_MAR2015BB.pdf). Discard rates vary greatly by species. For example, less than 1% of swordfish were discarded, but 100% of ocean sunfish and blue sharks were returned to sea, with the majority being alive (PFMC 2015). We have awarded a 20%–40% discard rate to account for the overall discard rate of 25% between 2010 and 2015 (see Appendix for data) (PFMC 2015).

Appendix B: Discard rate

	Average of Number Kept	Average of Catch per 100 Sets	Average of Number kept per 100 sets	Average of Number discarded dead, unknown or damaged per 100 sets
Target				
Swordfish	189	148	146	5
Common Thresher Shark	90	105	96	6
Other retained				
Shortfin Mako Shark	143	120	115	3
Albacore	130	109	106	12
Bluefin Tuna	101	95	88	17
Yellowfin Tuna	1	1	1	0
Other bycatch				
Opah	124	135	133	8
Pacific Pomfret	32	55	49	5
Skipjack Tuna	19	28	16	13
Louvar	16	16	15	1
Bullet Mackerel	26	37	15	22
Pacifc Bonito	16	9	8	1
Unidentified Tuna	9	10	8	2
Pacific Mackerel	5	30	7	22
Pacific Bonito	5	6	6	1
Jack Mackerel	2	4	3	1
Spiny Dogfish	1	1	1	0
Unidentified Invertebrate	0	2	0	2
Common Mola	0	617	0	17
Jumbo (Humboldt) Squid	0	4	0	2
Bay Pipefish	0	1	0	0

Slender Mola	0	4	0	0
Oarfish	0	1	0	1
Striped Marlin	0	2	0	2
Oilfish	0	1	0	1
Unidentified Rockfish	0	2	0	0
Pelagic Stingray	0	2	0	0
Remora	0	1	0	0
Pacific Electric Ray	0	3	0	1
Other sharks				
Bigeye Thresher Shark	1	4	2	2
Soupfin Shark	1	1	1	0
Pelagic Thresher Shark	1	2	1	1
Salmon Shark	0	7	0	6
Megamouth Shark	0	2	0	0
Smooth Hammerhead Shark	0	12	0	10
Blue Shark	0	63	0	43
Sevengill Shark	0	1	0	1
Turtle				
Leatherback Sea Turtle	0	1	0	0
Marine Mammal				
Northern Right Whale Dolphin	0	2	0	2
Sperm Whale	0	4	0	2
Short Beak Common Dolphin	0	4	0	4
California Sea Lion	0	8	0	7
Northern Elephant Seal	0	1	0	1
Dall's Porpoise	0	1	0	1
Risso's Dolphin	0	1	0	1
Gray Whale	0	1	0	1
Shortfin Pilot Whale	0	1	0	1
Long Beak Common Dolphin	0	2	0	2

Bottlenose Dolphin	0	2	0	2		
Minke Whale	0	1	0	0		
Grand Total	34	61	30	7		
	913			233	discard rate	0.25497