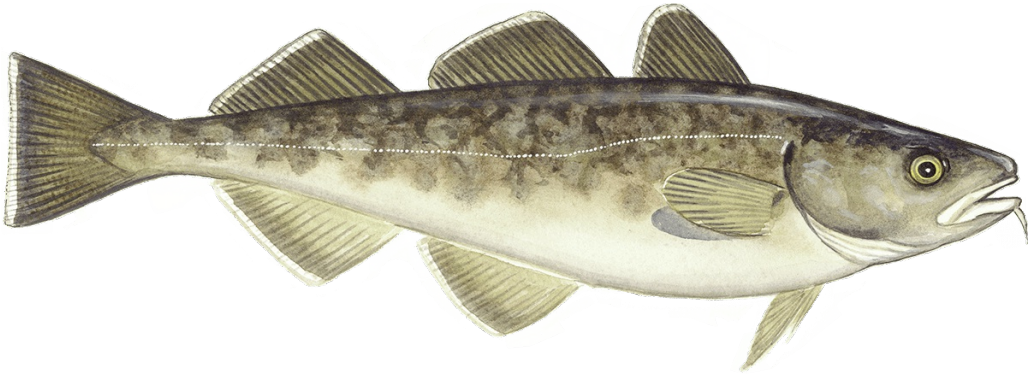
Monterey Bay Aquarium Seafood Watch®

Groundfish



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Alaska: Gulf of Alaska and Bering Sea

Bottom trawls, Set longlines, Pots

April 1, 2019

Seafood Watch Consulting Researcher

Seafood Watch Standard used in this assessment: Standard for Fisheries vF3

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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 Watch Assessment. Each assessment 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." This ethic is operationalized in the Seafood Watch standards, available on our website here. In producing the assessments, 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 assessments 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 Watch assessments in any way they find useful.

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.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard. 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 review addresses the major commercial groundfish species caught in federally-managed groundfish fisheries off the coast of Alaska, in the Gulf of Alaska (GOA), and the Bering Sea Aleutian Islands (BSAI) management regions including: sablefish, atka mackerel, Greenland turbot, flathead sole, kamchatka and arrowtooth flounder, Pacific cod, Pacific Ocean Perch, and shortspine thornyhead, shotraker, blackspotted, rougheye, yelloweye, northern, and light dusky rockfish.

Federal Alaskan groundfish fisheries are managed by the North Pacific Fishery Management Council (NPFMC). Population assessments are conducted and reviewed by the NPFMC on an annual or biennial schedule. Fishery dependent and fishery-independent data inform stock assessments for the main species reviewed in this report. In general, the predominance of "green" ratings confirms that most of the stocks are healthy, and there is extant up-to-date, publicly-available information for these stocks.

Criterion 1 scores are informed by stock status or biomass trends and fishing mortality, and the majority of reviewed species are at or above scientifically determined management reference points. One notable exception is the decline in stock status for Pacific cod. Retrospective analyses suggest that fishing mortality levels may have exceeded target reference points in previous years in the BSAI. Warming ocean temperatures in Alaska will continue to pose challenges to Alaska groundfish stock sustainability and management.

Bycatch rates vary significantly across fisheries; however, the majority of fisheries scored "green" or "yellow" for impacted bycatch species and discard ratios. BSAI longline fishery interactions with endangered species short-tailed albatross (Greenland turbot), Steller sea lions (sablefish), and sperm whales (sablefish) influenced "red" scores for Criterion 2 for these fisheries. Greenland turbot and sablefish longline fisheries in the BSAI also catch a significant amount of giant (rattail) grenadier relative to target landings.

All fisheries reviewed scored well or "green" under Criterion 3 or "management effectiveness." Regulations are in place to evaluate stock status and fishing effort, to reduce bycatch rates, and to ensure that ongoing monitoring and compliance for fishing fleets are in place. Nearly all vessels involved with Alaska federal groundfish experience either partial or full observer coverage, and landings data are tracked electronically so that management agencies can adaptively respond in-season.

By their nature groundfish tend to be demersal species, and the fisheries that target them correspondingly use bottom-tending gears. As such, the potential for habitat disturbance is present for all of the gears reviewed including trawl, longline, and pot gear. Management efforts to reduce negative impacts to benthic habitat include Essential Fish Habitat and Habitat Areas of Particular Concern designations, area closures, gear modifications, etc. All fisheries reviewed received a "green" score for Criterion 3 except for BSAI trawl fisheries occurring over rocky or hard substrates (rockfish, atka mackerel).

All fisheries reviewed received "best choice" rating overall, with the exception of longline sablefish and longline shortspine thornyhead, yelloweye and rougheye rockfish, trawled shortraker rockfish, and BSAI longline Greenland turbot, which all received a "good alternative" rating.

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
Pacific cod Alaska Gulf of Alaska, Bottom trawls, United States of America, Pacific cod trawl	Yellow (2.644)	Yellow (2.236)	Green (5.000)	Green (3.873)	**Best Choice (3.271)**
Pacific cod Alaska Gulf of Alaska, Set longlines, United States of America, Pacific cod longline	Yellow (2.644)	Yellow (2.236)	Green (5.000)	Green (4.472)	**Best Choice (3.390)**
Pacific cod Alaska Bering Sea, Bottom trawls, United States of America, Pacific cod trawl	Green (3.318)	Yellow (2.236)	Green (5.000)	Green (3.873)	**Best Choice (3.462)**
Pacific cod Alaska Bering Sea, Set longlines, United States of America, Pacific cod longline	Green (3.318)	Yellow (2.236)	Green (5.000)	Green (4.472)	**Best Choice (3.588)**
Pacific cod Alaska Gulf of Alaska, Pots, United States of America, Pacific cod pot	Yellow (2.644)	Green (5.000)	Green (4.000)	Green (4.472)	**Best Choice (3.921)**
Greenland turbot Alaska Bering Sea, Set longlines, United States of America, Greenland turbot longline	Green (4.284)	Red (1.677)	Green (5.000)	Green (4.472)	**Good Alternative (3.560)**
Pacific cod Alaska Bering Sea, Pots, United States of America, Pacific cod pot	Green (3.318)	Green (3.413)	Green (4.000)	Green (4.472)	**Best Choice (3.772)**
Shortspine thornyhead Alaska, Set longlines, United States of America, Sablefish longline	Green (3.413)	Red (1.677)	Green (5.000)	Green (4.472)	**Good Alternative (3.363)**

Sablefish Alaska, Set longlines, United States of America, Sablefish longline	Green (5.000)	Red (1.677)	Green (5.000)	Green (4.472)	**Good Alternative (3.700)**
Sablefish Alaska, Pots, United States of America, Sablefish pot	Green (5.000)	Green (5.000)	Green (4.000)	Green (4.472)	**Best Choice (4.598)**
Northern rockfish Alaska Bering Sea, Bottom trawls, United States of America, Atka mackerel trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**
Pacific Ocean perch Alaska Bering Sea, Bottom trawls, United States of America, Atka mackerel trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**
Atka mackerel Alaska Bering Sea, Bottom trawls, United States of America, Atka mackerel trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**
Pacific Ocean perch Alaska Bering Sea, Bottom trawls, United States of America, Rockfish trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**
Pacific Ocean perch Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**
Northern rockfish Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**

Light dusky rockfish Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Green (5.000)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.646)**
Shortspine thornyhead Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Green (3.413)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.314)**
Shortraker rockfish Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Yellow (2.236)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Good Alternative (2.981)**
Shortraker rockfish Alaska Bering Sea, Bottom trawls, United States of America, Rockfish trawl	Yellow (2.236)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Good Alternative (2.981)**
Rougheye rockfish Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Green (3.413)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.314)**
Blackspotted rockfish Alaska Gulf of Alaska, Bottom trawls, United States of America, Rockfish trawl	Green (3.413)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.314)**
Blackspotted rockfish Alaska Bering Sea, Bottom trawls, United States of America, Rockfish trawl	Green (3.413)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.314)**
Rougheye rockfish Alaska Bering Sea, Bottom trawls, United States of America, Rockfish trawl	Green (3.413)	Yellow (2.236)	Green (5.000)	Yellow (3.162)	**Best Choice (3.314)**

Yelloweye rockfish Alaska, Set longlines, United States of America, Sablefish longline	Yellow (2.236)	Red (1.677)	Green (5.000)	Green (4.472)	**Good Alternative (3.026)**
Rougheye rockfish Alaska, Set longlines, United States of America, Sablefish longline	Green (3.413)	Red (1.677)	Green (5.000)	Green (4.472)	**Good Alternative (3.363)**
Yelloweye rockfish Alaska Gulf of Alaska, Set longlines, United States of America, Pacific cod longline	Yellow (2.236)	Yellow (2.236)	Green (5.000)	Green (4.472)	**Best Choice (3.251)**
Greenland turbot Alaska Bering Sea, Bottom trawls, United States of America, Greenland turbot trawl	Green (4.284)	Green (5.000)	Green (5.000)	Green (3.873)	**Best Choice (4.512)**
Arrowtooth flounder Alaska Bering Sea, Bottom trawls, United States of America, Greenland turbot trawl	Green (5.000)	Green (4.284)	Green (5.000)	Green (3.873)	**Best Choice (4.512)**
Kamchatka flounder Alaska Bering Sea, Bottom trawls, United States of America, Greenland turbot trawl	Green (5.000)	Green (4.284)	Green (5.000)	Green (3.873)	**Best Choice (4.512)**
Flathead sole Alaska Bering Sea, Bottom trawls, United States of America, Greenland turbot trawl	Green (5.000)	Green (4.284)	Green (5.000)	Green (3.873)	**Best Choice (4.512)**

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 Concern2, 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.

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[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 analysis encompasses the major commercial groundfish species caught in federally-managed groundfish fisheries off the coast of Alaska, with the exception of Marine Stewardship Council (MSC) certified pollock and flatfish complex. The Pacific cod fishery is also MSC-certified; however, Pacific cod is included in this report due to GOA stock abundance declines in 2017 and 2018.

Alaskan groundfish fisheries target a variety of species. A species was included in this review if the catch of the species in a given fishery composed >5% of that fishery's catch, or >20% species' total mortality across all fisheries (and >10 t catch). Species of concern such as Prohibited Species Catch (PSC), seabirds, sharks, and marine mammals were also included where appropriate.

Groundfish catch is managed with stock, species group, or complex-specific Total Allowable Catches (TACs). A TAC is derived from, and is less than or equal to, the Acceptable Biological Catch (ABC). The maximum ABC, in turn, is less than the estimated Overfishing Limit (OFL) for the stock, species group, or complex. The OFL defines the maximum annual catch beyond which overfishing is said to be occurring.

A tier system is used to determine the annual catch limits for commercial groundfish species in Alaska. Each stock is assigned to one of six possible tiers, generally with the most information-rich stocks in Tier 1 and the most information-poor stocks in Tier 6. Tier 3 is the most commonly-used tier for the stocks addressed in this assessment, with the exception of a few rockfish, shark, and skate complexes (typically Tier 5).

Stocks managed under Tier 3 have OFLs and ABCs derived from stock-specific estimates of biomass (B), the fishing mortality rate (F) estimated to result in 40% of the equilibrium level of spawning per recruit that would occur in the absence of fishing ($F_{40\%}$). For Tier 3 stocks, the Maximum Sustainable Yield (MSY) level is defined as $SB_{35\%}$ (NPFMC 2017), and this term will be used throughout the review as a target reference point for Tier 3 species. Tier 5 stocks are those for which reliable estimates of B and natural mortality (M) exist, but $F_{40\%}$ and $F_{35\%}$ do not. Tier 5 stocks are therefore managed with Overfishing Limits (OFLs) and ABCs that are derived from B and M such that $F_{OFL} = M$, and $maxF_{ABC} = 0.75*M$ (NPFMC 2017).

Species Overview

Species

There are twelve primary fisheries (described below) reviewed in this assessment:

Alaska sablefish: Mature sablefish in Alaska are typically found at depths >200 m along the upper continental slope (Hanselman et al. 2017). Sablefish are primarily targeted using longline and pot fishing gear (to a much lesser extent). The sablefish fishery in Alaska is the only federal fishery managed statewide, since stock structure and movement data suggest there is only one stock in Alaska. TACs and quotas are, however, allocated by gear type and region. Longline landings in the GOA constitute the majority sablefish catch. Pot fishing gear for sablefish was legalized in the GOA in 2015. Although the volume of sablefish catch is moderate (2013 to 2017 average 8,972 t for longline, 517 t pot), the value of sablefish per pound is quite high, and it is one of the most lucrative fisheries in Alaska.

BSAI Atka mackerel trawl: The Atka mackerel trawl fishery refers to the sub-section of the Amendment 80 trawl fleet that targets Atka mackerel with bottom trawl gear designed to access rough substrates (Lowe et al. 2017). Atka mackerel are a substrate-spawning fish with male parental care (Lowe et al. 2017). The Atka mackerel fishery occurs only in the BSAI management area. Since 2013, the primary species caught in this fishery included Atka mackerel (75% of catch; 64,500 t catch in 2017), Pacific ocean perch (POP; 10% of catch),

and northern rockfish (~5% of catch). A series of management measures have been implemented since 2010 in order to mitigate the fishery's potential impact on the endangered stock of western Steller sea lions (NPFMC 2017) (Fissel et al. 2017).

BSAI Greenland turbot trawl and longline: Greenland turbot are a deep-dwelling species targeted in trawl and longline fisheries in the BSAI only. The majority (~2/3) of Greenland turbot catch from 1995 to 2006 was from the longline fishery; however, in more recent years trawl-caught Greenland turbot has exceeded longline landings. In some years, Greenland turbot catch occurs largely in other target fisheries (e.g., flatfish trawl, Pacific halibut, Pacific cod). The estimated catch of Greenland turbot in 2017 was 2832 t, which represents an increase from the 5-year average catch of ~1,200 t. Primary bycatch species in this fishery include grenadier (species complex), Kamchatka and arrowtooth flounder, skates, and flathead sole.

GOA and BSAI Rockfish trawl: Rockfish tend to be a long-lived, slow-growing species preferring rocky and varied terrain as benthic habitats (Lunsford et al. 2015) (Shotwell et al. 2017). The BSAI rockfish trawl fishery is a bottom trawl fishery in which Amendment 80 catcher-processors (CPs) acting in cooperatives typically target POP (~70% of catch 2013 to 2017, ~32,543 t catch in 2017) and other rockfish species using bottom trawl gear designed for rough substrate (NOAA 2005).

The GOA rockfish trawl fishery primarily targets POP (~60% of catch from 2013 to 2017; ~23,880 t catch in 2017), northern rockfish (~12% of catch) and dusky rockfish (~10% of catch), primarily in the western and central GOA. In 2007 the Central Gulf of Alaska Rockfish Program was implemented to enhance resource conservation and improve economic efficiency for harvesters and processors who participate in the central GOA rockfish fishery (Shotwell et al. 2017). The North Pacific Fishery Management Council (NPFMC) is currently reviewing proposed legislation to require full retention of rockfish in GOA and BSAI fixed gear fisheries.

GOA and BSAI Pacific cod longline, trawl, pot: Pacific cod fisheries in the BSAI and GOA represent a large scale groundfish fishery in Alaska, only exceeded by pollock in terms of volume and revenue. In 2017, roughly 270,000 t of Pacific cod were caught, and 85% of Pacific cod catch occurred in the BSAI. Pacific cod vessels are typically CPs or catcher vessels (CVs), with specific quota and seasonal allocations. Pacific cod tend to inhabit shallower zones over muddy substrate; as such, Pacific cod fisheries can have less of an impact on benthic habitats as compared to fixed gear fisheries over rocky substrates (NOAA 2005).

Production Statistics

The commercial groundfish fisheries off Alaska had a total catch of 2.3 million t in 2016 (including catch in federal and state waters). Groundfish accounted for 88% of Alaska's 2016 total catch. In 2016, Alaska pollock, Pacific cod, and rockfish catches were at decadal highs, while sablefish catch was at a decadal low (Figure A). Stock assessment estimates as of November 2017 suggest a substantial reduction in the 2018 catch specifications, particularly in the GOA (Fissel et al. 2017).

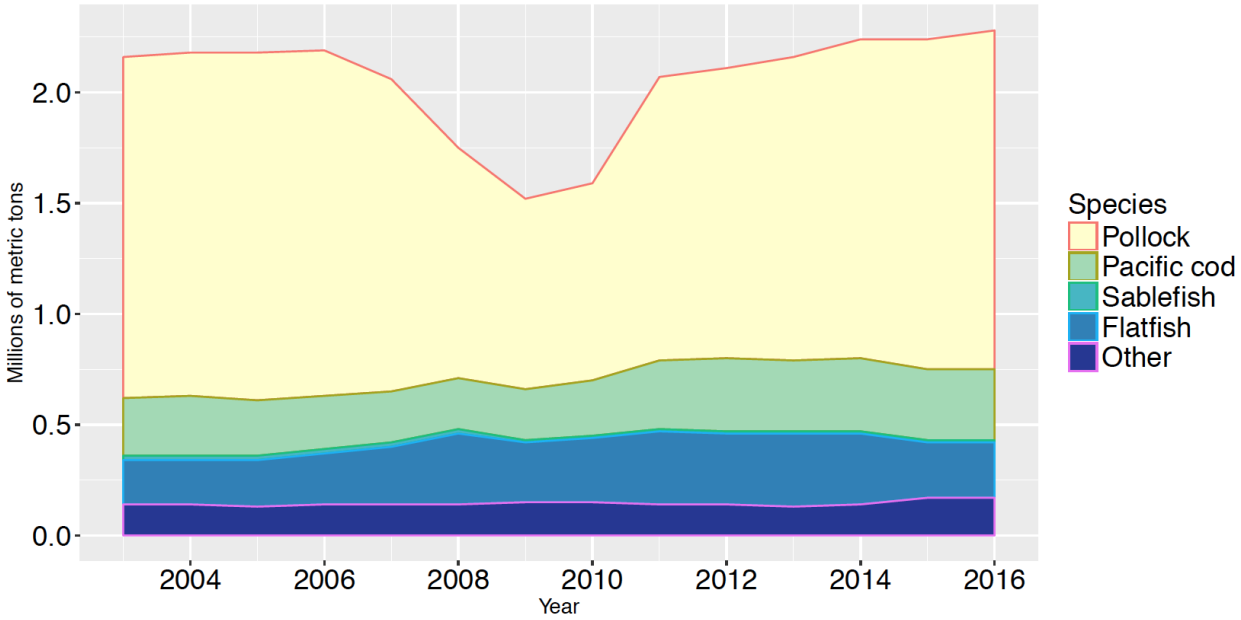

Figure 1 Groundfish catch in the commercial fisheries off Alaska by species, 2003-2016 (Fissel et al. 2017).

Sablefish is primarily harvested by the GOA longline gear shoreside sector, which usually accounts for upwards of 90% of the annual catch (Fissel et al. 2017). Since the mid-2000s, decreasing sablefish biomass has ratcheted down sablefish TAC and catch. This trend continued through 2016 as catches decreased to 10,900 t in 2016, down from 11,700 t in 2015. Survey data suggest sablefish biomass may increase in the next few years, and TACs are increasing, reflecting the upward trend (Hanselman et al. 2017).

Atka mackerel is predominantly caught in the BSAI, primarily in the AI by the Amendment 80 Fleet. The 2016 catch of Atka mackerel was roughly 56,000 t. Atka mackerel TACs were significantly reduced in 2012 and 2013 due to area closures for Steller sea lions and survey-based changes in the spatial apportionment of TAC. Recent increases in 2016 and 2017 TAC reflect the continued health of the Atka mackerel stock and expanded fishing opportunities in the AI (Fissel et al. 2017).

The fisheries for Pacific cod are the second largest by volume in Alaska with a catch of 325,000 t in 2016, an increase of 1.2% from 2015 (Fissel et al. 2016). Pacific cod catches in 2017 were below 2016 levels and reflected a 10% and 5% reduction in the GOA and BSAI TACs, respectively. Stock assessment estimates as of November 2017 suggest a substantial reduction in the 2018/2019 catch specifications, particularly in the GOA (Fissel et al. 2017).

Rockfish catch in Alaska totaled 64,000 t in 2016, an increase of 10% with a notable increase in the GOA POP catch. In the BSAI, POP catch was stable at 30,000 t, and the catch of northern rockfish decreased to 3,000 t. In the GOA, POP catch increased 16%, and at 21,000 t is the highest level since at least 2003 (Fissel et al. 2017).

Importance to the US/North American market.

The groundfish fisheries of Alaska are an important segment of the US fishing industry (Fissel et al. 2017). In 2015, groundfish accounted for 51% of the weight of total US domestic landings and 18% of the ex-vessel value

of total US domestic landings (Fisheries of the United States, 2015). Alaska fisheries as a whole (including salmon, halibut, herring, and shellfish) accounted for 61.6% of the weight of total US domestic landings and 33.2% of the ex-vessel value of total US domestic landings (Fissel et al. 2017).

The first wholesale value of 2016 groundfish catch after primary processing was USD 2,379 million. The 2016 total groundfish catch decreased by 2%, and the total first-wholesale value of groundfish catch increased by 4%, relative to 2015. Statewide, the groundfish fisheries accounted for the largest share (51%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon (*Oncorhynchus spp.*) fishery was second with USD 444 million or 26% of the total Alaska ex-vessel value (NPFMC 2017).

The ex-vessel value of BSAI groundfish increased from USD 1,125 million in 2015 to USD 1,166 million in 2016 (Figure A), and first-wholesale revenues from the processing and production of groundfish in the BSAI increased by 5% between 2015 (USD 1,932 million) and 2016 (USD 2,025 million). Concurrently, the total quantity of groundfish products from the BSAI increased from 819,000 t to 832,000 t, a 2% increase. For BSAI Pacific cod, a negative price effect combined with significant positive quantity effects, resulting in a USD 22 million net increase in first-wholesale revenues for Pacific cod from the BSAI for 2015–2016 (Figure 2). There was both a negative price effect and negative quantity effect for rockfish, resulting in a net negative effect of USD 8 million. Atka mackerel and sablefish had little change in price or quantity 2015–2016.

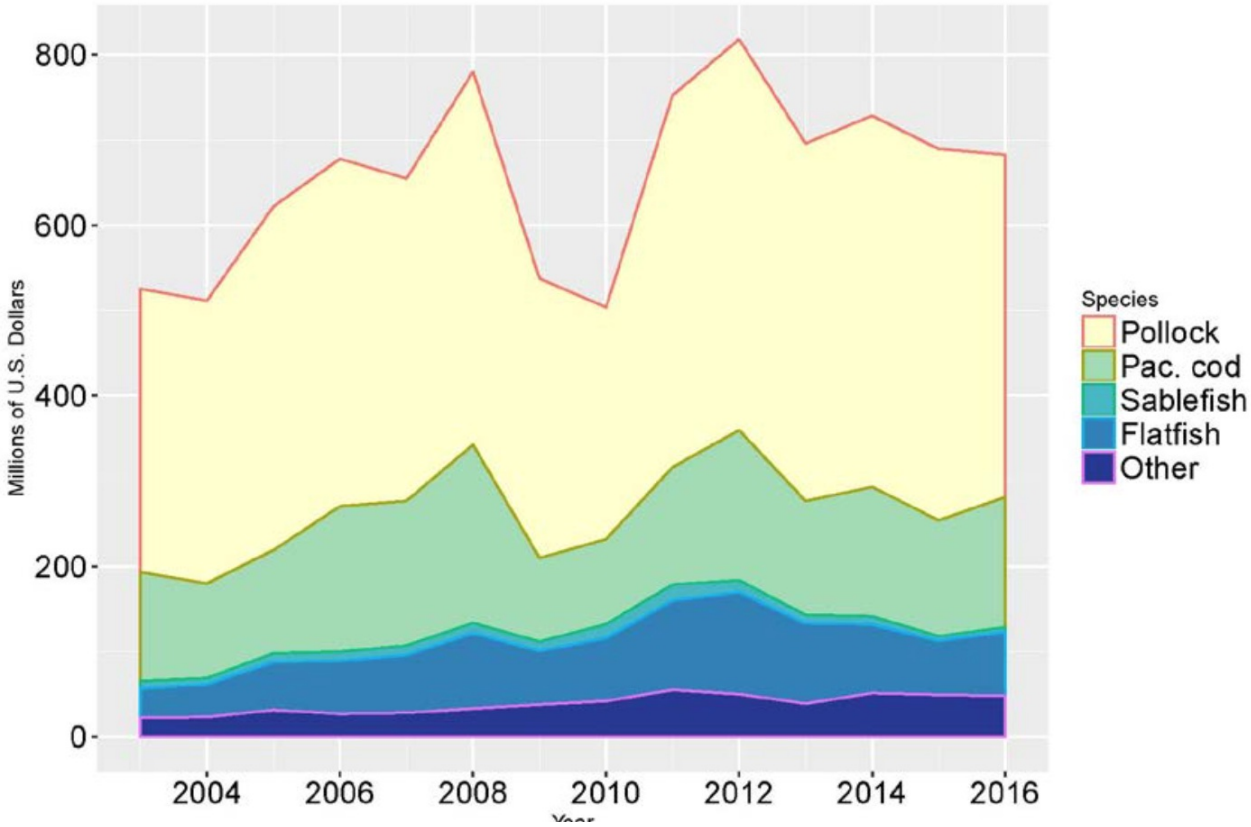

Figure 2 Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the BSAI area by species, 2003-2016 (base year = 2016)(Fissel et al. 2017).

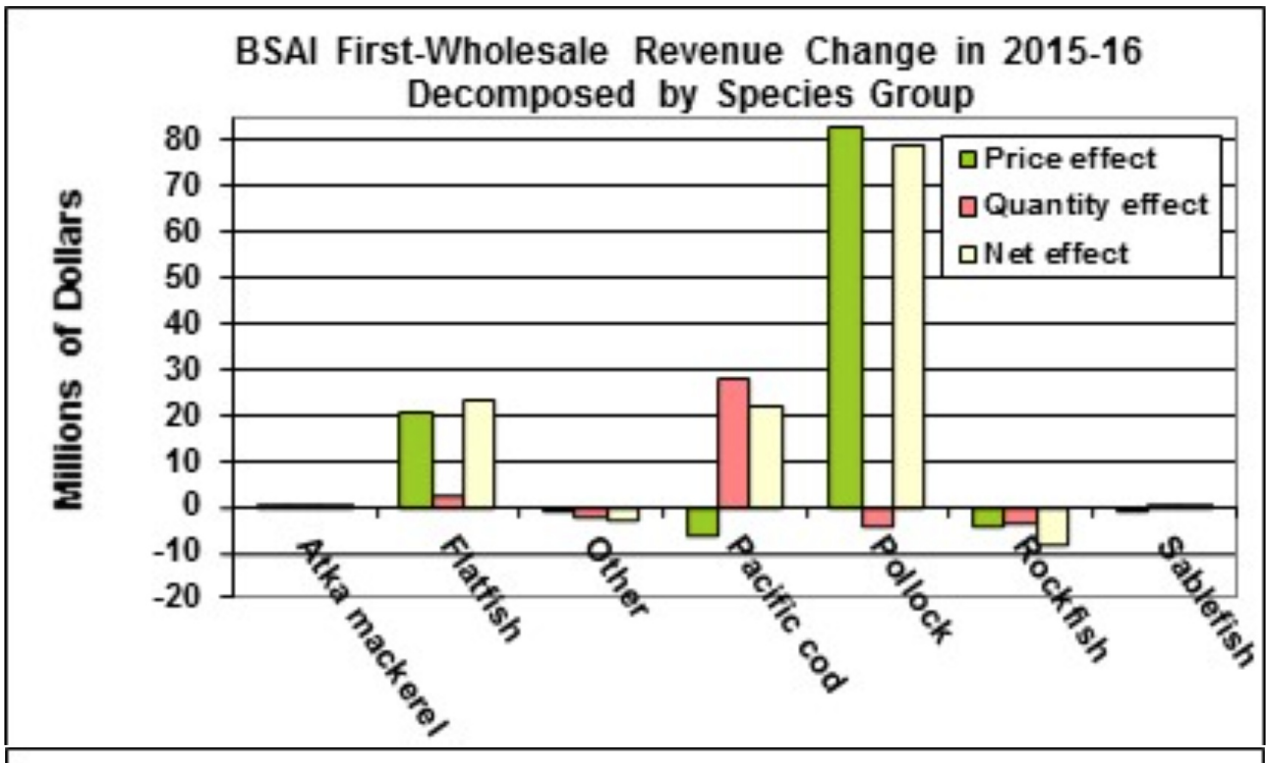

Figure 3 Decomposition of the change in first-wholesale revenues from 2015-16 in the BSAI area by species group. The price effect refers to the change in revenues due to the change in the first-wholesale price index (current dollars per metric ton) for each group. The quantity effect refers to the change in revenues due to the change in production (in metric tons) for each group. The net effect is the sum of price and quantity effects (NPFMC 2017).

The ex-vessel value of GOA groundfish decreased from USD 208 million in 2015 to USD 189 million in 2016 (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the GOA were relatively flat between 2015 (USD 354 million) and 2016 (USD 353 million) (NPFMC 2017a). At the same time, the total quantity of groundfish products from the GOA increased from 126,000 t to 135,000 t, a 7% increase. By species group, negative quantity effects were offset somewhat by smaller positive price effects for Pacific cod, but still resulting in a USD 12 million net decrease in first-wholesale revenues from the GOA for 2015–16 (Figure 4). This was countered to an extent by positive price and negative quantity effects for sablefish resulting in a positive net effect of USD 9 million. There was also a small negative price effect and larger positive quantity effect for rockfish, resulting in a net positive effect of almost USD 3 million (NPFMC 2017a).

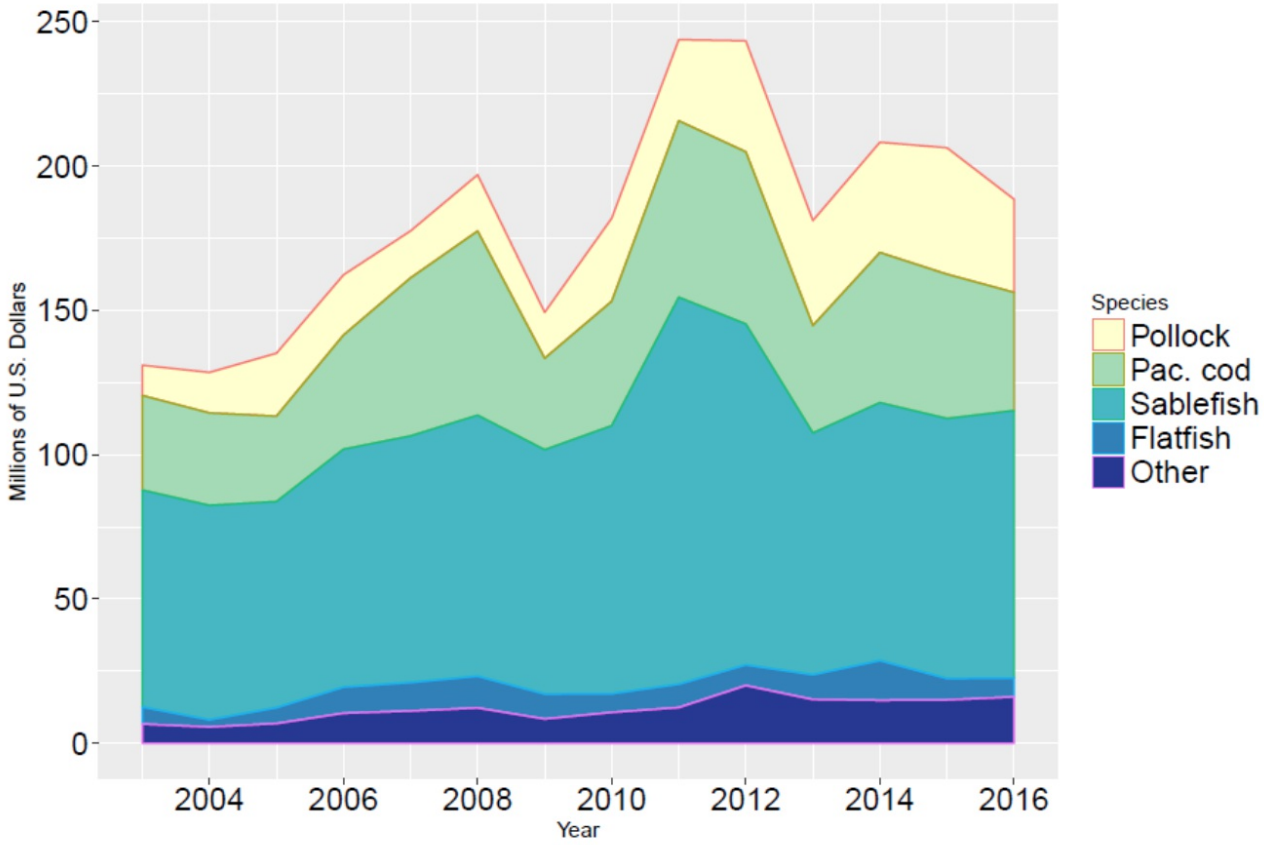

Figure 4 Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2003-2016 (base year = 2016) (Fissel et al. 2017).

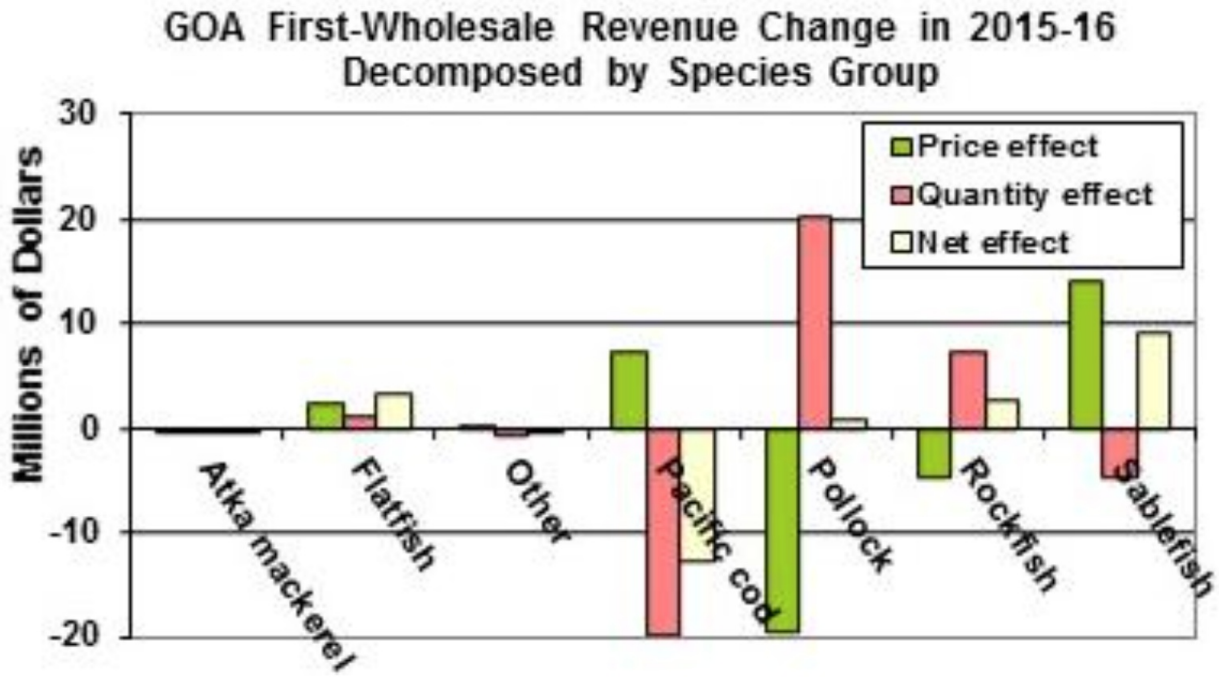

Figure 5 Decomposition of the change in first-wholesale revenues from 2015-16 in the GOA area by species group. The price effect refers to the change in revenues due to the change in the first-wholesale price index (current dollars per metric ton) for each group. The quantity effect refers to the change in revenues due to the change in production (in metric tons) for each group. The net effect is the sum of price and quantity effects (NPFMC 2017a).

Common and market names.

Table 1. Common names, market names, and primary product forms of groundfish reviewed (Fissel et al. 2017) (NMFS 2018).

Common Name	Additional Common or Market Name (s)	Main Product Forms
Arrowtooth flounder	Flounder, arrowtooth, paltus	Head and Gut (H&G), converted to fillets
Atka mackerel	Mackerel, atkafish	H&G or whole fish, converted to surimi or salted and split form
Flathead sole	Sole, flounder, flathead flounder	H&G or whole fish, converted to fillets
Greenland turbot	Turbot, Greenland halibut, Newfoundland turbot, Blue halibut	H&G or whole fish, converted to fillets
Kamchatka flounder	Flounder, paltus, Arctic halibut	H&G or whole fish, converted to fillets
Northern rockfish	Rockfish	H&G or whole fish, converted to fillets
Pacific cod	Cod, Alaska cod, grey cod, true cod	H&G or whole fish, converted to roe, fillets or salted split
Pacific halibut	Halibut, Alaskan halibut	H&G, converted to fillets or collars
Pacific Ocean perch	POP, rockfish	H&G or whole fish, converted to fillets
Rockfish (blackspotted, dusky, northern, rougheye, shortraker)	Rockfish	H&G or whole fish, converted to fillets
Sablefish	Black cod, butterfish, skil, beshow, coalfish	H&G, converted to fillets or rounds, collars
Shortspine thornyhead rockfish	Idiotfish, thornyhead	H&G or whole fish, converted to fillets

Primary product forms

See Table 1 above.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. 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

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*

Criterion 1 Summary

ARROWTOOTH FLOUNDER			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Bottom trawls | United States of America | Greenland turbot trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

ATKA MACKEREL			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Bottom trawls | United States of America | Atka mackerel trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

BLACKSPOTTED ROCKFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)

Alaska/Bering Sea | Bottom trawls | United States of America | Rockfish trawl	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)

FLATHEAD SOLE			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Bottom trawls | United States of America | Greenland turbot trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

GREENLAND TURBOT			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Set longlines | United States of America | Greenland turbot longline	3.67: Low Concern	5.00: Low Concern	Green (4.284)
Alaska/Bering Sea | Bottom trawls | United States of America | Greenland turbot trawl	3.67: Low Concern	5.00: Low Concern	Green (4.284)

KAMCHATKA FLOUNDER			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Bottom trawls | United States of America | Greenland turbot trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

LIGHT DUSKY ROCKFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

NORTHERN ROCKFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Bottom trawls | United States of America | Atka mackerel trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

PACIFIC COD			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Pacific cod trawl	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)
Alaska/Gulf of Alaska | Set longlines | United States of America | Pacific cod longline	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)
Alaska/Bering Sea | Bottom trawls | United States of America | Pacific cod trawl	3.67: Low Concern	3.00: Moderate Concern	Green (3.318)
Alaska/Bering Sea | Set longlines | United States of America | Pacific cod longline	3.67: Low Concern	3.00: Moderate Concern	Green (3.318)
Alaska/Gulf of Alaska | Pots | United States of America | Pacific cod pot	2.33: Moderate Concern	3.00: Moderate Concern	Yellow (2.644)
Alaska/Bering Sea | Pots | United States of America | Pacific cod pot	3.67: Low Concern	3.00: Moderate Concern	Green (3.318)

PACIFIC OCEAN PERCH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Bering Sea | Bottom trawls | United States of America | Atka mackerel trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

Alaska/Bering Sea | Bottom trawls | United States of America | Rockfish trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

ROUGHEYE ROCKFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)
Alaska/Bering Sea | Bottom trawls | United States of America | Rockfish trawl	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)
Alaska | Set longlines | United States of America | Sablefish longline	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)

SABLEFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska | Set longlines | United States of America | Sablefish longline	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)
Alaska | Pots | United States of America | Sablefish pot	5.00: Very Low Concern	5.00: Low Concern	Green (5.000)

SHORTRAKER ROCKFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	1.00: High Concern	5.00: Low Concern	Yellow (2.236)

Alaska/Bering Sea | Bottom trawls | United States of America | Rockfish trawl	1.00: High Concern	5.00: Low Concern	Yellow (2.236)

SHORTSPINE THORNYHEAD			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska | Set longlines | United States of America | Sablefish longline	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)
Alaska/Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	2.33: Moderate Concern	5.00: Low Concern	Green (3.413)

YELLOWEYE ROCKFISH			
Region | Method	**Abundance**	**Fishing Mortality**	**Score**
Alaska | Set longlines | United States of America | Sablefish longline	1.00: High Concern	5.00: Low Concern	Yellow (2.236)
Alaska/Gulf of Alaska | Set longlines | United States of America | Pacific cod longline	1.00: High Concern	5.00: Low Concern	Yellow (2.236)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

ARROWTOOTH FLOUNDER

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Very Low Concern

BSAI arrowtooth flounder are assessed biennially, and the fishery is not classified as overfished (Spies et al. 2017a). Projected female SSB for 2018 increased from the 2016 to 490,663 t or 93% of unfished SSB (Spies et al. 2017a). For 2018, the projected SSB is approximately 264% of the target reference point $SB_{35\%}$ and the B/B_{MSY} ratio is 2.67 (NMFS FSSI 2017); therefore, BSAI arrowtooth flounder receives a score of "very low" concern for abundance.

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

The estimated end of year catch of BSAI arrowtooth flounder in 2017 was 6,516 t or 0.10 of the ABC. Fully selected fishing mortality remains low and averaged 0.04 from 2008 to 2016 (2008 was the inception of the Amendment 80 program) (Spies et al. 2016). Catches and cumulative fishing mortality values are well below target management reference points, and BSAI arrowtooth flounder receives a score of "low" concern for fishing mortality in BSAI Greenland turbot and sablefish fisheries.

Justification:

Catches of BSAI arrowtooth flounder have decreased since 2010, in part due to increasing pollock TACs (staying under the 2 million t cap) and decreasing halibut PSC use (often caught in conjunction with arrowtooth) by CPs regionally (Spies et al. 2017a).

ATKA MACKEREL

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Very Low Concern

Projected BSAI Atka mackerel SSB for 2018 is 88,928 t or 45% of unfished SSB. For 2018, the projected SSB is approximately 130% of the target reference point $SB_{35\%}$ (Lowe et al. 2017). The estimated B/B_{MSY} is 1.41 (NMFS FSSI 2017), and the BSAI Atka mackerel population receives a score of "very low" concern for abundance.

Justification:

Atka mackerel are widely distributed along the continental shelf across the North Pacific Ocean and Bering Sea from Asia to North America. Atka mackerel are a substrate-spawning fish with male parental care and brooding behaviors (Lowe et al. 2017). Atka mackerel exhibit patchy distributions that can render them vulnerable to overfishing. BSAI Atka mackerel model-estimated and observed biomass in the BSAI have been relatively constant since the early 1990's (Figure A), however SSB has declined from its 2005 peak (Lowe et al. 2017).

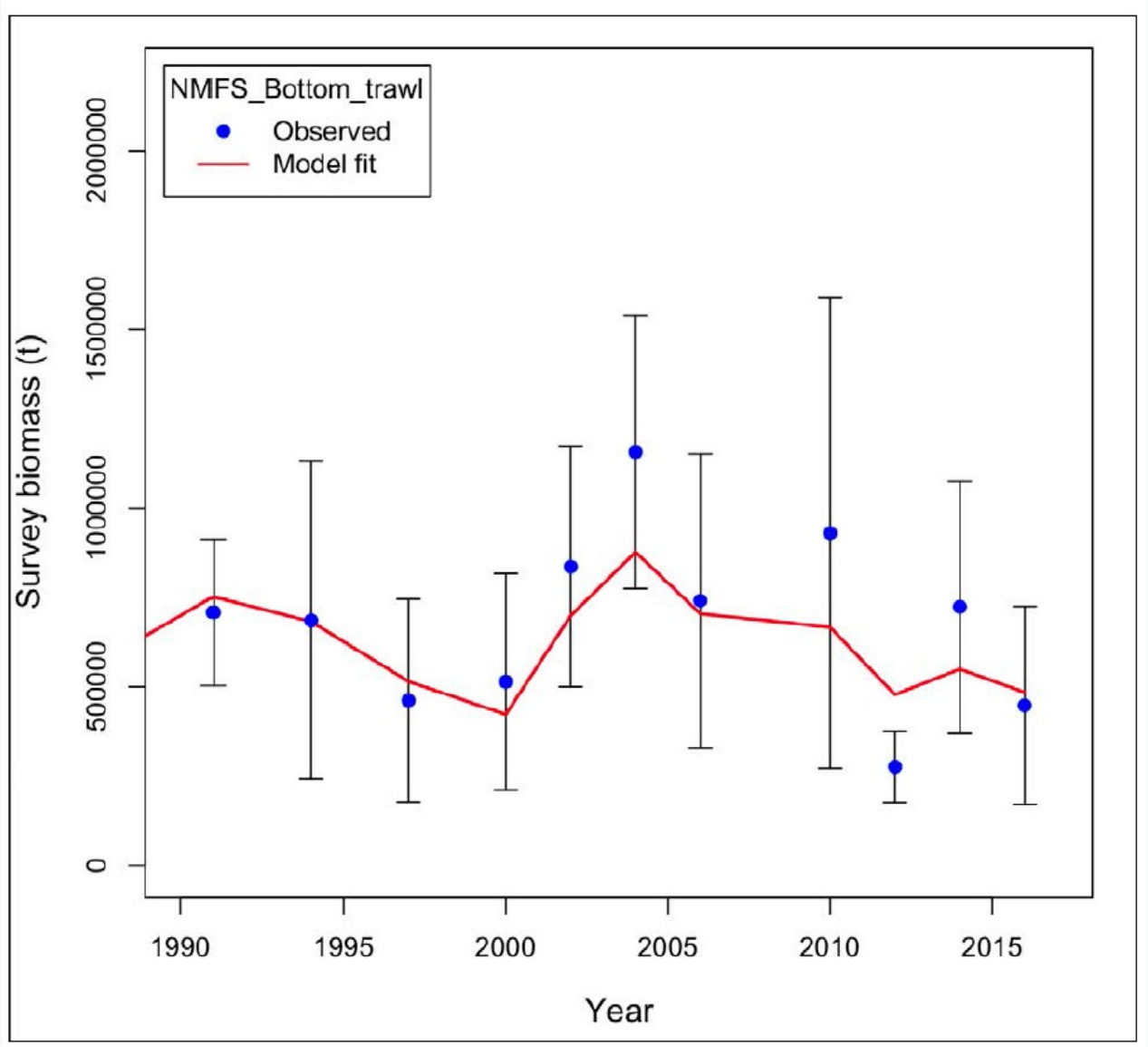

Figure 6 Observed (dots) and predicted (trend line) survey biomass estimates (t) for Bering Sea/Aleutian Islands Atka mackerel. Error bars represent two standard errors (based on sampling) from the survey estimates (Lowe et al. 2017).

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Low Concern

The estimated catch of BSAI Atka mackerel in 2017 was 64,449 t or 0.74 of the ABC (87200 t). F_{ABC} is conservatively set at a maximum of 0.38 per the Tier 3a management category (Lowe et al. 2017). Fishing mortality from all sources is below target reference points, and the Atka mackerel fishery receives a score of "low" concern for fishing mortality.

Justification:

From 1970 to 1979, Atka mackerel were landed off Alaska almost exclusively by foreign fleets of Russia, Japan, and the Republic of Korea. The fishery was largely domesticated by the end of the 1980s. Currently, BSAI Atka mackerel TAC is apportioned in three different regions; however, the majority of Atka mackerel is caught in the AI, almost exclusively by the Amendment 80 fleet (Lowe et al. 2017). BSAI Atka mackerel fishing mortality has varied since the inception of the fishery but has been well below the harvest control rule F_{ABC}=0.38 all years (with the exception of 1996). The estimated F_{2017}=0.282, and the catch/biomass (age 3+) = 0.125 (Figure A).

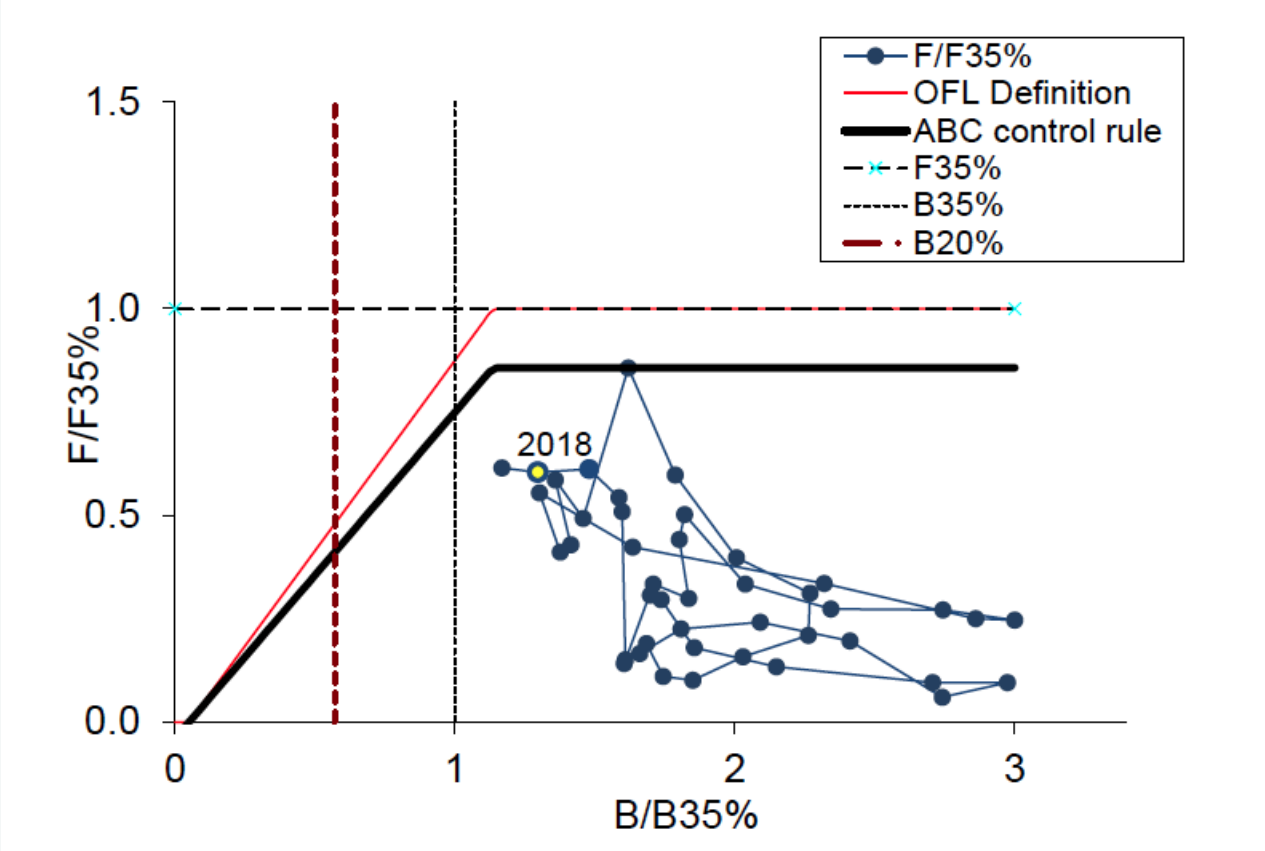

Figure 7 AI Atka mackerel spawning biomass relative to B35% and fishing mortality relative to FOFL (1977-2019). The ratio of fishing mortality to FOFL is calculated using the estimated selectivity pattern in that year. Estimates of spawning biomass and B35% are based on current estimates of weight-at-age and mean recruitment. Because these estimates change as new data become available, this figure can only be used in a general way to evaluate management performance relative to biomass and fishing mortality reference levels (Lowe et al. 2017).

BLACKSPOTTED ROCKFISH

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

GOA blackspotted rockfish is managed as part of the rougheye/blackspotted (RE/BS) complex due to its similarity in appearance with rougheye rockfish (Spencer and Rooper 2016). GOA RE/BS are assessed bienially using an age-structured model as a Tier 3a species. Projected GOA RE/BS SSB2018 is 15,059 t or 66% of unfished SSB, and the ratio of SSB:SSB40 is 1.67. Recent recruitment has been steady and near the median of the recruitment time series, as evidenced by the young fish returns over time on the trawl survey (Shotwell et al. 2017). Two survey indices also suggest that GOA RE/BS biomass has been steady since the mid-1980s, and the estimated B:BMSY is 1.92 (NOAA FSSI 2017). However, due to issues with the recent (2008) speciation of blackspotted rockfish and limited data regarding historical catches and their moderate vulnerability status (Table 3), GOA blackspotted rockfish receive a score of "moderate" concern for abundance.

Justification:

Table 3. Blackspotted rockfish, Alaska, Gulf of Alaska trawl

Blackspotted rockfish, Alaska, Gulf of Alaska trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference
Average age at maturity (years)	27	2	(AFSC 2018)	Areal overlap		3	(Shotwell et al. 2017)
Average maximum age (years)	110	3	(Shotwell et al. 2017)	Vertical overlap		3	(Shotwell et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Shotwell et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	54	1	(Shotwell et al. 2017)	Post-capture mortality		3	(Shotwell et al. 2017)

Average size at maturity (cm) (not to be used when scoring invertebrate species)	38	2	(Shotwell et al. 2017)	Susceptibility Subscore	2.325
Reproductive strategy	Live bearer	3	(Shotwell et al. 2017)		
Trophic level	3.8	3	fishbase.org	Productivity-Susceptibility Score	3.15
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium
Quality of Habitat	Moderately altered	2	(Shotwell et al. 2017)		
Productivity Subscore		2.125			

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

BSAI blackspotted rockfish are managed as part of the RE/BS complex due to their similarity in appearance (Spencer and Rooper 2016), and the RE/BS complex is assessed biennially using an age-structured model as Tier 3b stock. Projected RE/BS SSB for 2018 is 8,208 t or 40% of unfished SSB. For 2018, the projected SSB is approximately 99% of the target reference points $SB_{40\%}$ and 112% $SB_{35\%}$ (Spencer and Rooper 2017). The estimated B:BMSY is 0.9 (NMFS FSSI 2017). The blackspotted rockfish stock is near target reference points; however, due to data limitations by species and moderate vulnerability (Table 3) BSAI blackspotted rockfish receives a score of "moderate" concern for abundance.

Justification:

Fish historically referred to as “rougheye” rockfish are now recognized as two separate species: blackspotted and rougheye rockfish (Orr and Hawkins 2008). Rougheye rockfish are distributed from the eastern AI near Unalaska Island along the continental slope to southern Oregon, whereas blackspotted rockfish are distributed along the continental slope from Japan to California (Orr and Hawkins 2008) (Spencer and Rooper 2016). Rougheye rockfish are relatively scarce west of the eastern AI whereas blackspotted rockfish are encountered fairly regularly throughout the BSAI area (Spencer and Rooper 2016). However, species specific distribution and biomass estimates are unavailable in most cases due to the difficulty in distinguishing the two species.

Overall, the RE/BS stock biomass has been increasing since 2000 (Figure A). It is important to note that biomass and size trends differ by area, and RE/BS rockfish biomass in the western AI has decreased moderately and fish tend to be smaller in size (Spencer and Rooper 2016).

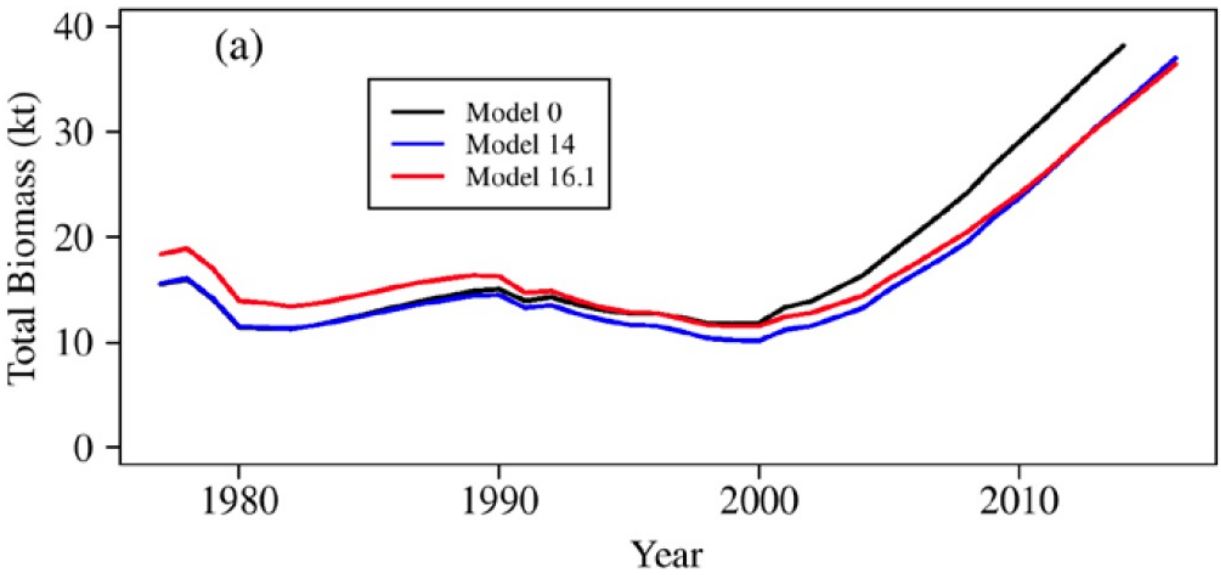

Figure 8 Estimated BSAI blackspotted and rougheye rockfish complex total biomass (Spencer & Rooper 2016).

Table 3. Blackspotted rockfish, Alaska, Bering Sea Aleutian Islands trawl

Blackspotted rockfish, Alaska, BSAI trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference
Average age at maturity (years)	27	3	(Shotwell et al. 2015)	Areal overlap		3	(Shotwell et al. 2015)
Average maximum age (years)	110	3	(Shotwell et al. 2015)	Vertical overlap		3	(Shotwell et al. 2015)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Shotwell et al. 2015)

Average maximum size (cm) (not to be used when scoring invertebrate species)	54	1	(Shotwell et al. 2015)	Post-capture mortality	3	(Shotwell et al. 2015)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	38	2	(Shotwell et al. 2015)	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3	(Shotwell et al. 2015)			
Trophic level	3.8	3	fishbase.org	Productivity-Susceptibility Score	3.15	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Shotwell et al. 2015)			
Productivity Subscore		2.125				

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

GOA blackspotted rockfish is a bycatch only fishery, taken predominantly in targeted rockfish bottom trawl fisheries and sablefish fisheries. Managed as the RE/BS complex, the 2017 catch of GOA RE/BS (522 t) was well below target reference points and was approximately 0.39 of the Tier 3a ABC (Shotwell et al. 2017). Since 2005, the TACs for RE/BS rockfish have not been fully taken, and catches are generally between 20% to 60% of TAC (Shotwell et al. 2017). RE/BS fishing mortality has been below the $F_{40\%}$ management reference point since 1990 and receives a score of "low" concern for fishing mortality.

Justification:

Estimated RE/BS fishing mortality increased in the late 1980s and returned to lower levels from 1993 to present (Shotwell et al. 2015). The spike may have been due to the management of RE/BS in the slope rockfish complex prior to 1991 and the disproportionate harvest on shortraker (which co-occurs with RE/BS) due to their high value. In general, fishing mortality is relatively low because most of the available TAC has

not been caught historically (Shotwell et al. 2015).

In 2017, 66% of the RE/BS catch was from bottom trawls, 33% from longline, and 1% from pelagic trawls. Approximately 78% of the bottom trawl catch was taken in the targeted rockfish fishery while 22% was taken in the flatfish fisheries. For longline gear, nearly all the RE/BS catch appears to come as "true" bycatch in the sablefish or halibut longline fisheries, with 70% of the 2017 catch taken in the sablefish fishery and 15% in the halibut fishery (Shotwell et al. 2015).

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of BSAI RE/BS in 2017 was 204 t or 0.40 of the ABC (501 t) (Spencer and Rooper 2017). Fishing mortality from all sources is at or below target reference points, and the fishery receives a score of "low" concern for fishing mortality

Justification:

The ABC for BSAI RE/BS is currently apportioned among two areas: the western and central AI, and eastern AI and EBS. Catches of RE/BS has been under TACs, however, two issues of concern exist. First, while fully selected fishing mortality rates have been low since 2000 (<0.1), relatively high exploitation rates occurred in the 1990s, and the effects on the stock are unknown (Spencer and Rooper 2017). Second, BSAI RE/BS exploitation rates (ratio of annual catch to beginning year biomass ages 3+) averaged 0.009 from 2004 to 2017, which is below the exploitation rate associated from fishing at $F_{40\%}$. However, exploitation rates in the western AI subarea have been much higher than other areas, and averaged 0.042 from 2004 to 2017. Western AI exploitation rates have decreased since 2013 (Figure A).

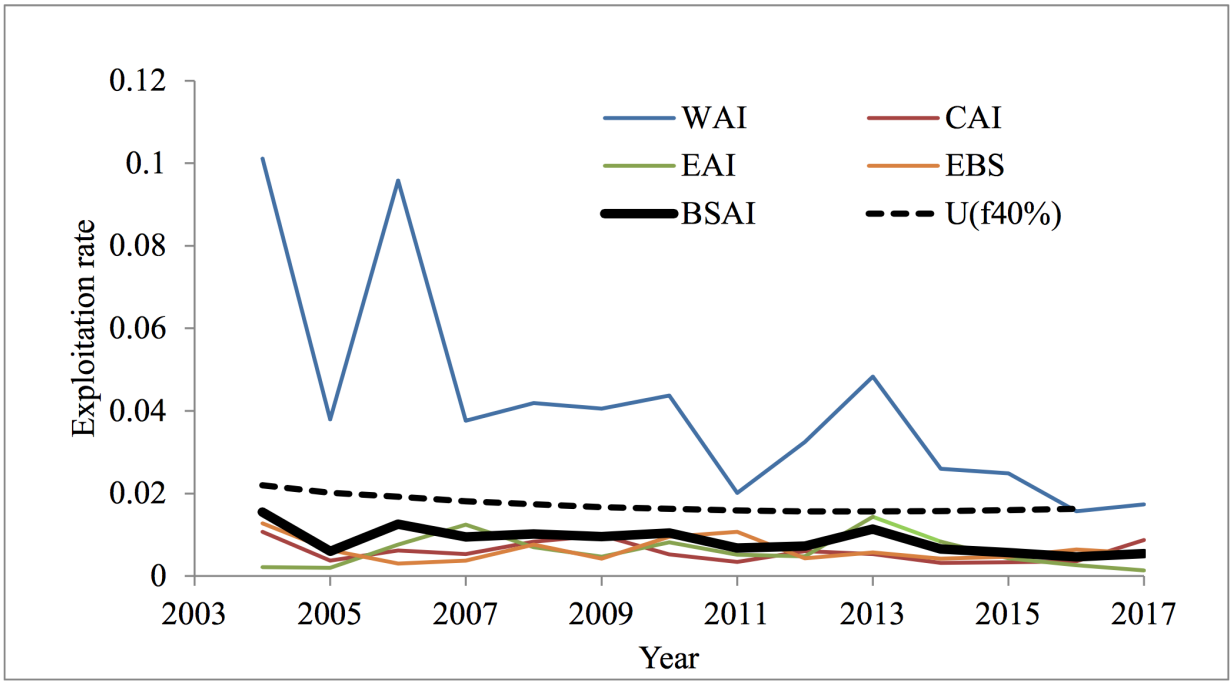

Figure 9 Figure B1. Exploitation rates within BSAI subareas for blackspotted/rougheye rockfish , with reference exploitation rates of 0.75*M and UF40% (Spencer & Rooper 2016).

FLATHEAD SOLE

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Very Low Concern

"Flathead sole" as currently managed by the NPFMC in the BSAI represents a two-species complex consisting of true flathead sole (*Hippoglossoides elassodon*) and its morphologically-similar congener Bering flounder (*H. robustus*). True flathead sole makes up the majority of the biomass and catch and is reviewed here. Flathead sole is assessed biennially as a Tier 3a stock, and projected female SSB for 2018 was 214,124 t or 66% of unfished SSB (McGilliard 2017). For 2018, the projected SSB is approximately 189% of the target reference point $SB_{35\%}$. Flathead sole is not classified as overfished, and the B/B_{MSY} ratio is 2.07 (NMFS 2017 FSSI); therefore, flathead sole receives a score of "very low" concern for abundance.

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

True flathead sole makes up the majority of the catch in this fishery. Flathead sole are caught in directed BSAI flatfish trawl fisheries and as bycatch, primarily in Greenland turbot fisheries. The estimated catch of BSAI flathead sole in 2017 was 9,145 t or 0.14 of the ABC (McGilliard 2017). Estimates of flathead sole fishing mortality have been relatively constant since 1990 (<= 0.1) (McGilliard et al. 2016). Catches and fishing mortality values are below target management reference points, and flathead sole receives a score of "low" concern for fishing mortality in the Greenland turbot trawl fishery.

GREENLAND TURBOT

Factor 1.1 - Abundance

ALASKA/BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

Low Concern

Greenland turbot is assessed biennially using an age-structured, split sex model. Estimated total and spawning biomass declined dramatically from the mid-1970s in the BSAI, likely due to poor recruitment and relatively high fishing effort (Barbeaux et al. 2016). Spawning biomass stabilized somewhat beginning in 2013 but remains well below historic levels. Projected female SSB for 2018 is 58,035 t or 56% of unfished SSB. For 2018, the projected SSB is approximately 161% of target reference point $SB_{35\%}$ (Bryan and Barbeaux 2017). Greenland turbot abundance is at or above target reference points; however, Greenland turbot receives a score of "low" concern for abundance due to low recruitment levels post-2010 and associated concerns about continued ocean warming in the EBS (M. Bryan, NMFS, personal communication 2018).

Justification:

Greenland turbot have a wide distribution in the Pacific Ocean and have been found from the Sea of Japan to the waters off Baja California north to the Beaufort and Chukchi seas (Barbeaux et al. 2016). Greenland turbot primarily inhabit the deeper slope and shelf waters (between 100 m to 2000 m) in bottom temperatures ranging from –2°C to 5°C and are most abundant found in the northern Bering Sea. Greenland turbot recruitment has been linked with bottom temperatures, and low recruitment since 2010 supports this relationship (Figures A,B).

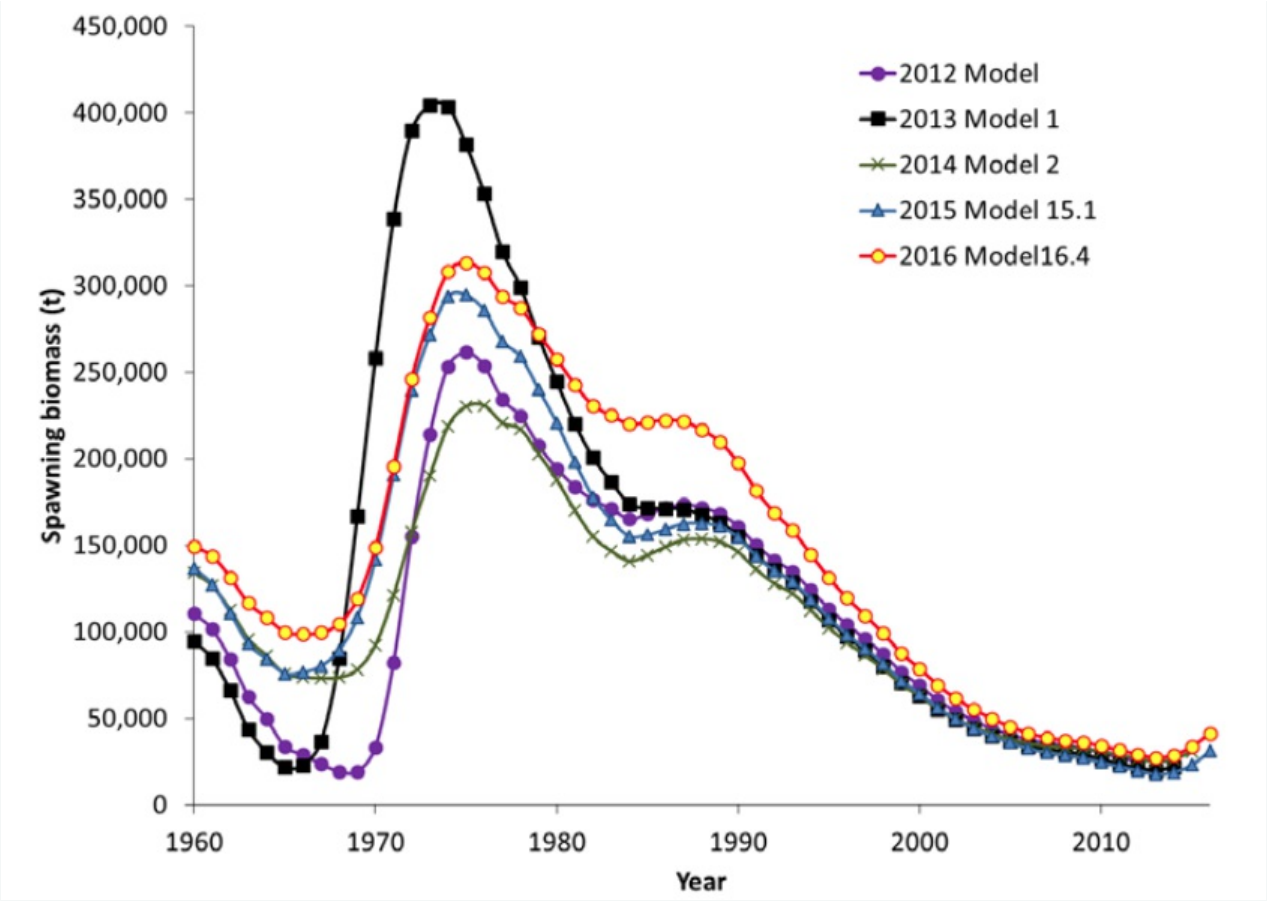

Figure 10 Female spawning biomass in tons for BSAI Greenland Turbot for Model 16.4 and previous years' stock assessments (Barbeaux et al. 2016).

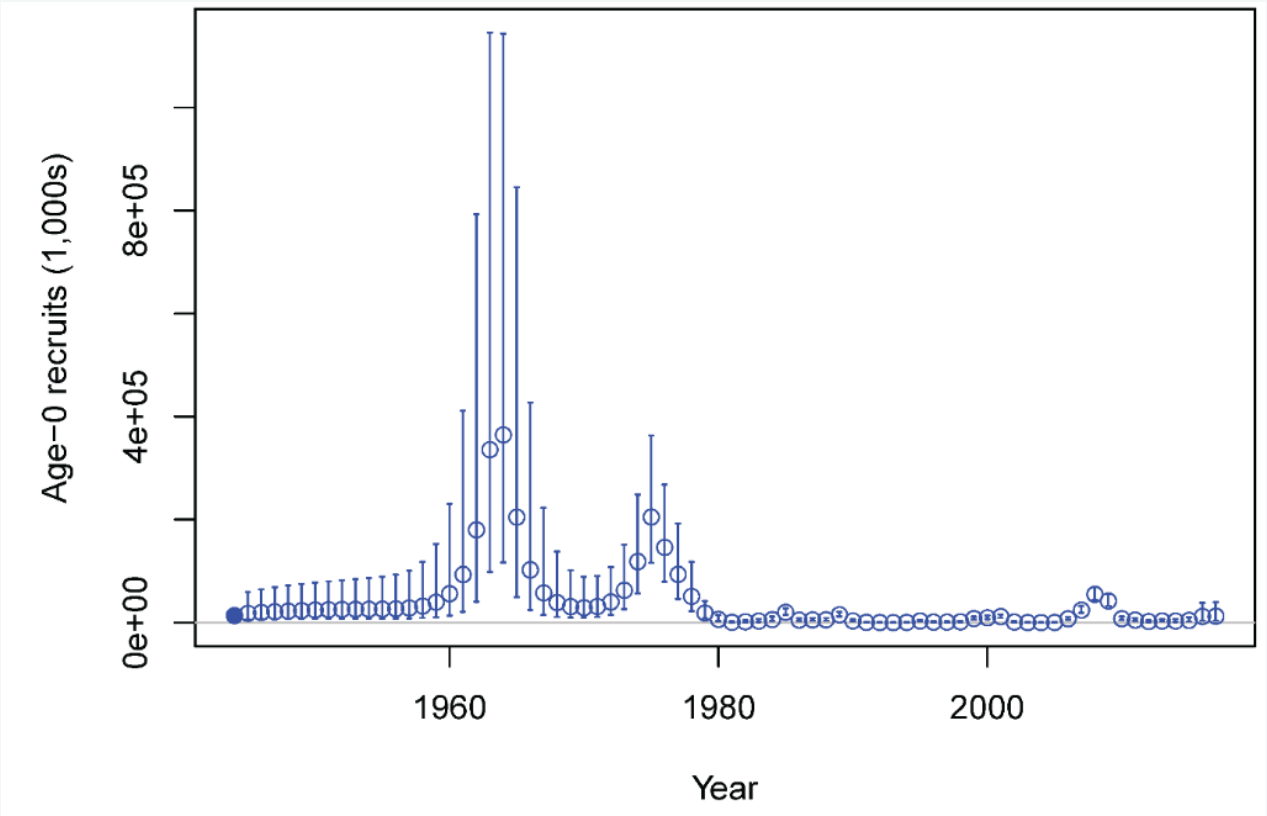

Figure 11 Age-0 recruits (bottom) in thousands current Greenland turbot assessment model (Barbeaux et al. 2016).

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

Low Concern

The estimated catch of Greenland turbot in 2017 was 2,832 t or 0.43 of the ABC (6644 t). Apical fishing mortality was relatively high 2009 to 2012 (peaked at 0.23 in 2012; some reference points may have been exceeded during this time based on retrospective analyses), fishing mortality decreased beginning in 2013 to 2016 and ranged from 0.06 to 0.08. Although fishing mortality can be difficult to assess or predict for the Greenland turbot fishery because the catches are not allocated by gear type (Barbeaux et al. 2016), assessment methods to set ABCs and TACs have improved in recent years, and fishing mortality from all sources is at a sustainable level given the species ecological role. Therefore, the Greenland turbot fishery receives a score of "low" concern for fishing mortality.

Justification:

Catches of Greenland turbot peaked from 1972 to 1976 when foreign fisheries were still present in the Bering Sea. Low recruitment levels in the early 1980s led to reductions in Greenland turbot catches through the 1980s, and from 1990 to 1995, fishery managers set the ABC and TACs to 7000 t as an added conservation measure (Barbeaux et al. 2016). Catches are allocated regionally in the EBS and AI management areas (but not by gear type).

The majority (~2/3) of Greenland turbot catch from 1995 to 2006 was from the longline fishery. In 2007 to 2009 and 2012 to 2014, trawl-caught Greenland turbot exceeded the level of catch by longline vessels. Shifts in the proportion of catch by sector was due in part to changes arising from Amendment 80 (2007) and potentially from loss of revenue associated with killer whale depredation (Peterson et al. 2014). In some years, Greenland turbot catch occurs largely in other target fisheries (e.g., flatfish trawl, Pacific halibut, Pacific cod); however, in 2016 there was a large directed catch of Greenland turbot in the directed fishery (40.7% in 2016 up from 1.7% in 2015) (Barbeaux et al. 2016). Fishing mortality rates have been stable and below target reference points since 2013 (Figure A).

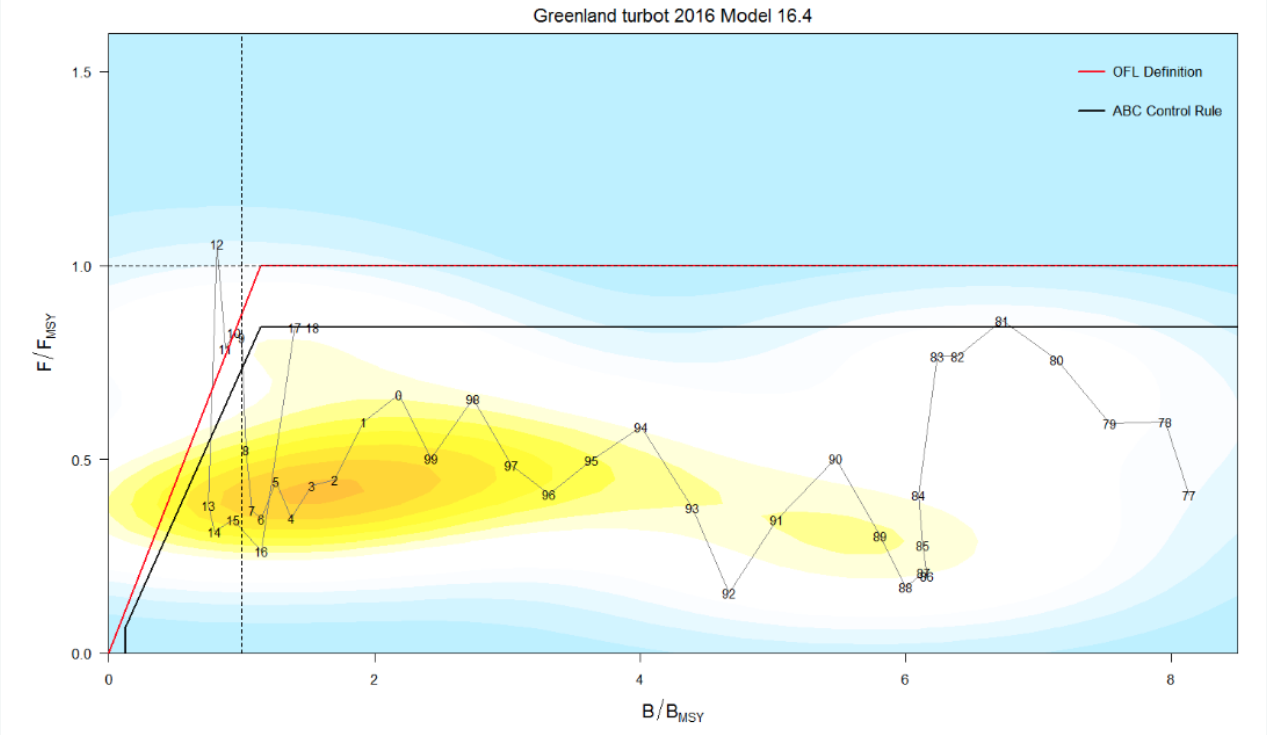

Figure 12 For Model 16.4 ratio of historical F/Fmsy versus female spawning biomass relative to Bmsy for BSAI Greenland turbot, 1977-2018. Note that the proxies for Fmsy and Bmsy are F35% and B35%, respectively. The Fs presented are the sum of the full Fs across fleets (Barbeaux et al. 2016).

GREENLAND TURBOT

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

Greenland turbot is assessed biennially using an age-structured, split sex model. Estimated total and spawning biomass declined dramatically from the mid-1970s in the BSAI, likely due to poor recruitment and relatively high fishing effort (Barbeaux et al. 2016). Spawning biomass stabilized somewhat beginning in 2013 but remains well below historic levels. Projected female SSB for 2018 is 58,035 t or 56% of unfished SSB. For 2018, the projected SSB is approximately 161% of target reference point $SB_{35\%}$ (Bryan and Barbeaux 2017). Greenland turbot abundance is at or above target reference points; however, Greenland turbot receives a score of "low" concern for abundance due to low recruitment levels post-2010 and associated concerns about continued ocean warming in the EBS (M. Bryan, NMFS, personal communication 2018).

Justification:

Greenland turbot have a wide distribution in the Pacific Ocean and have been found from the Sea of Japan to the waters off Baja California north to the Beaufort and Chukchi seas (Barbeaux et al. 2016). Greenland turbot primarily inhabit the deeper slope and shelf waters (between 100 m to 2000 m) in bottom temperatures ranging from –2°C to 5°C and are most abundant found in the northern Bering Sea. Greenland turbot recruitment has been linked with bottom temperatures, and low recruitment since 2010 supports this relationship (Figures A,B).

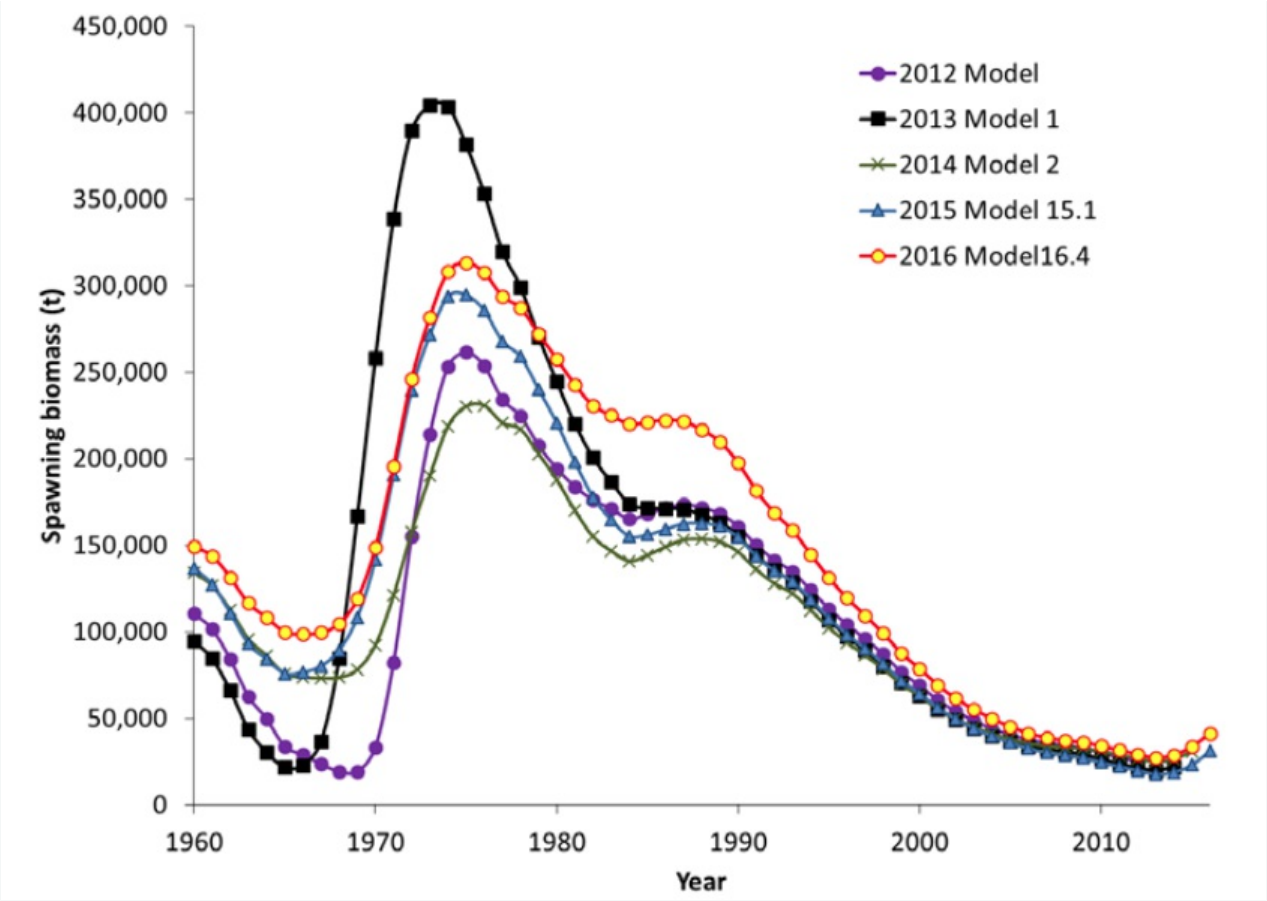

Figure 13 Female spawning biomass in tons for BSAI Greenland Turbot for Model 16.4 and previous years' stock assessments (Barbeaux et al. 2016).

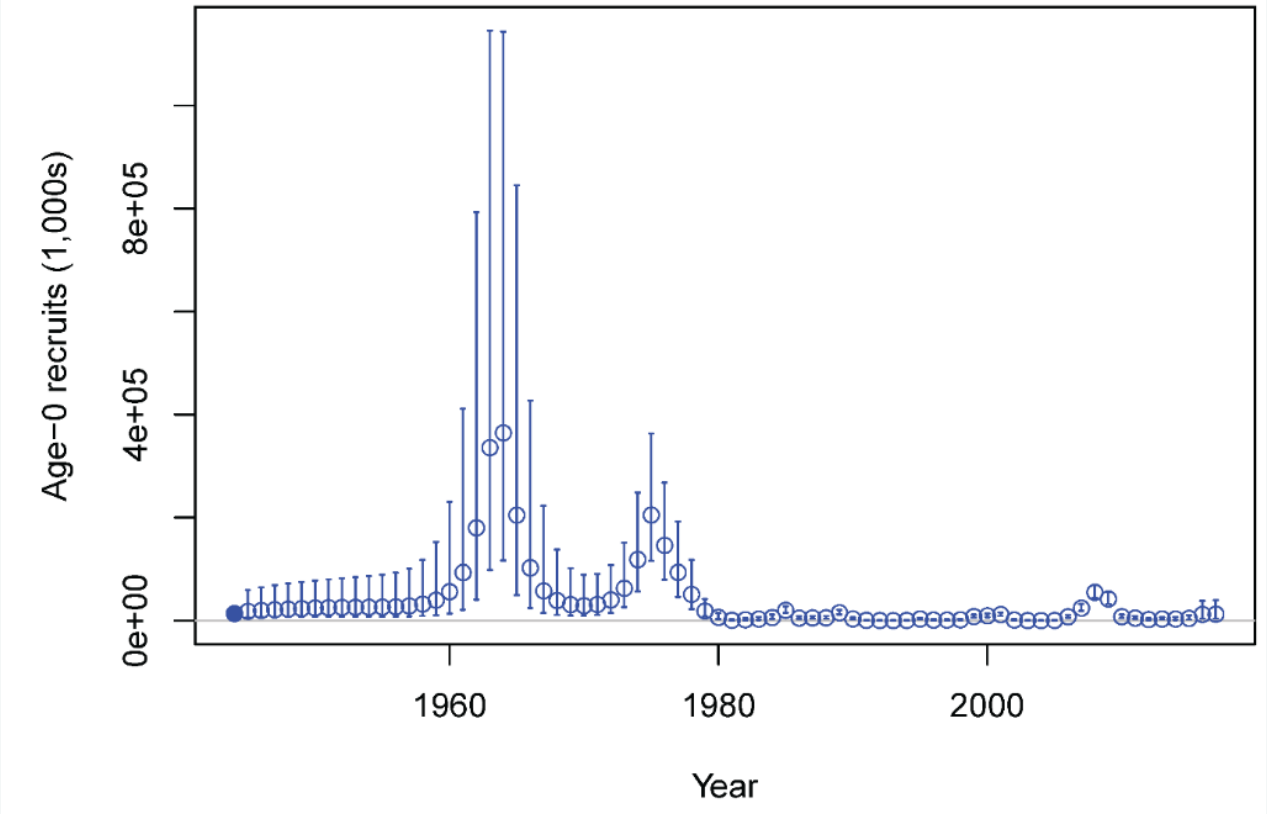

Figure 14 Age-0 recruits (bottom) in thousands current Greenland turbot assessment model (Barbeaux et al. 2016).

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

The estimated catch of Greenland turbot in 2017 was 2,832 t or 0.43 of the ABC (6644 t). Apical fishing mortality was relatively high 2009 to 2012 (peaked at 0.23 in 2012; some reference points may have been exceeded during this time based on retrospective analyses), fishing mortality decreased beginning in 2013 to 2016 and ranged from 0.06 to 0.08. Although fishing mortality can be difficult to assess or predict for the Greenland turbot fishery because the catches are not allocated by gear type (Barbeaux et al. 2016), assessment methods to set ABCs and TACs have improved in recent years, and fishing mortality from all sources is at a sustainable level given the species ecological role. Therefore, the Greenland turbot fishery receives a score of "low" concern for fishing mortality.

Justification:

Catches of Greenland turbot peaked from 1972 to 1976 when foreign fisheries were still present in the Bering Sea. Low recruitment levels in the early 1980s led to reductions in Greenland turbot catches through the 1980s, and from 1990 to 1995, fishery managers set the ABC and TACs to 7000 t as an added conservation measure (Barbeaux et al. 2016). Catches are allocated regionally in the EBS and AI management areas (but not by gear type).

The majority (~2/3) of Greenland turbot catch from 1995 to 2006 was from the longline fishery. In 2007 to 2009 and 2012 to 2014, trawl-caught Greenland turbot exceeded the level of catch by longline vessels. Shifts in the proportion of catch by sector was due in part to changes arising from Amendment 80 (2007) and potentially from loss of revenue associated with killer whale depredation (Peterson et al. 2014). In some years, Greenland turbot catch occurs largely in other target fisheries (e.g., flatfish trawl, Pacific halibut, Pacific cod); however, in 2016 there was a large directed catch of Greenland turbot in the directed fishery (40.7% in 2016 up from 1.7% in 2015) (Barbeaux et al. 2016). Fishing mortality rates have been stable and below target reference points since 2013 (Figure A).

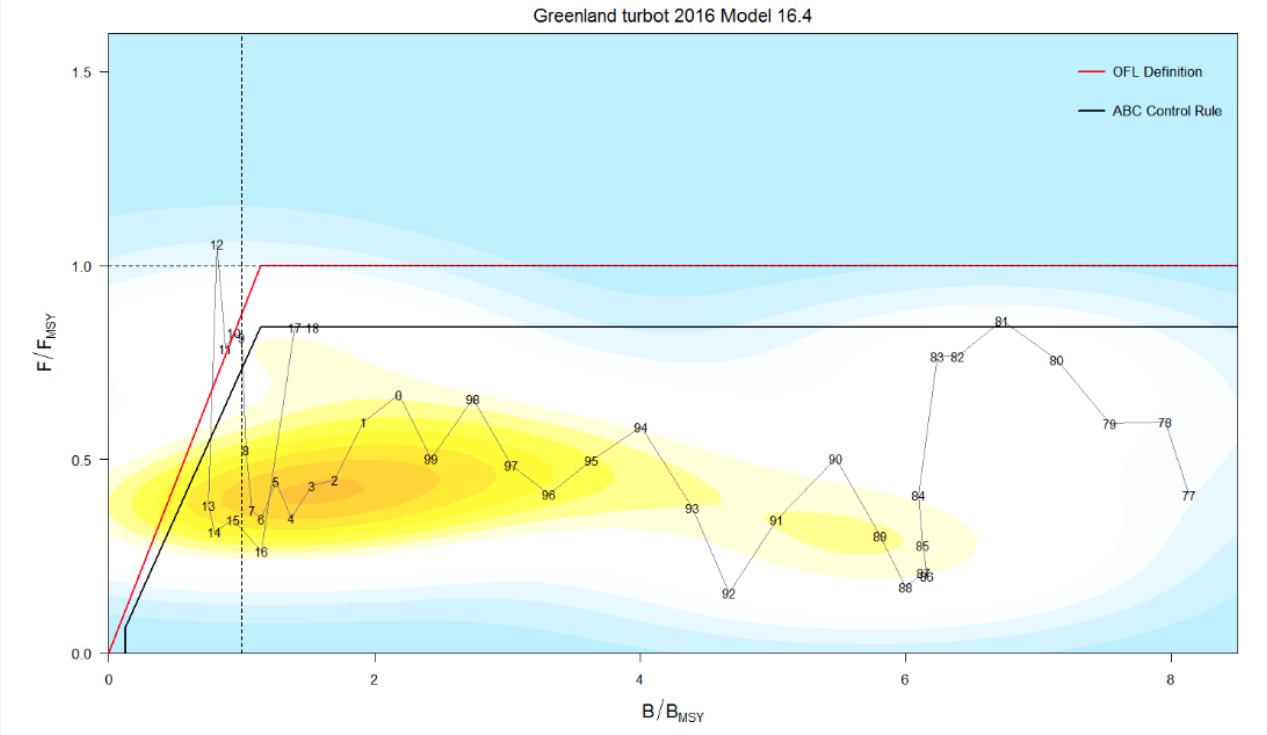

Figure 15 For Model 16.4 ratio of historical F/Fmsy versus female spawning biomass relative to Bmsy for BSAI Greenland turbot, 1977-2018. Note that the proxies for Fmsy and Bmsy are F35% and B35%, respectively. The Fs presented are the sum of the full Fs across fleets (Barbeaux et al. 2016).

KAMCHATKA FLOUNDER

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Very Low Concern

Kamchatka flounder is assessed biennially as a Tier 3 stock with an age-structured model, relying on fishery dependent and fishery independent data sources. Projected female SSB for 2018 was 63,718 t or 50% of unfished SSB (Bryan and Wilderbuer 2017). For 2018, the projected SSB is approximately 143% of the target reference point $SB_{35\%}$. The Kamchatka flounder fishery is not classified as overfished (NMFS FSSI 2017) (Bryan and Wilderbuer 2017), and Kamchatka flounder receives a score of "very low" concern for abundance.

Justification:

Estimated total biomass of Kamchatka flounder has increased moderately since 1990 (Figure A) (Bryan and Wilderbuer 2017).

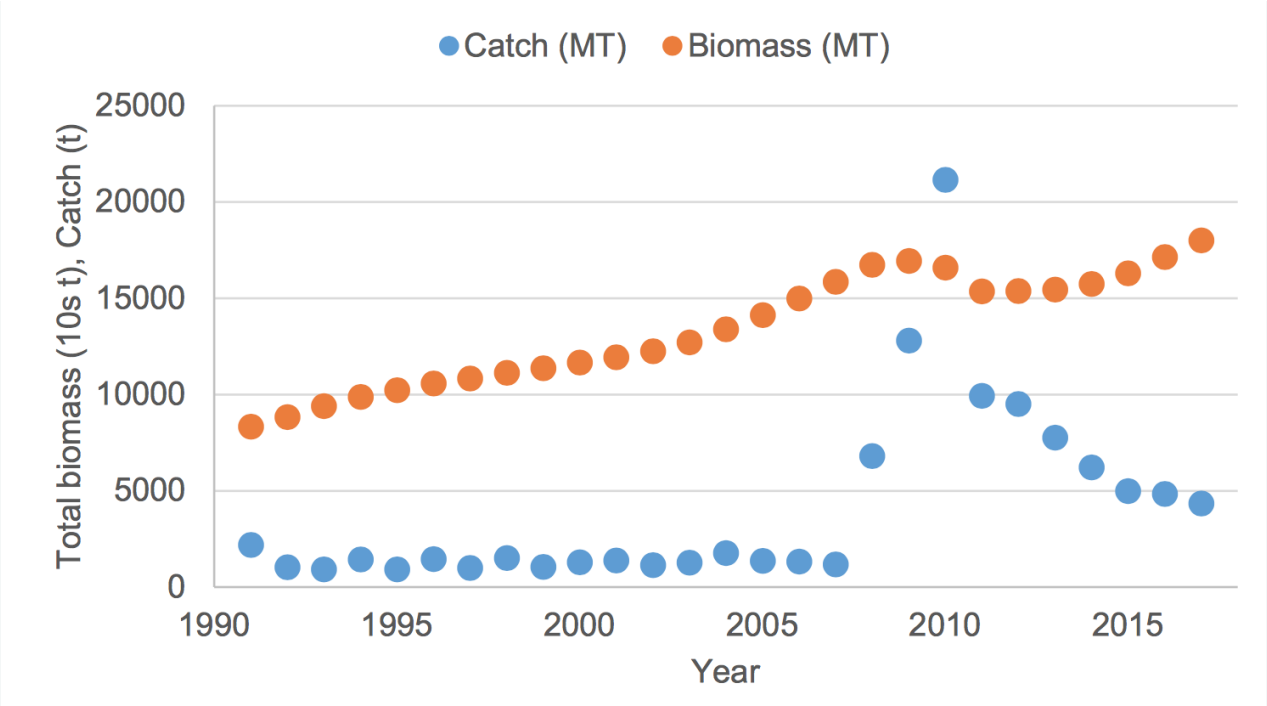

Figure 16 Time series of total biomass (10s of tons), catch (tons) of kamchatka flounder (Bryan & Wilderbuer 2017).

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

Kamchatka flounder is caught in directed BSAI flatfish trawl fisheries and as bycatch, primarily in Greenland turbot fisheries. The estimated catch of BSAI Kamchatka flounder in 2017 was 4,501 t or 0.51 of the ABC. Fully selected fishing mortality averaged 0.045 from 2011 to 2016 and remains well below the $F_{40\%}$ value of 0.066 (Wilderbauer et al. 2016). Catches and fishing mortality values are below target management reference points, and Kamchatka flounder receives a score of "low" concern for fishing mortality in the Greenland turbot hook and line and trawl fisheries.

LIGHT DUSKY ROCKFISH

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Very Low Concern

GOA dusky rockfish is assessed biennially using an age-structured model. Projected GOA dusky rockfish SSB for 2018 is 21,559 t or 44% of unfished SSB. For 2018, the projected SSB is approximately 125% of the target reference point $SB_{35\%}$ (Fenske et al. 2017).The estimated $B:B_{MSY}$ is 1.46 (NMFS FSSI 2017), and GOA dusky rockfish receives a score of "very low" concern for abundance.

Justification:

Dusky rockfish exhibit one of the most northerly distributions of all rockfish species in the Pacific and are concentrated along the outer continental shelf at depths of 100 to 200 m (Lunsford et al. 2015). Survey-estimated dusky rockfish biomass generally declined moderately after exceptionally high 2005 values (Lunsford et al. 2015); however, more recent data suggests that biomass estimates may be stabilizing while they still exhibit significant inter-annual variability (Fenske et al. 2017) (Figure A). It is important to note survey biomass time series estimates for dusky rockfish are characterized by high variability because the survey does a poor job sampling untrawlable habitat where dusky rockfish are often encountered (Lunsford et al. 2015).

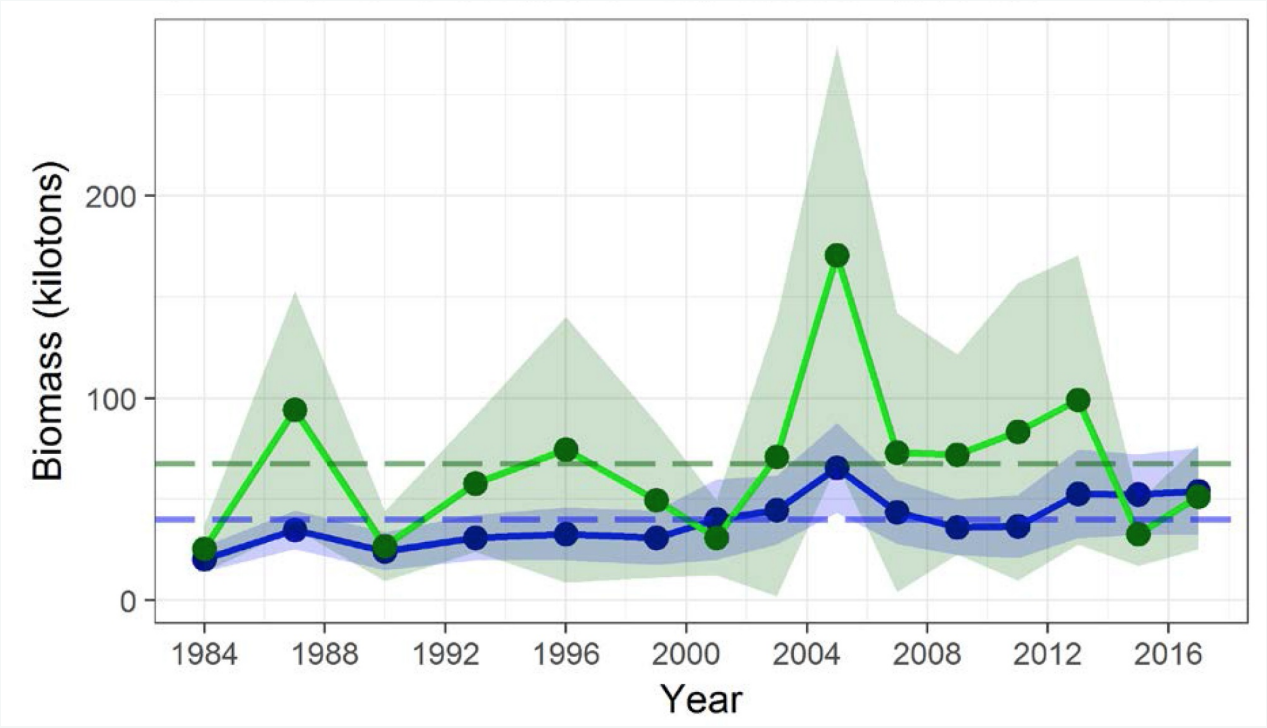

Figure 17 Comparison of dusky rockfish abundance estimates from Gulf of Alaska trawl survey using the geostatistical abundance estimator (blue) and the design based estimator (green), with approximate 95% confidence intervals (Fenske et al. 2017).

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of GOA dusky rockfish in 2017 was 2,622 t or 0.61 of the ABC (4278 t). The fishery is not classified as overfished or approaching an overfishing condition (Fenske et al. 2017). Fishing mortality from all sources is at or below target reference points, and the fishery receives a score of "low" concern for fishing mortality.

Justification:

Dusky rockfish are taken in three main zones in the GOA: the western, central, and eastern management areas. Dusky rockfish are caught almost exclusively with bottom trawls in the central and western areas of the of GOA (trawling is prohibited in part of Southeast Outside/West Yakutat area). GOA dusky rockfish are harvested as part of the GOA Rockfish Program, which allocated rockfish quota by sector and species beginning in 2007. The dusky rockfish catch/biomass ratio has ranged from 0.02 to 0.06 since 1991 (Figure A)

(Fenske et al. 2017). Fishing mortality has been below the F40% reference point since 2000 and has generally declined since the early 1980s and 1990s (Figure B) (Lunsford et al. 2015).

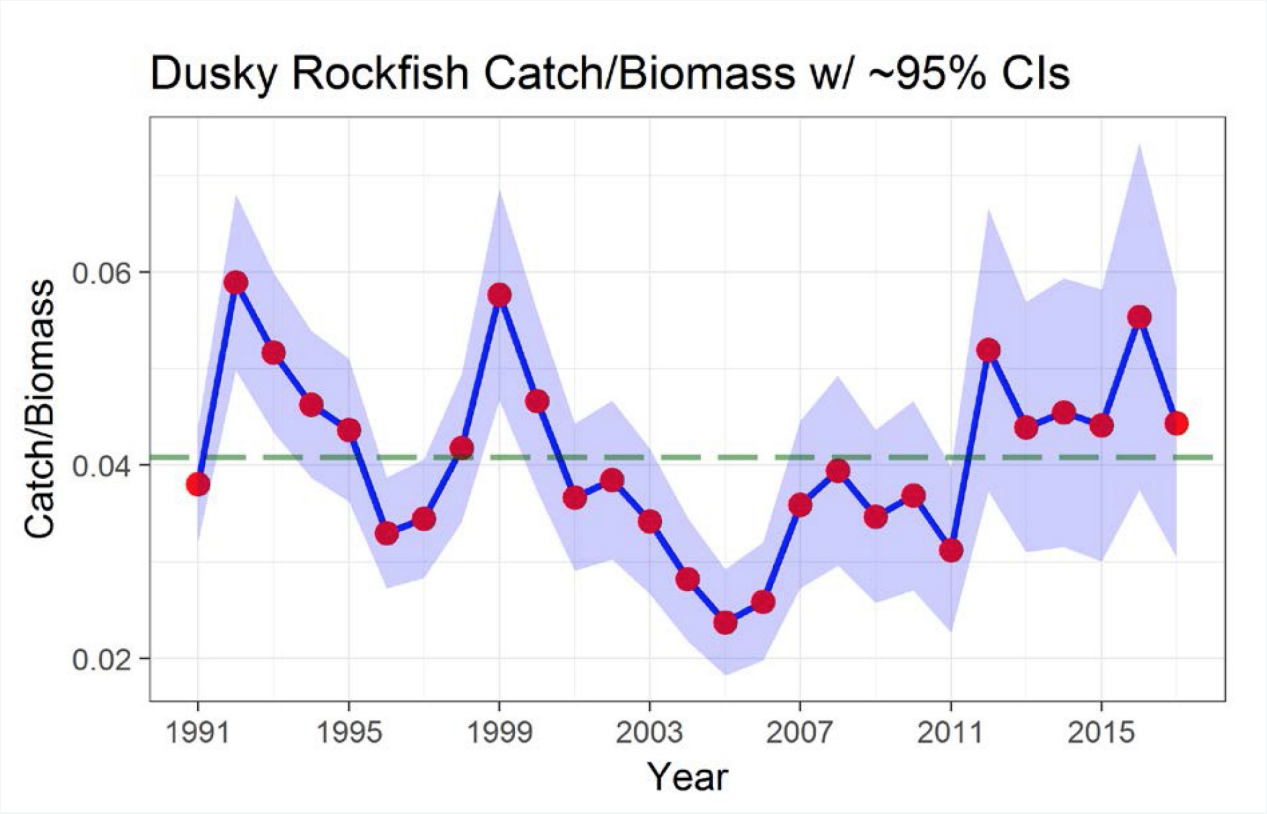

Figure 18 GOA Dusky rockfish catch/biomass ratio with approximate 95% confidence intervals. Green dashed line is long-term average for the time series. Biomass is age 4+ biomass from the age structured assessment model (Fenske et al. 2017).

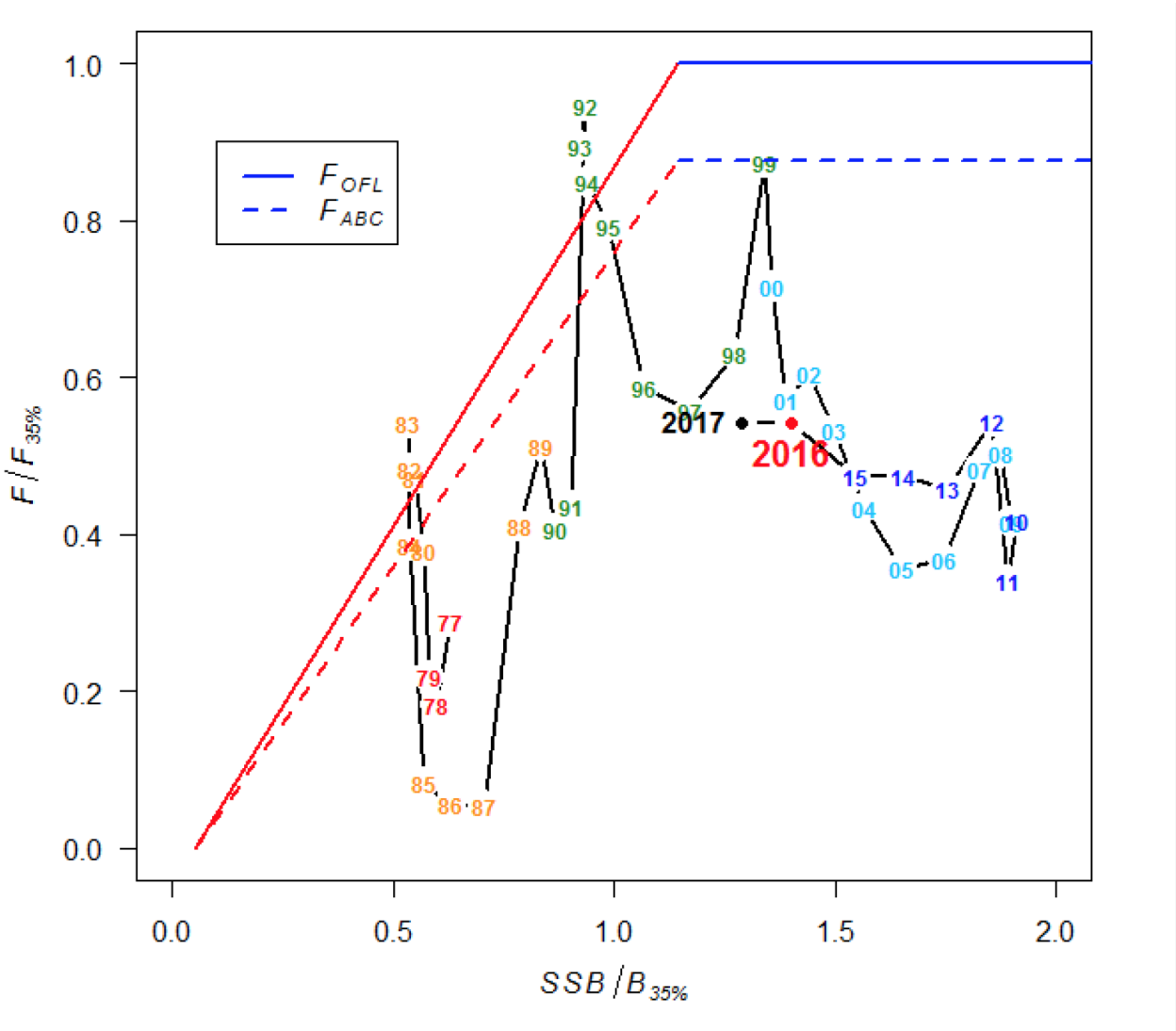

Figure 19 Time series of dusky rockfish estimated spawning biomass relative to the unfished level and fishing mortality relative to FOFL for the 2015 model. (Lunsford et al. 2015).

NORTHERN ROCKFISH

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Very Low Concern

BSAI northern rockfish is assessed biennially using an age-structured model. Projected northern rockfish SSB for 2018 is 106,486 t or 65% of unfished SSB. For 2018, the projected SSB is approximately 185% of the target reference points $SB_{35\%}$ (Spencer & Ianelli 2017). The estimated $B:B_{MSY}$ is 1.92 (NMFS FSSI 2017), and BSAI northern rockfish receives a score of "very low" concern for abundance.

Justification:

Northern rockfish are a slow growing, long-lived demersal species, typically captured at depths between 100 m and 200 m. Estimated total and spawner biomass has increased steadily since the mid-1970s (Figure A); however, high regional variability in biomass estimates adds some uncertainty to estimates (Spencer and

Ianelli 2016a).

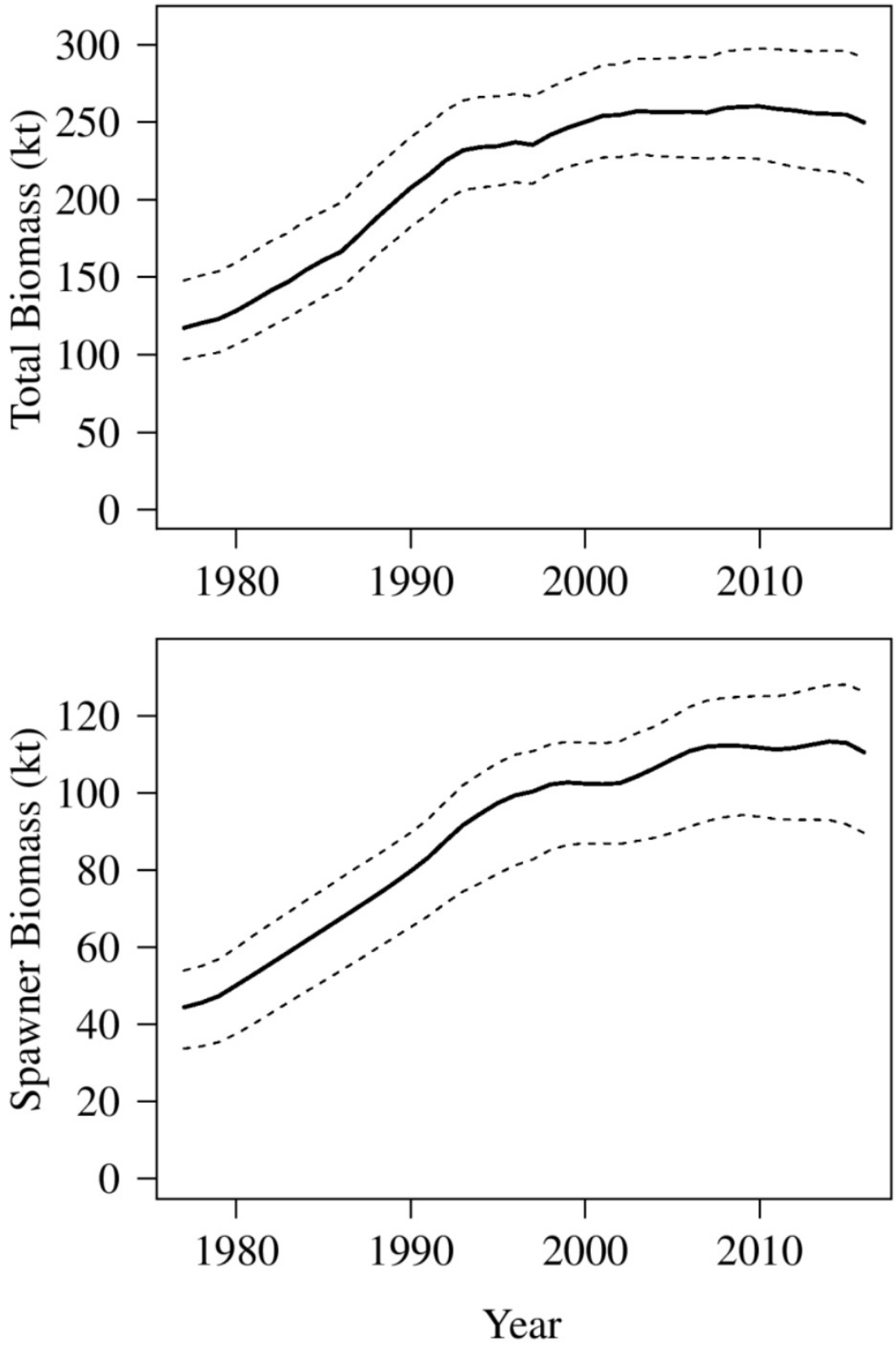

Figure 20 Total and spawner biomass for BSAI northern rockfish with 95% confidence intervals from MCMC

integration (Spencer & Ianelli 2016).

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Low Concern

The estimated catch of BSAI Northern rockfish in 2017 was 4698 t or 0.35 of the ABC (13264 t) (Spencer and Ianelli 2017). The fishery is not classified as overfished or approaching overfishing (NMFS FSSI 2017). Fishing mortality from all sources is at or below target reference points, and the fishery receives a score of "low" concern for fishing mortality.

Justification:

Northern rockfish are primarily taken with trawl fishing gear as part of the Atka Mackerel fishery, and harvest data from 2004 to 2010 shows that approximately 88% of the BSAI northern rockfish were harvested in the Atka mackerel fishery during that time. Although typically a bycatch species, northern rockfish have been targeted more recently (potentially as a result of restrictions in the Atka mackerel fishery) (Spencer and Ianelli 2017). In 2015, this targeting resulted in a catch of 7,197 t exceeding the TAC of 3,250 (the 2015 catch was well below the ABC of 12,488 t). Northern rockfish TAC has historically been set much lower than the ABC.

Fully selected fishing mortality remained relatively low from 1980 to 1990 when harvests were minimal and then increased during the mid-1990s but has remained well under target reference points and has not exceeded 0.035 (Figure A).

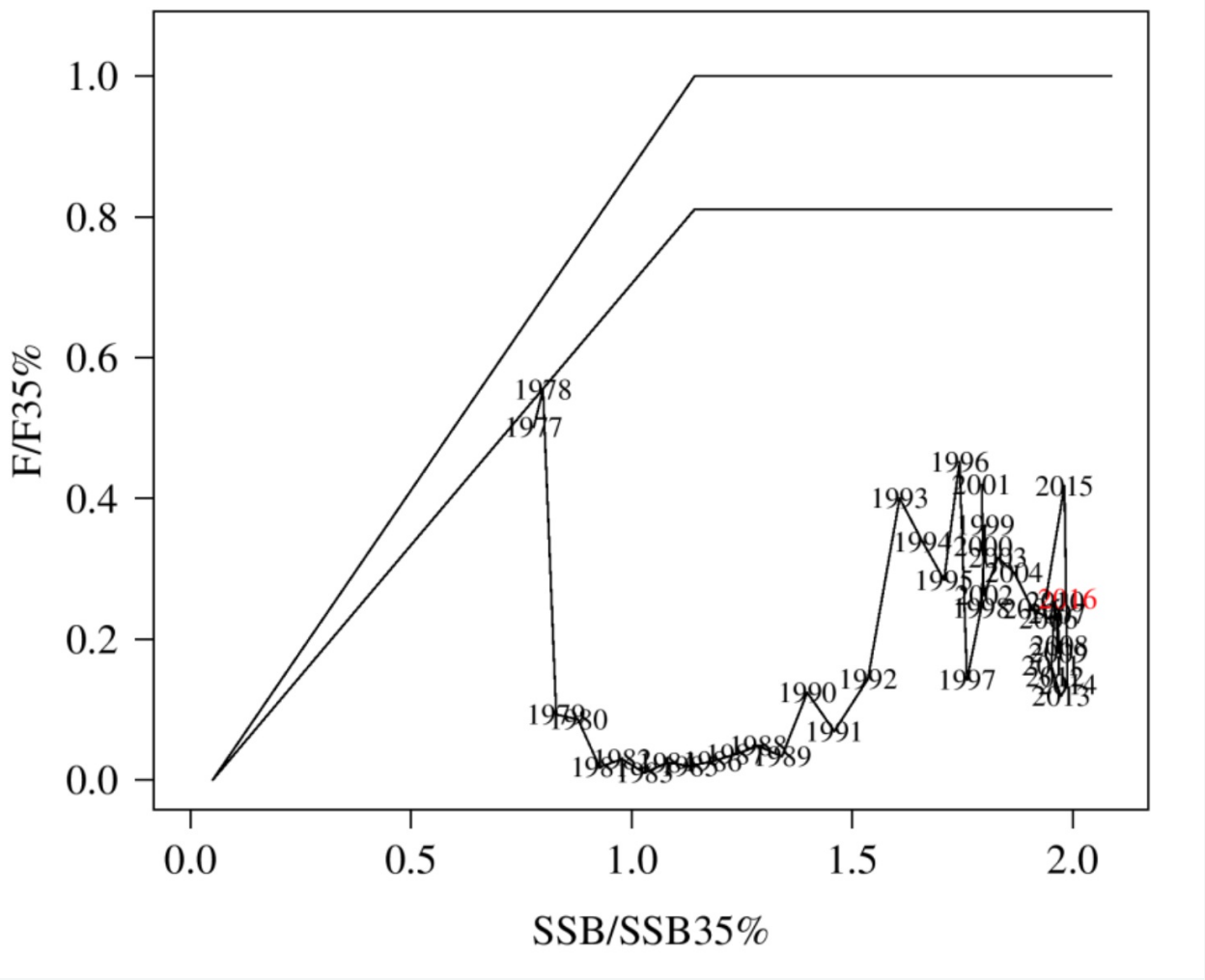

Figure 21 Estimated fishing mortality and SSB from 1977-2016 (with 2016 in red) in reference to OFL (upper line) and ABC (lower line) harvest control rules (Spencer & Ianelli 2016).

NORTHERN ROCKFISH

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Very Low Concern

Projected GOA northern rockfish SSB for 2018 is 28,017 t or 40% of unfished SSB. For 2018, the projected SSB:$SB_{35\%}$ is approximately 1.14 (Cunningham et al. 2017). The estimated B:B_{MSY} is 1.28 (NMFS 2017), and GOA northern rockfish receive a score of "very low" concern for abundance.

Justification:

Survey biomass estimates have been variable since 1996, and the 2017 biomass estimate is near the time trend average (1984 to 2017) (Figure A).

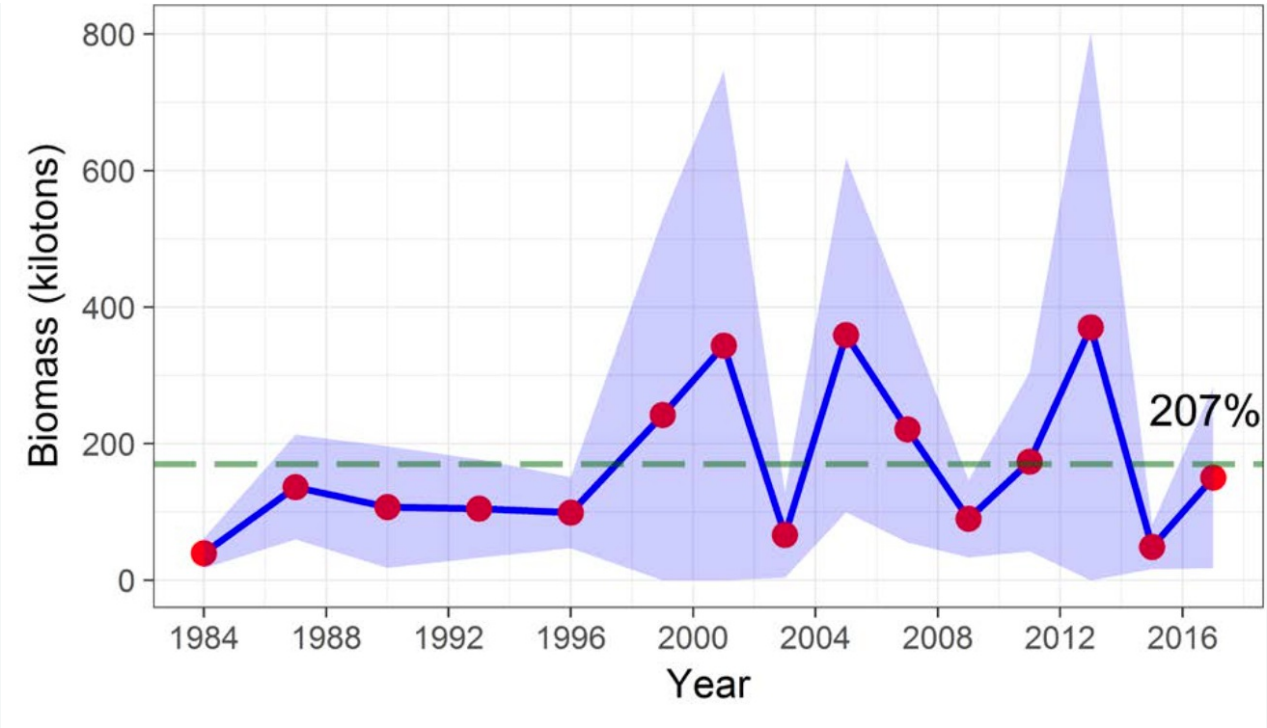

Figure 22 GOA Northern Rockfish survey biomass with 95% CIs. Design-based biomass index for GOA northern rockfish from the NMFS bottom trawl survey, point estimates in red circles) with 95% sampling error confidence intervals (shaded area), from 1984-2017. Green dashed line is long-term average for the time series. Text percentage is the change of the 2017 index from the 2015 index (Cunningham et al. 2017).

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated 2017 catch of GOA northern rockfish was 1,836 t or 0.48 of the ABC (3790 t). GOA northern rockfish are generally not prosecuted to the full extent (77% to 92% of TAC taken 2010 to 2015), and less than half of the TAC was harvested in 2017. The fishery is not classified as overfished or approaching overfishing (Cunningham et al. 2017) (NMFS FSSI 2017), and GOA northern rockfish receives a score of "low" concern for fishing mortality.

Justification:

GOA northern rockfish are harvested with trawl gear, and TAC is allocated by management area. The majority of GOA northern rockfish catch occurs in the Central GOA region.The northern rockfish catch/biomass ratio ranged from 0.019 to 0.052 from 1991 to 2016 (Figure A). The 2017 projected catch/biomass ratio of 0.024 is 46% less than that observed in 2016 (0.044) (Cunningham et al. 2017).

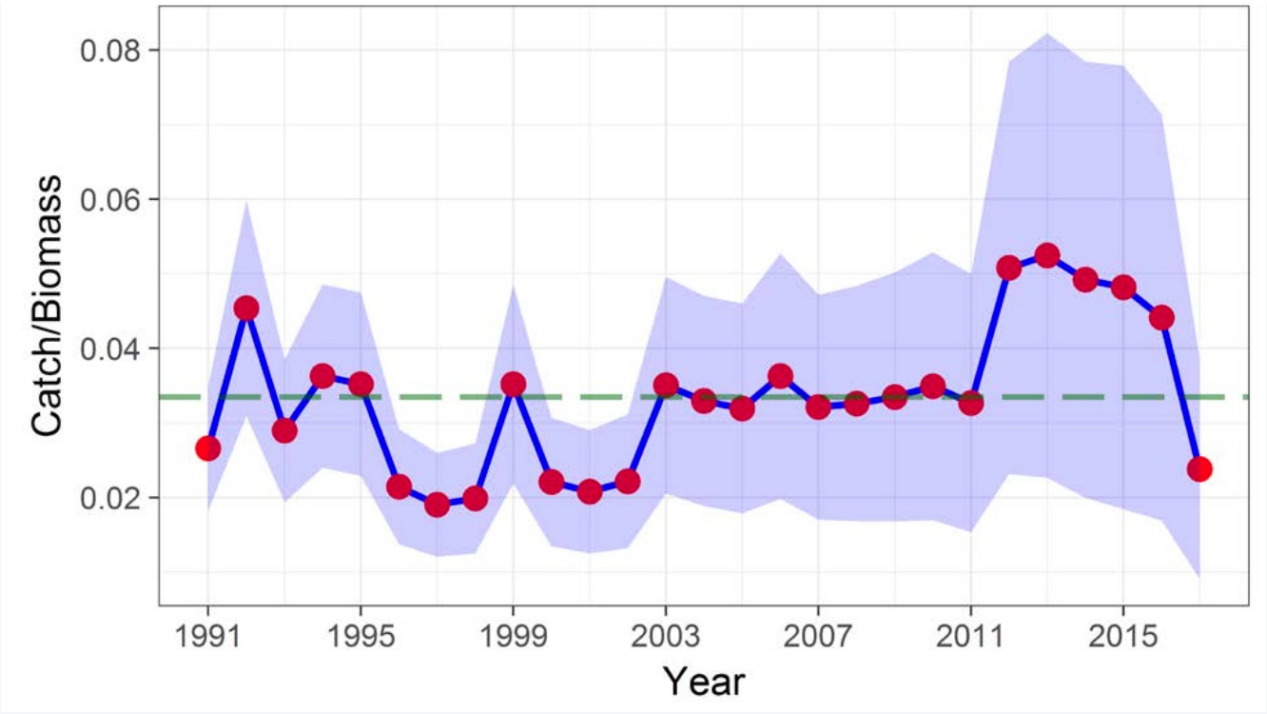

Figure 23 GOA Northern rockfish Catch/Biomass with ~95% CIs. Modeled catch over total biomass (point estimates in red circles) with 95% sampling error confidence intervals (shaded area) for Gulf of Alaska northern rockfish from 1991-2017. Green dashed line is long-term average for the time series. Total biomass is ages 2+ from the age-structured model (Cunningham et al. 2017).

PACIFIC COD

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Moderate Concern

GOA Pacific Cod is assessed annually, and data inputs that inform the assessment include fishery independent data sources such as the annual longline survey and biennial trawl survey and fishery dependent data collected by on-board observers. Projected female SSB for 2018 decreased to 36,209 t or 21% of unfished SSB. This represents a 71% decline in abundance and a 58% decrease in biomass since 2015 (Barbeaux, NMFS, NPFMC presentation February 2018). For 2018, the projected SSB is approximately 61% of the target reference points $SB_{35\%}$. Recent declines in Pacific cod spawning biomass and abundance coupled with SSB values less than 70% of the target reference point $SB_{35\%}$ yield a score of "moderate" concern for abundance.

Justification:

Pacific cod is a transoceanic species found at depths from shoreline to approximately 500 m. Projected 2018 SSB is at its lowest level in the time series (Figure A) and is expected to continue declining through 2019 (Barbeaux, NMFS, NPFMC presentation February 2018). A number of factors have been discussed as potential mechanisms for the dramatic decline in Pacific cod abundance in the GOA. Anomalous warm temperatures 2014 to 2016 led to increases in sea surface temperature (SST) and seafloor temperatures in the GOA (Barbeaux et al. 2017). Research suggests a connection between water temperature and larval production, where warm SSTs are linked with low larval abundance (Doyle and Mier 2016). Additionally, warm temperatures may also negatively impact growth potential and metabollic efficiency of Pacific cod during

various life history stages (Doyle and Mier 2016) (Barbeaux et al. 2017) (Figure B), and a substantial increase in natural mortality occurred in 2015 and 2016 (Barbeaux et al. 2017).

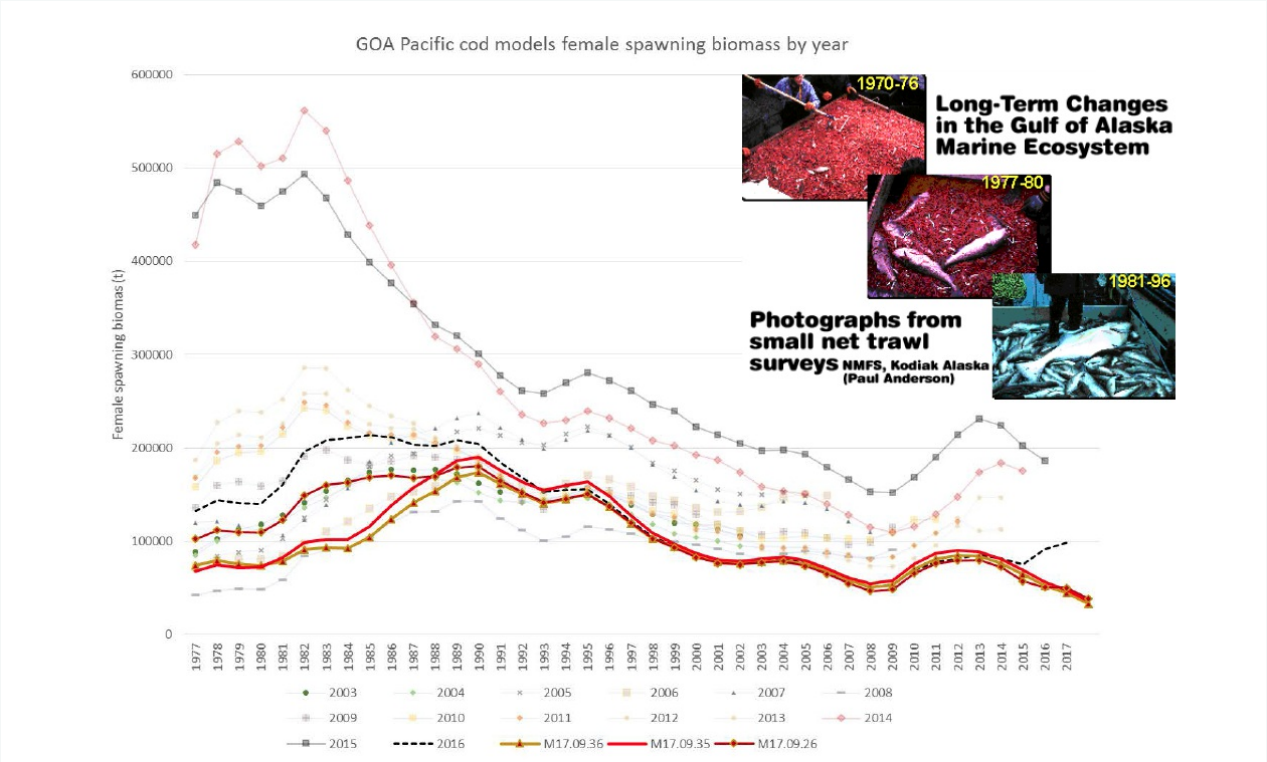

Figure 24 1977-2016 GOA Pacific cod female spawning biomass from the 2003 through the 2016 stock assessments with the authors's preferred models M17.09.35,36, 26, and (inset) images from the NMFS small net survey off Kodiak Alaska showing change in species composition over time (Barbeaux et al. 2017).

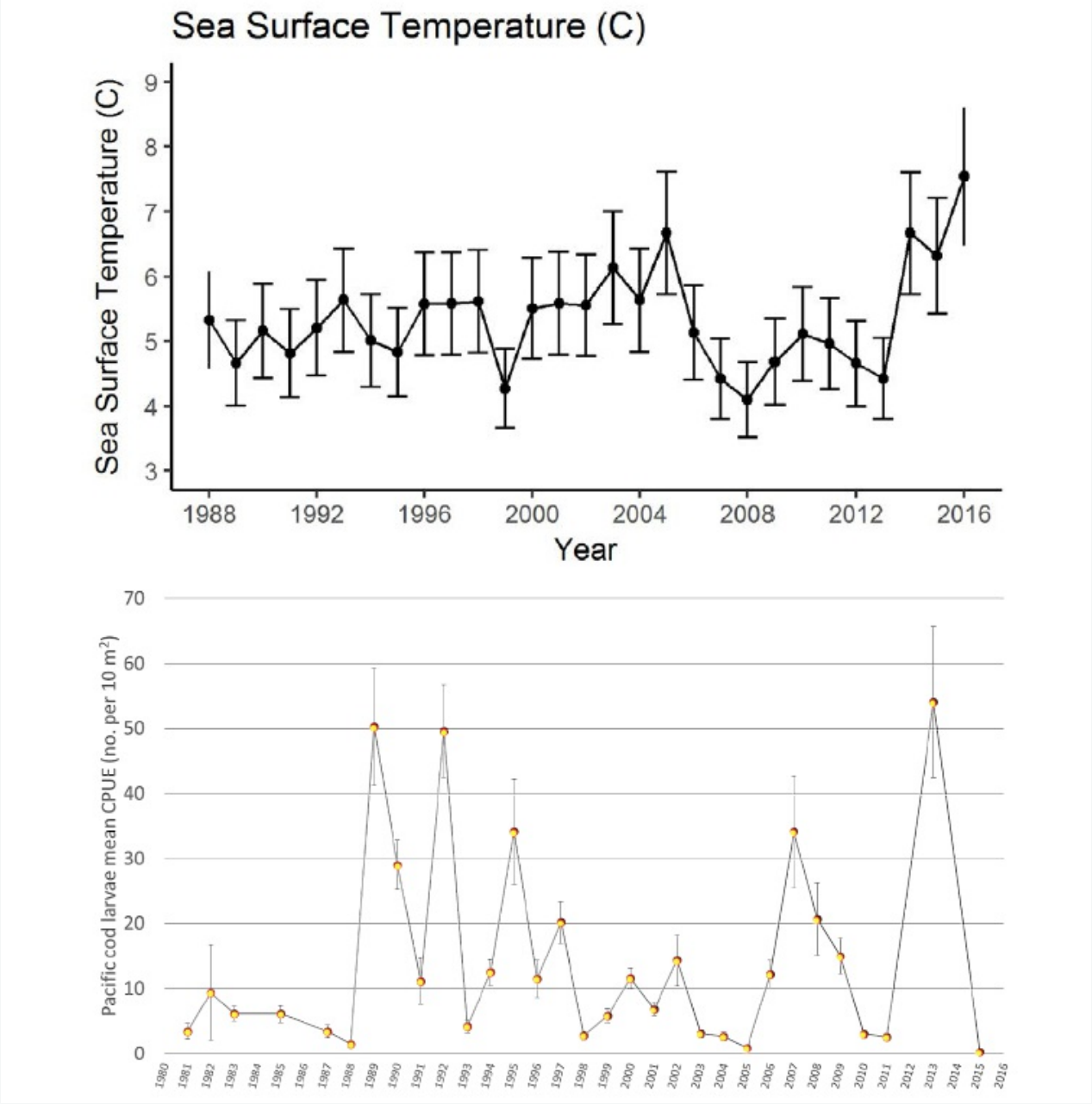

Figure 25 SST (top) and larval abundance from late spring icthyoplankton surveys in the GOA using all stations within a core area covering Shelikof Sea valley and Semidi bank area (Barbeaux et al. 2017).

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Low Concern

Pacific cod in the BSAI is assessed annually. Beginning in 2014, the EBS and AI Pacific cod stocks were assessed and managed separately; TACs and ABCs are set independently (AI represents roughly 5% of the total BSAI biomass). The EBS Pacific cod projected female SSB for 2018 is 217,000 t or 40% of unfished SSB. For 2018, the projected SSB is approximately 113% of the target reference point $SB_{35\%}$ for Tier 3 stocks. AI Pacific cod are managed as a Tier 5 stock and assessed with a random effects model that estimates biomass and natural mortality. Estimated biomass in the AI has been stable to increasing despite declines seen in the GOA and EBS. The EBS Pacific cod stock B/B_{MSY} ratio is 1.56 (NMFS FSSI 2017). It is not overfished or

approaching overfishing (Thompson 2017) (Thomson and Palsson 2017); however, data are limited for the AI Pacific cod stock. Although the AI Pacific cod stock represents a small fraction of BSAI Pacific cod as whole, uncertainty remains for this subpopulation and, therefore, BSAI Pacific cod receives a score of "low" concern for abundance (Thompson 2017).

Justification:

The estimated biomass of EBS Pacific cod decreased in 2017 from a relatively high 2015 value; however, spawning biomass increased moderately through 2017 (Thompson 2017) (Figure A).

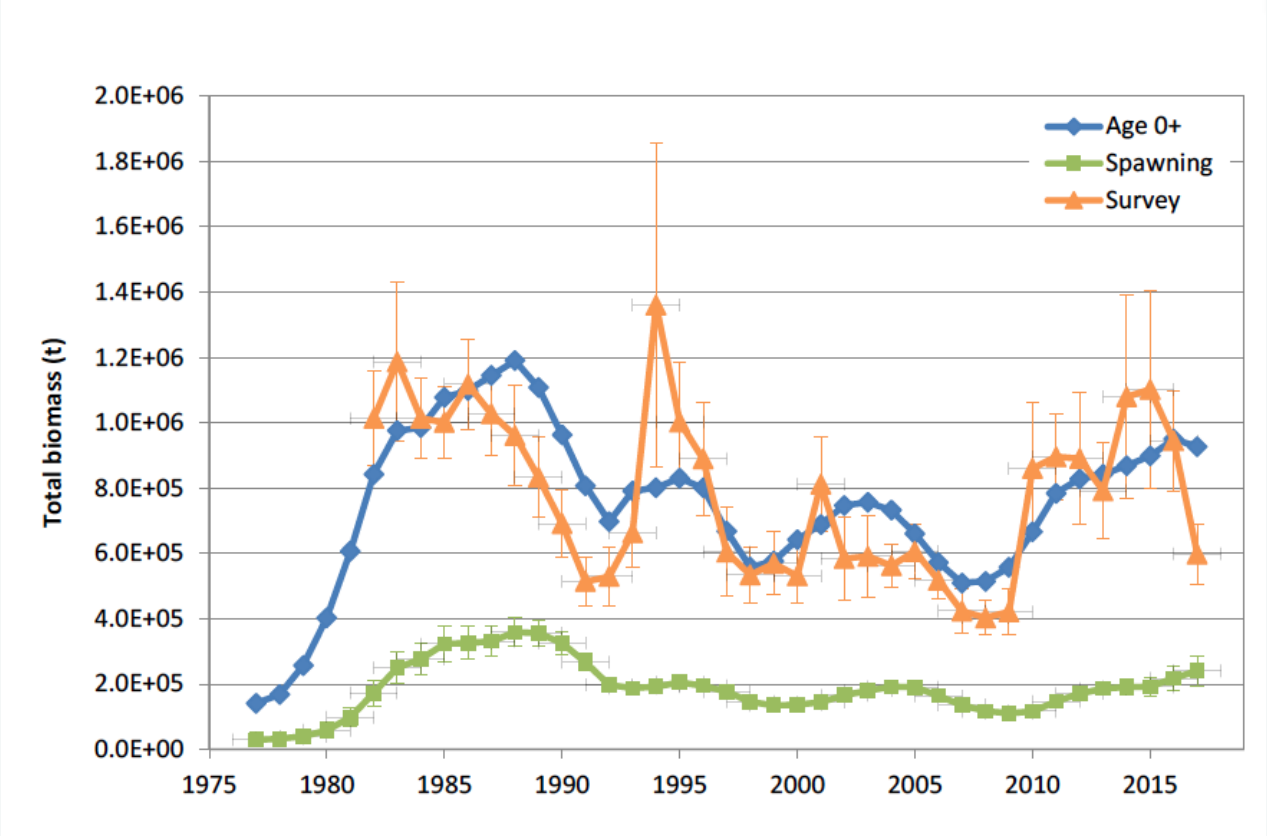

Figure 26 Time series of age 0+ and EBS female spawning biomass based on model estimates. Survey biomass is shown for comparison (Thompson 2017)..

AI Pacific cod biomass exhibited a moderate decline from 1990 to 2010 but has showed an increasing trend since 2010 (Thomson and Palsson 2017) (Figure B).

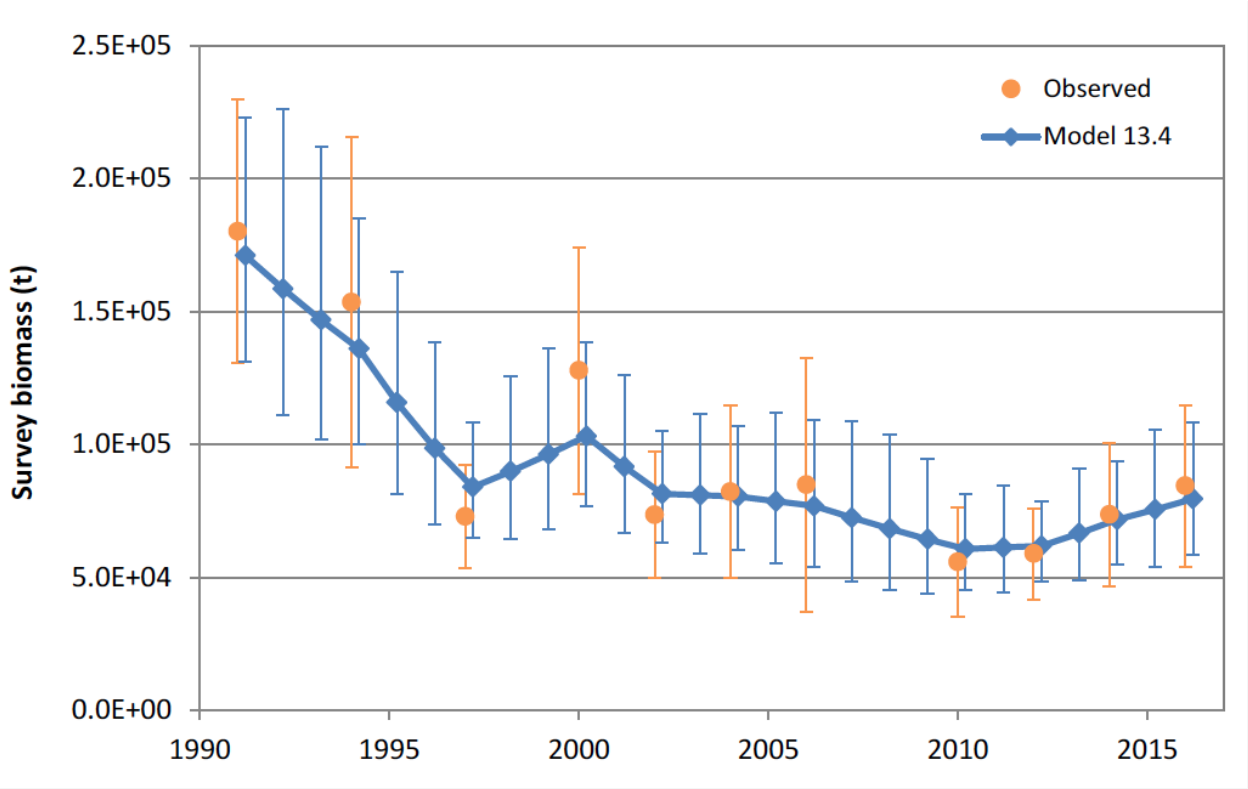

Figure 27 Fit of model to survey AI Pacific cod biomass time series, with 95% confidence intervals for the observations and estimates (Thomson & Palsson 2017).

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Moderate Concern

The estimated end of year catch of GOA Pacific cod in 2017 was 35,509 t, or 0.40 of the ABC (88,342 t). Low Pacific cod catches in 2017 were associated with recent declines in biomass seen in the GOA (Barbeaux et al. 2017). Since 2008, the Pacific cod ABC has been set at the maximum level per the Tier 3 status of the stock. However, in 2018 managers set the F_{ABC} below the maximum permissible F_{ABC} to increase the probability (to roughly 50%) that the stock will not fall below 20% of unfished spawning biomass for 2019 and 2020 (F_{ABC} = 0.53 and 0.31 for 2017 and 2018, respectively) (Barbeaux et al. 2017). The Pacific cod population is not classified as experiencing overfishing (Barbeaux et al. 2017). Model-estimated F increased steadily with the decline in abundance from 1990 to 2008, with continued high F through 2016, associated with increased catches and declining recruitment. GOA Pacific cod receives a score of "moderate" concern for fishing mortality because F is fluctuating around target reference points, F has been below control rule levels in all but two years (2008, 2017; still under $F_{35\%}$), and F has been increasing since the early 1990s.

Justification:

Fishing mortality has been relatively high and increasing in the GOA Pacific cod fishery since 2000. In four years (2007, 2008, 2015, 2017), $F/F_{MSY} > 1$ and above Tier 3 target reference points set by fishery managers (Figure A). During these years, F was still below the lower target reference point F35% (Barbeaux et al. 2017}.

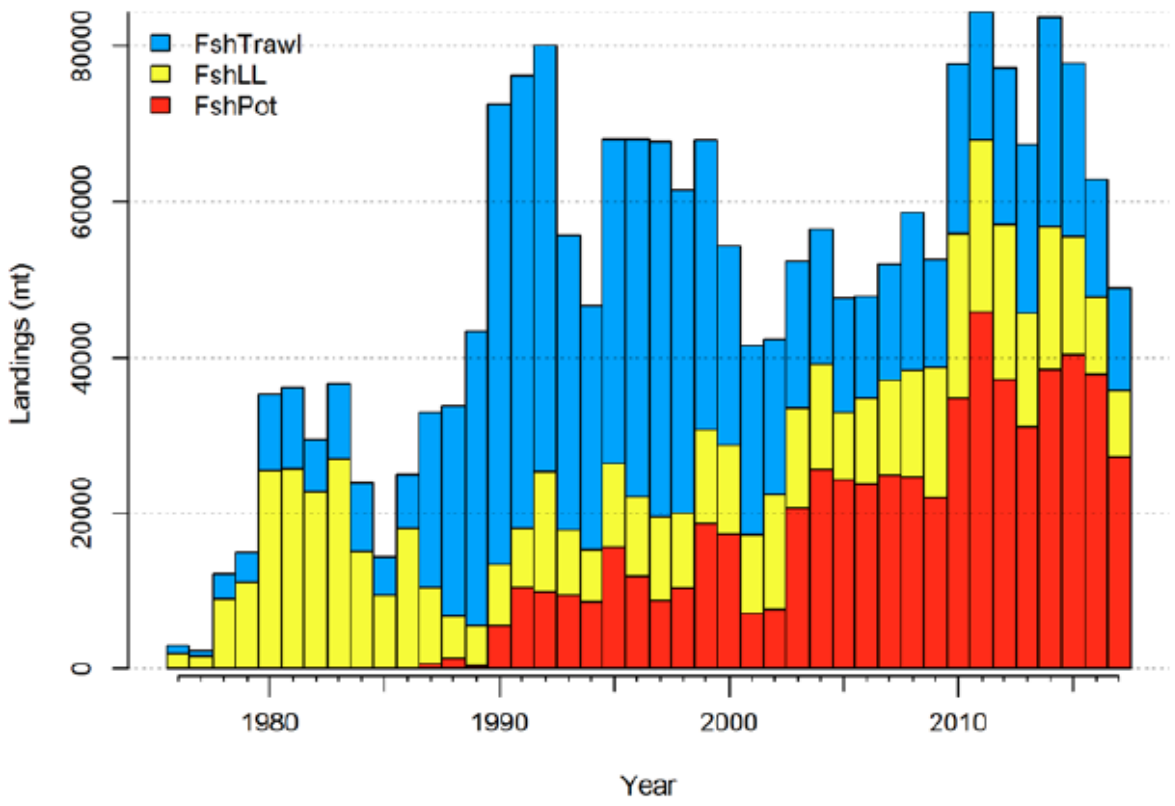

Figure 28 GOA Pacific cod catch from 1977-2017 (2017 estimated)(Barbeaux et al. 2017).

GOA Pacific cod is a multiple-gear fishery, including trawl, longline, pot, and jig components. Trawl gear historically took the largest share of catch from 1991 to 2002, although pot gear has taken the largest single-gear share of the catch in each year since 2003 (Barbeaux et al. 2017) (Figure C). F tends to higher for trawl and pot fisheries as compared to the longline fishery (Figure C). Pacific cod TAC is allocated in the Western and Central GOA among sectors as defined by gear type and processing capacity (CV and CP). The majority of landings (90%) occur by CVs delivering to shore-based processors. In most years, the fishery is fully exploited; however, in 2016 and 2017 the TAC was not fully taken, potentially due to poor fishing conditions (Barbeaux et al. 2017).

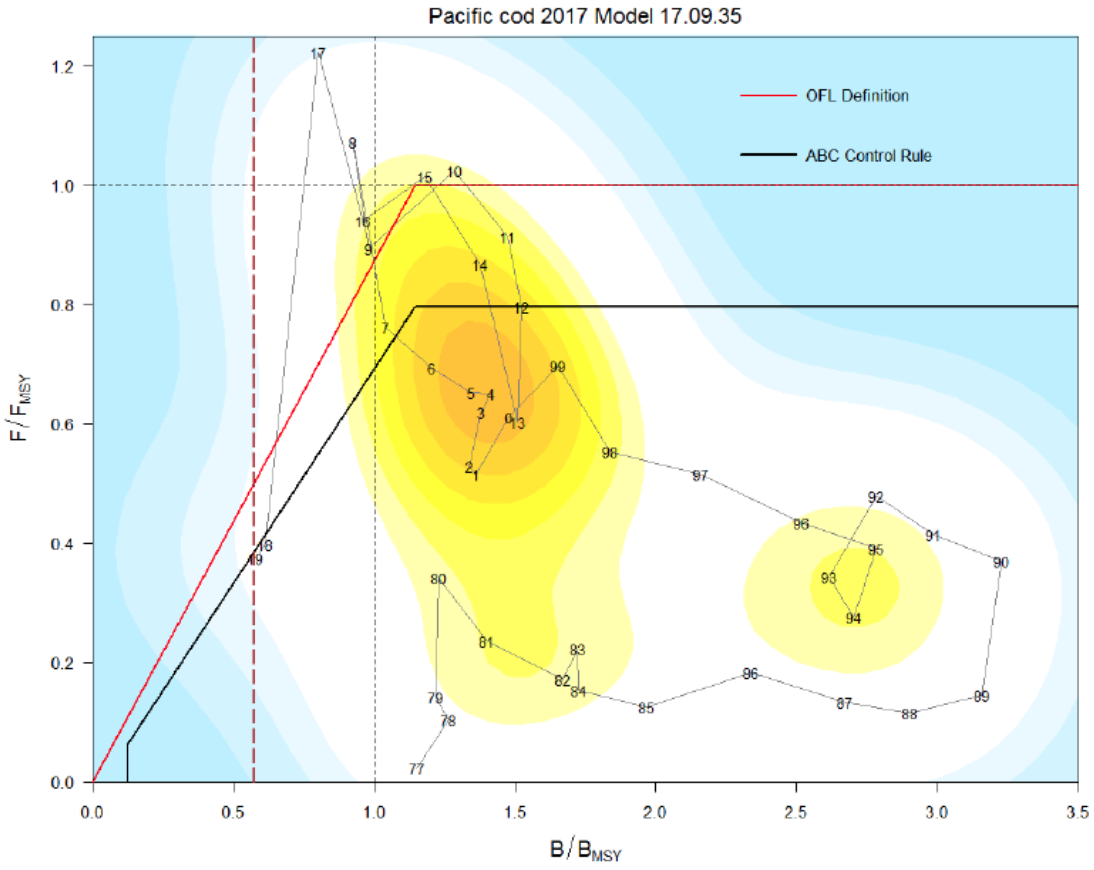

Figure 29 Ratio of historical F/FMSY verse female SSB/BMSY for GOA Pacific cod, 1977-2019. Note that proxies for FMSY and BMSY are F35% and B35%, respectively. The Fs presented here are the sum of the full Fs across fleets. Dashed line is at B20%, Steller sea lion closure rule for GOA Pacific cod (Barbeaux et al. 2017).

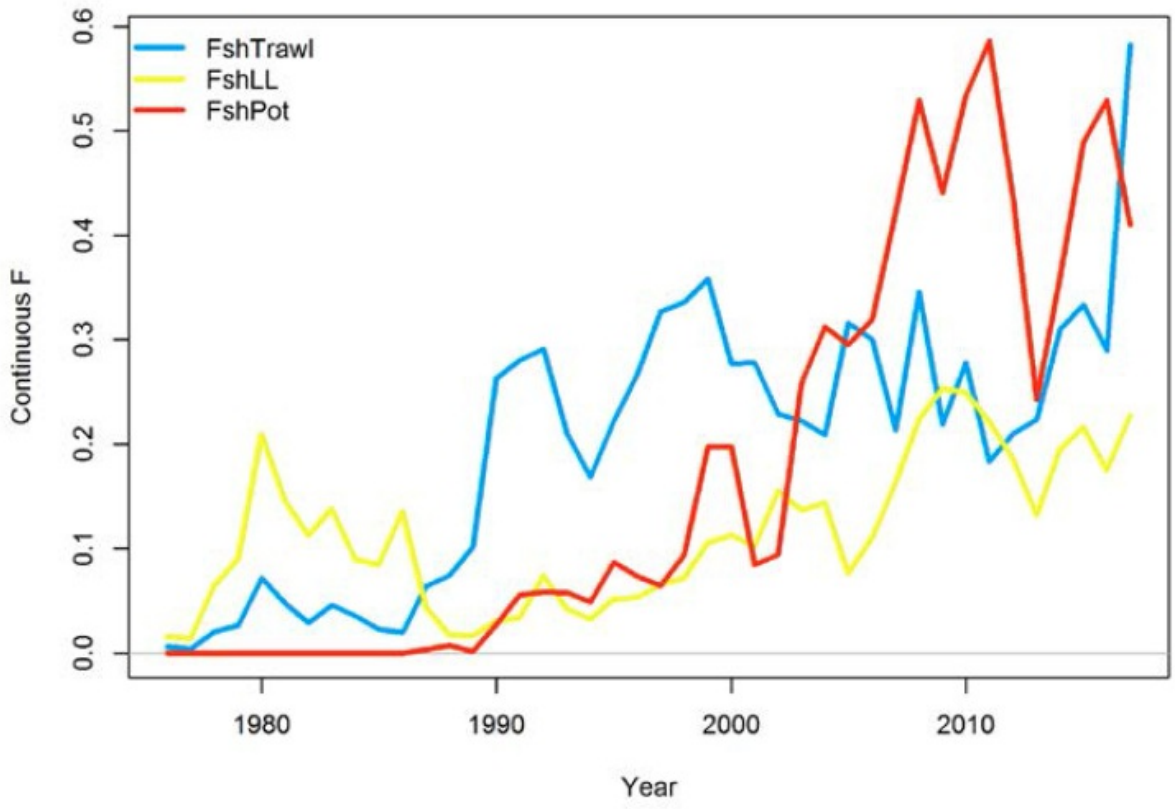

Figure 30 Estimated fishing mortality by trawl, longline, and pot GOA Pacific cod fisheries (Barbeax et al. 2017).

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Moderate Concern

The estimated end of year catch of EBS Pacific cod in 2017 was 235,043 t or 0.90 of the ABC. As a Tier 3 stock, 2018 EBS Pacific cod was set at F_{ABC}= 0.31, which is well below the model-estimated F_{OFL} (0.38). Retrospective analyses suggest that F may have been underestimated from 1994 to 2017, and F_{OFL} may have been exceeded in some of these years {Thomson 2017).

As a Tier 5 stock, AI Pacific cod F_{OFL} is set equal to the natural mortality rate (M), with an estimated 2018 value of F_{OFL}= 0.38. Prior to separate management of the AI and EBS stocks in 2014, TAC averaged about 83% of the ABC, and aggregate commercial catch averaged approximately 92% of TAC (since 1980). Overall, precautionary management ensures that TACs are well below ABC for AI and EBS Pacific cod. However, retrospective analyses suggest F target reference points were likely exceeded in a number of years from 1994 to 2017 for EBS Pacific cod, and therefore, BSAI Pacific cod fishing mortality receives a score of "moderate" concern.

Justification:

Similar to the GOA, EBS Pacific cod is harvested by multiple gear-types including: trawl, longline, pots, and jig. The breakdown of catch by major gear type from 2012 to 2016 is as follows: longline 54%, trawl 31%, pot gear 15%. Jig gear catches are negligible in the EBS in comparison to other gear types, averaging annually less than 200 t since 1992, and are not reviewed in this assessment (Thompson 2017). With regards to F, retrospective analyses and model changes made during the 2017 stock assessment cycle suggest that EBS

Pacific cod spawning biomass may have been overestimated, and therefore, F may have been underestimated in most years from 1994 to 2017. F_{OFL} may also have been exceeded in some years based on retrospective estimates (Thomson 2017) (Figure A).

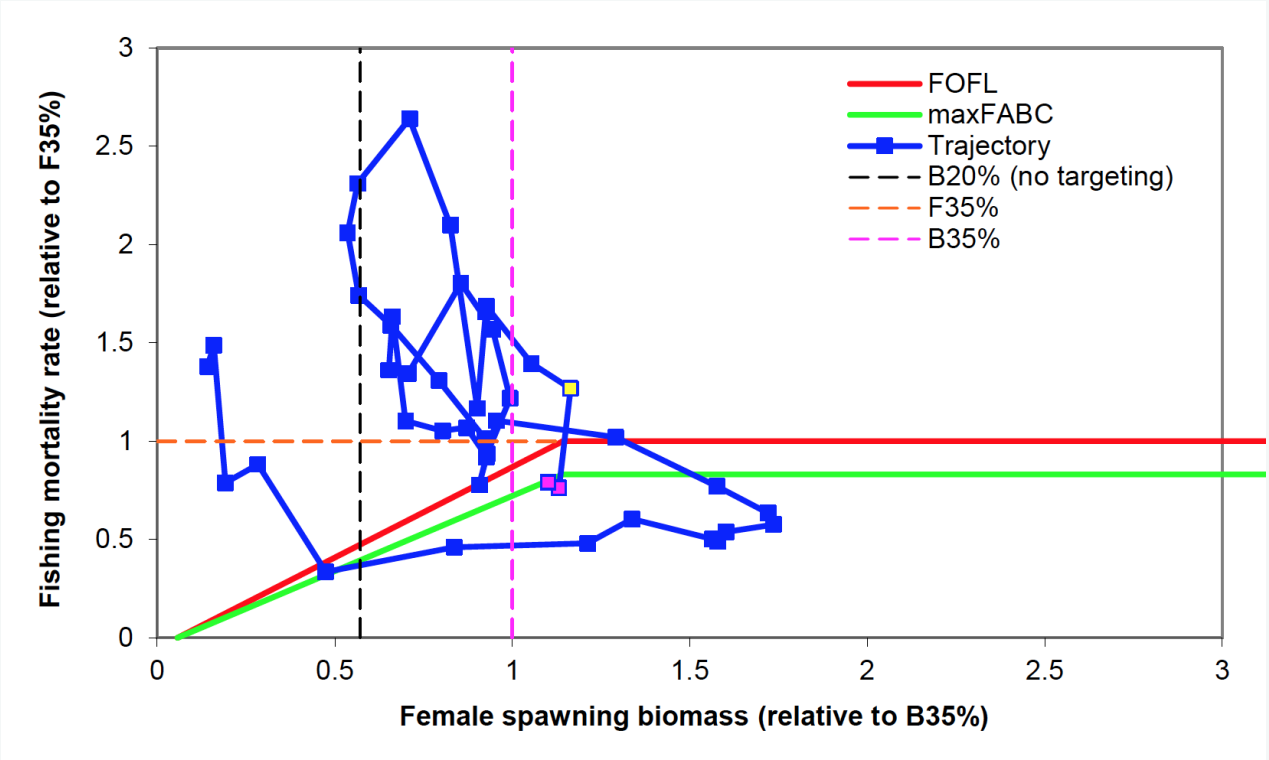

Figure 31 Trajectory of Pacific cod fishing mortality and spawning biomass based on the most current 2017 model, 1977-2019 (yellow square = 2018, magenta squares = 2019 and 2020)(Thompson 2017)..

AI Pacific cod catch is taken predominantly with trawl gear (approximately 80%), followed by longline gear. Pot gear is allowed but was not utilized in the AI in 2015 and 2016, and jig catches in the AI averaged less than 23 t annually since 1991 (Thomson and Palsson 2017). AI TAC is reduced to account for removals taken in the adjacent Alaska state Pacific cod fishery, and total catches (Federal + State) have been kept well below the overall AI ABC.

PACIFIC COD

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

GOA Pacific Cod is assessed annually, and data inputs that inform the assessment include fishery independent data sources such as the annual longline survey and biennial trawl survey and fishery dependent data collected by on-board observers. Projected female SSB for 2018 decreased to 36,209 t or 21% of unfished SSB. This represents a 71% decline in abundance and a 58% decrease in biomass since 2015 (Barbeaux, NMFS, NPFMC presentation February 2018). For 2018, the projected SSB is approximately 61% of the target reference points $SB_{35\%}$. Recent declines in Pacific cod spawning biomass and abundance coupled with SSB values less than 70% of the target reference point $SB_{35\%}$ yield a score of "moderate" concern for abundance.

Justification:

Pacific cod is a transoceanic species found at depths from shoreline to approximately 500 m. Projected 2018 SSB is at its lowest level in the time series (Figure A) and is expected to continue declining through 2019 (Barbeaux, NMFS, NPFMC presentation February 2018). A number of factors have been discussed as potential mechanisms for the dramatic decline in Pacific cod abundance in the GOA. Anomalous warm temperatures 2014 to 2016 led to increases in sea surface temperature (SST) and seafloor temperatures in the GOA (Barbeaux et al. 2017). Research suggests a connection between water temperature and larval production, where warm SSTs are linked with low larval abundance (Doyle and Mier 2016). Additionally, warm temperatures may also negatively impact growth potential and metabollic efficiency of Pacific cod during various life history stages (Doyle and Mier 2016) (Barbeaux et al. 2017) (Figure B), and a substantial increase in natural mortality occurred in 2015 and 2016 (Barbeaux et al. 2017).

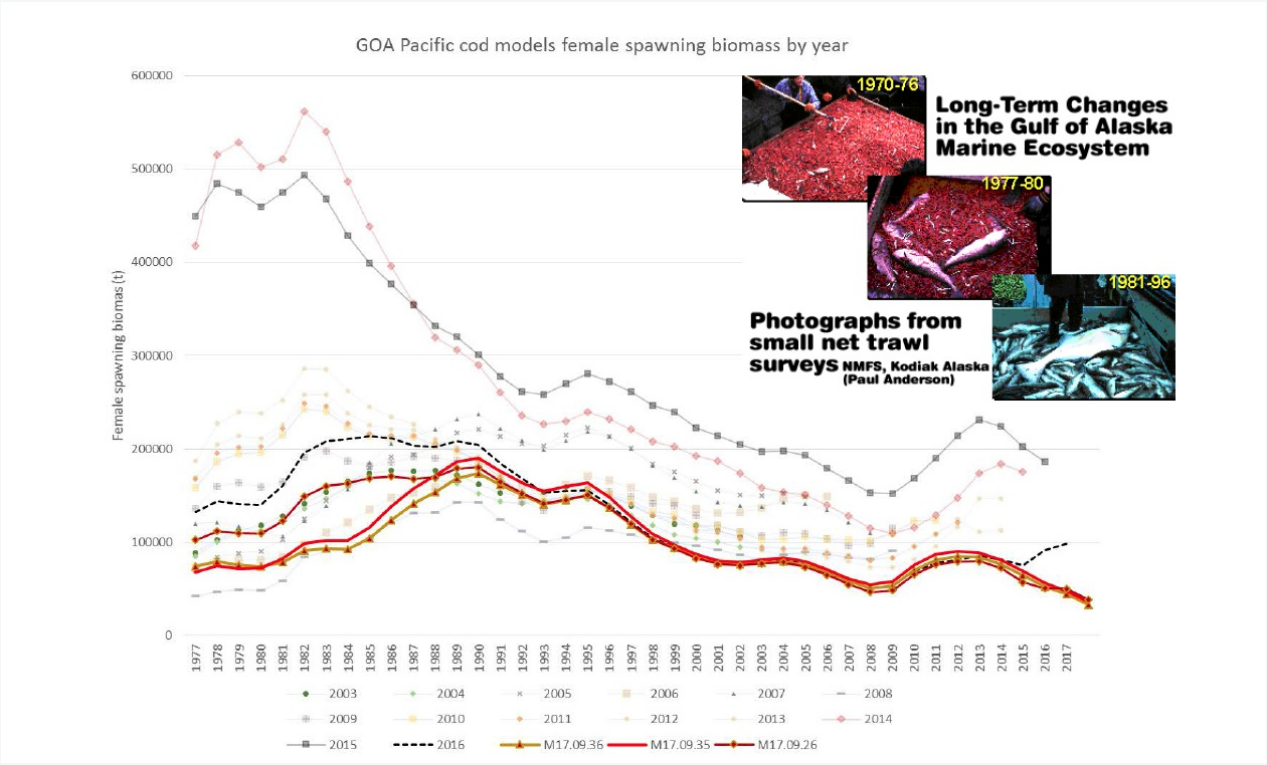

Figure 32 1977-2016 GOA Pacific cod female spawning biomass from the 2003 through the 2016 stock assessments with the authors's preferred models M17.09.35,36, 26, and (inset) images from the NMFS small net survey off Kodiak Alaska showing change in species composition over time (Barbeaux et al. 2017).

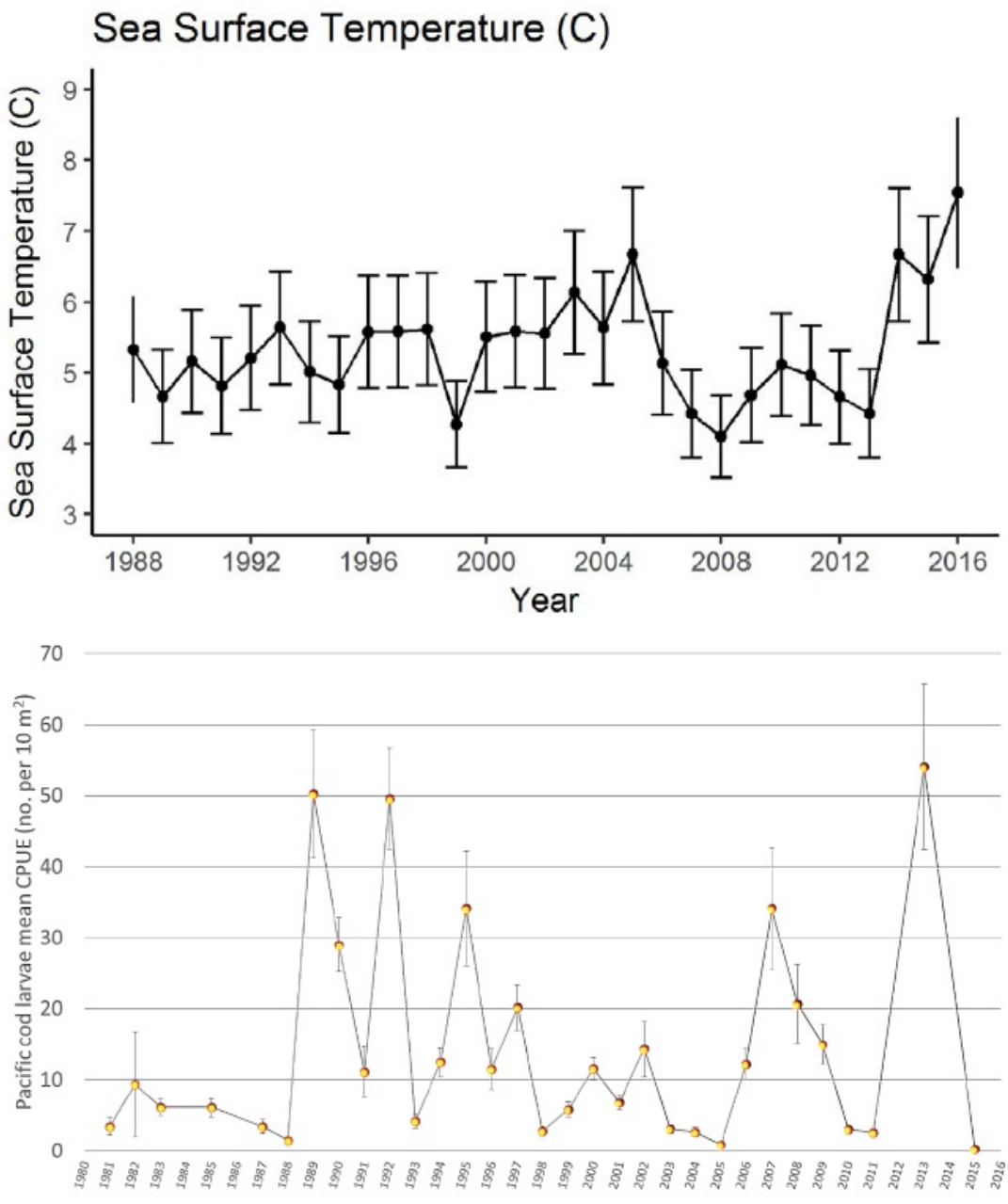

Figure 33 SST (top) and larval abundance from late spring icthyoplankton surveys in the GOA using all stations within a core area covering Shelikof Sea valley and Semidi bank area (Barbeaux et al. 2017).

ALASKA/BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Low Concern

Pacific cod in the BSAI is assessed annually. Beginning in 2014, the EBS and AI Pacific cod stocks were assessed and managed separately; TACs and ABCs are set independently (AI represents roughly 5% of the total BSAI biomass). The EBS Pacific cod projected female SSB for 2018 is 217,000 t or 40% of unfished SSB. For 2018, the projected SSB is approximately 113% of the target reference point $SB_{35\%}$ for Tier 3 stocks. AI Pacific cod are managed as a Tier 5 stock and assessed with a random effects model that estimates biomass and natural mortality. Estimated biomass in the AI has been stable to increasing despite declines seen in the GOA and EBS. The EBS Pacific cod stock B/B_{MSY} ratio is 1.56 (NMFS FSSI 2017). It is not overfished or

approaching overfishing (Thompson 2017) (Thomson and Palsson 2017); however, data are limited for the AI Pacific cod stock. Although the AI Pacific cod stock represents a small fraction of BSAI Pacific cod as whole, uncertainty remains for this subpopulation and, therefore, BSAI Pacific cod receives a score of "low" concern for abundance (Thompson 2017).

Justification:

The estimated biomass of EBS Pacific cod decreased in 2017 from a relatively high 2015 value; however, spawning biomass increased moderately through 2017 (Thompson 2017) (Figure A).

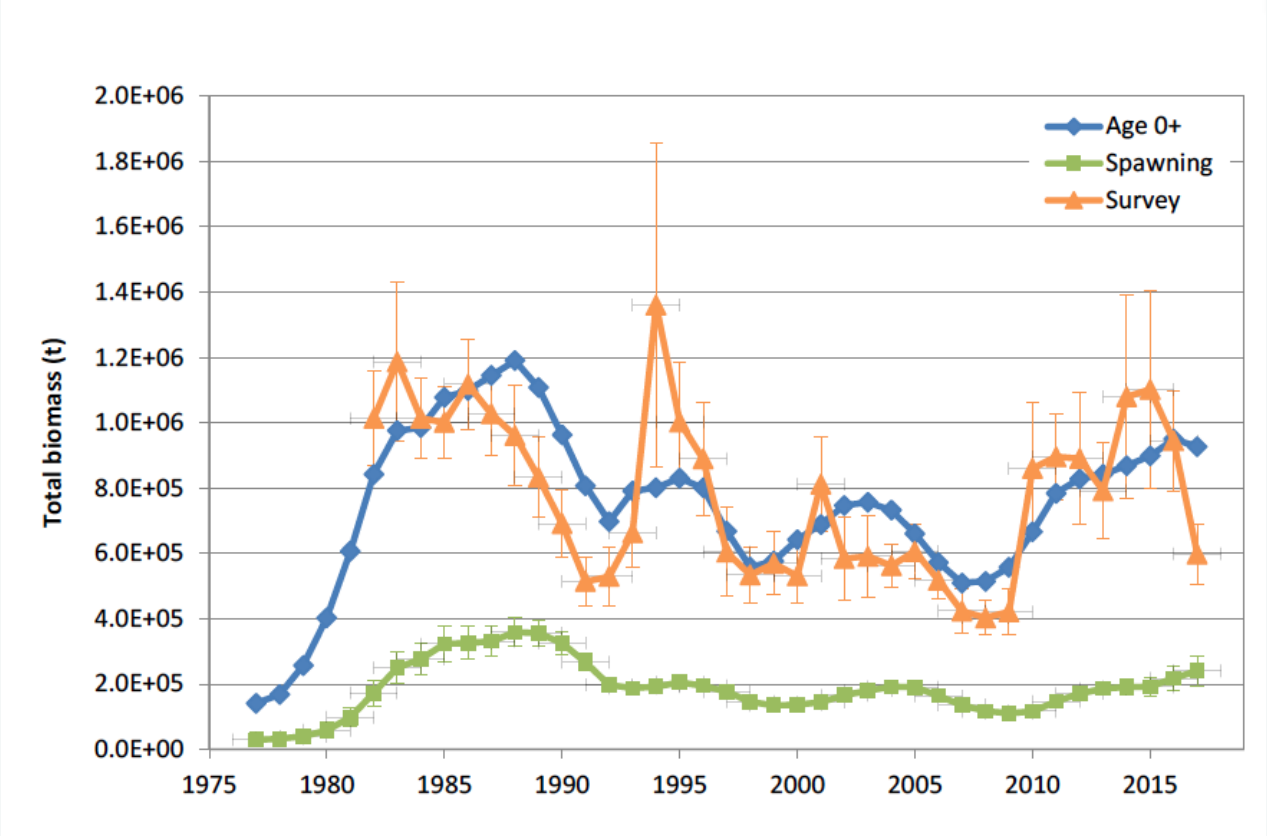

Figure 34 Time series of age 0+ and EBS female spawning biomass based on model estimates. Survey biomass is shown for comparison (Thompson 2017)..

AI Pacific cod biomass exhibited a moderate decline from 1990 to 2010 but has showed an increasing trend since 2010 (Thomson and Palsson 2017) (Figure B).

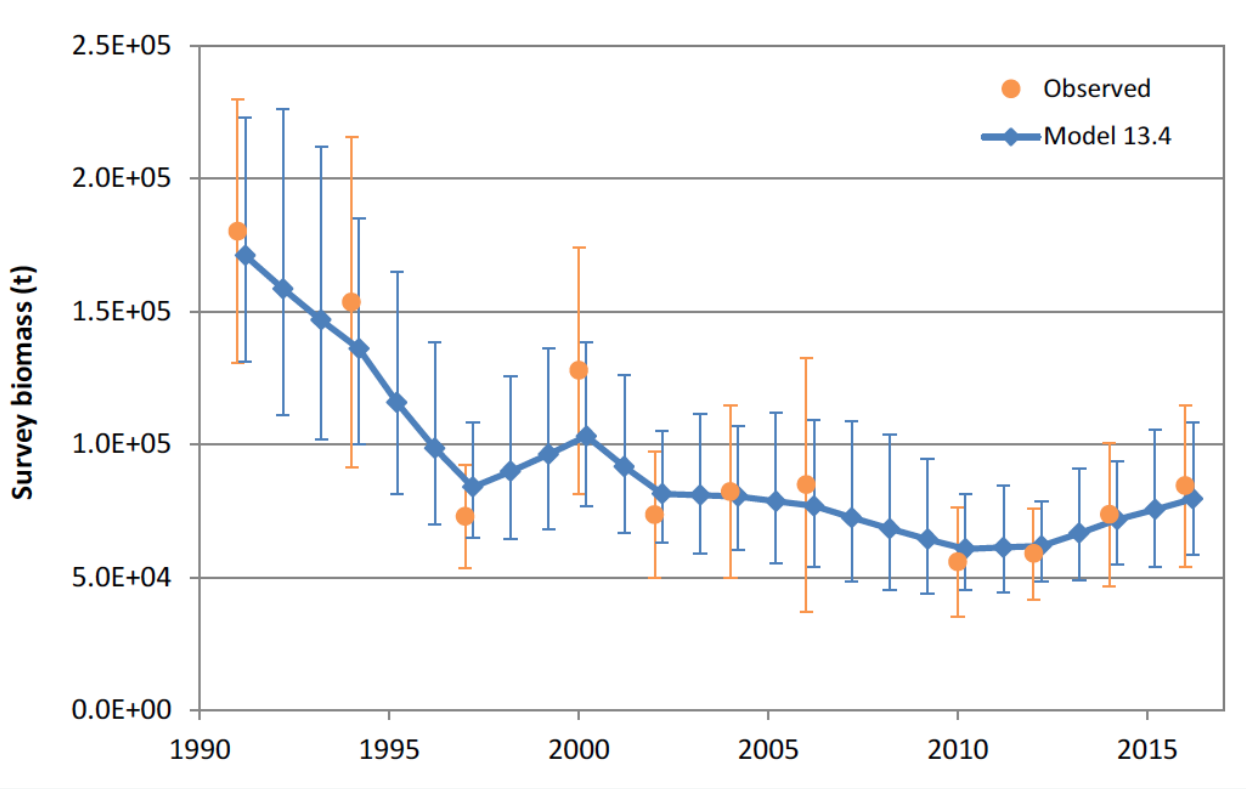

Figure 35 Fit of model to survey AI Pacific cod biomass time series, with 95% confidence intervals for the observations and estimates (Thomson & Palsson 2017).

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

The estimated end of year catch of GOA Pacific cod in 2017 was 35,509 t, or 0.40 of the ABC (88,342 t). Low Pacific cod catches in 2017 were associated with recent declines in biomass seen in the GOA (Barbeaux et al. 2017). Since 2008, the Pacific cod ABC has been set at the maximum level per the Tier 3 status of the stock. However, in 2018 managers set the F_{ABC} below the maximum permissible F_{ABC} to increase the probability (to roughly 50%) that the stock will not fall below 20% of unfished spawning biomass for 2019 and 2020 (F_{ABC} = 0.53 and 0.31 for 2017 and 2018, respectively) (Barbeaux et al. 2017). The Pacific cod population is not classified as experiencing overfishing (Barbeaux et al. 2017). Model-estimated F increased steadily with the decline in abundance from 1990 to 2008, with continued high F through 2016, associated with increased catches and declining recruitment. GOA Pacific cod receives a score of "moderate" concern for fishing mortality because F is fluctuating around target reference points, F has been below control rule levels in all but two years (2008, 2017; still under $F_{35\%}$), and F has been increasing since the early 1990s.

Justification:

Fishing mortality has been relatively high and increasing in the GOA Pacific cod fishery since 2000. In four years (2007, 2008, 2015, 2017), $F/F_{MSY} > 1$ and above Tier 3 target reference points set by fishery managers (Figure A). During these years, F was still below the lower target reference point F35% (Barbeaux et al. 2017}.

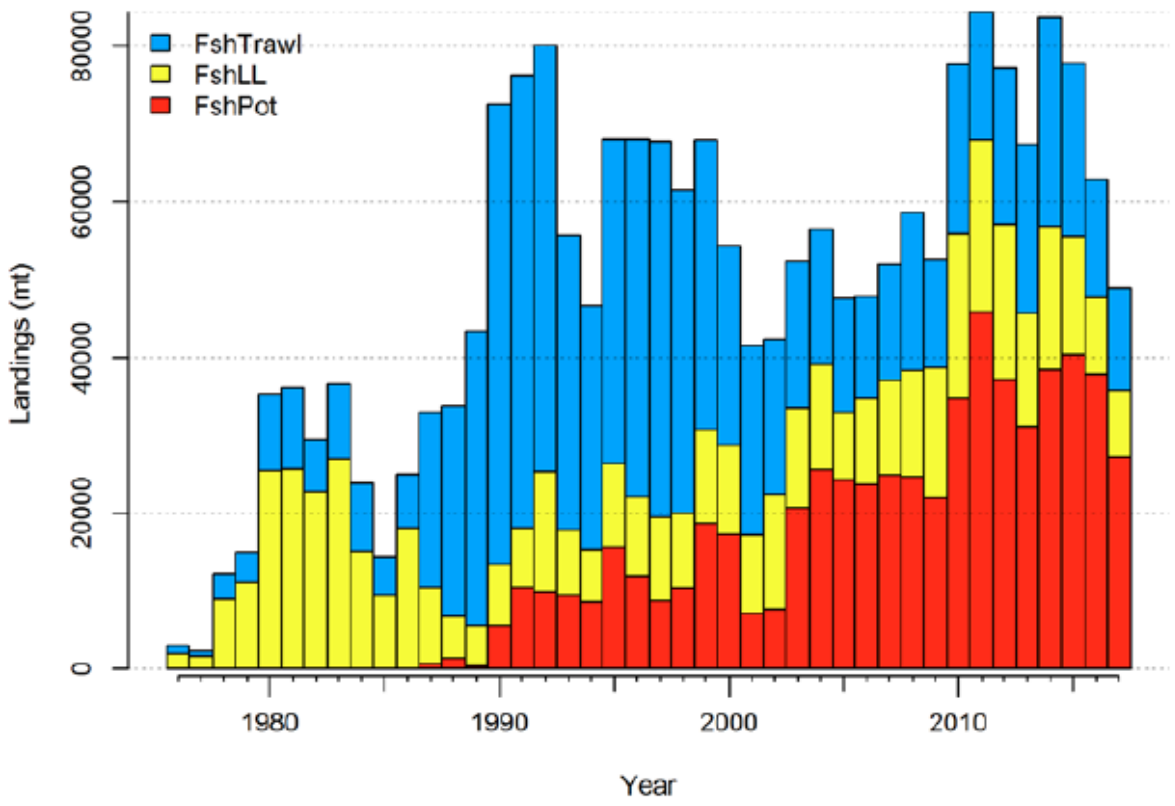

Figure 36 GOA Pacific cod catch from 1977-2017 (2017 estimated)(Barbeaux et al. 2017).

GOA Pacific cod is a multiple-gear fishery, including trawl, longline, pot, and jig components. Trawl gear historically took the largest share of catch from 1991 to 2002, although pot gear has taken the largest single-gear share of the catch in each year since 2003 (Barbeaux et al. 2017) (Figure C). F tends to higher for trawl and pot fisheries as compared to the longline fishery (Figure C). Pacific cod TAC is allocated in the Western and Central GOA among sectors as defined by gear type and processing capacity (CV and CP). The majority of landings (90%) occur by CVs delivering to shore-based processors. In most years, the fishery is fully exploited; however, in 2016 and 2017 the TAC was not fully taken, potentially due to poor fishing conditions (Barbeaux et al. 2017).

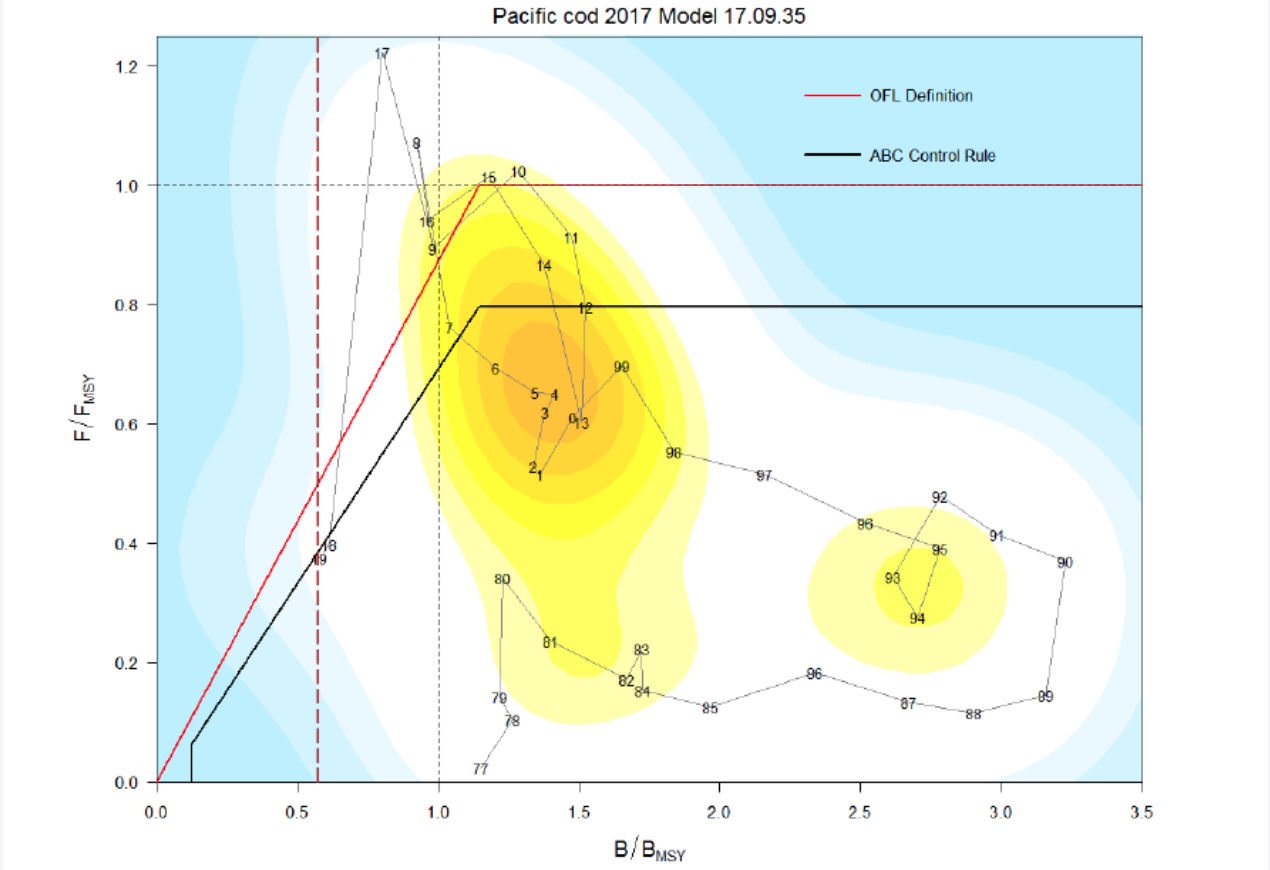

Figure 37 Ratio of historical F/FMSY verse female SSB/BMSY for GOA Pacific cod, 1977-2019. Note that proxies for FMSY and BMSY are F35% and B35%, respectively. The Fs presented here are the sum of the full Fs across fleets. Dashed line is at B20%, Steller sea lion closure rule for GOA Pacific cod (Barbeaux et al. 2017).

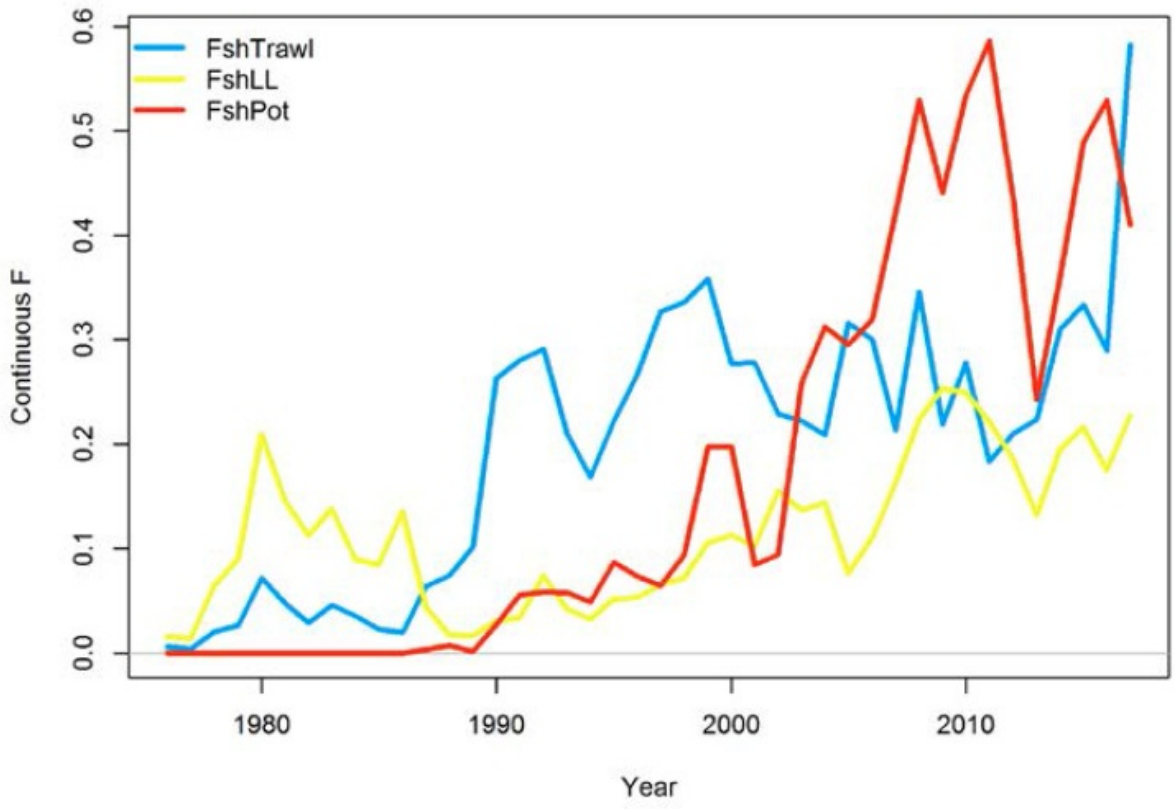

Figure 38 Estimated fishing mortality by trawl, longline, and pot GOA Pacific cod fisheries (Barbeax et al. 2017).

ALASKA/BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

The estimated end of year catch of EBS Pacific cod in 2017 was 235,043 t or 0.90 of the ABC. As a Tier 3 stock, 2018 EBS Pacific cod was set at F_{ABC}= 0.31, which is well below the model-estimated F_{OFL} (0.38). Retrospective analyses suggest that F may have been underestimated from 1994 to 2017, and F_{OFL} may have been exceeded in some of these years {Thomson 2017).

As a Tier 5 stock, AI Pacific cod F_{OFL} is set equal to the natural mortality rate (M), with an estimated 2018 value of F_{OFL}= 0.38. Prior to separate management of the AI and EBS stocks in 2014, TAC averaged about 83% of the ABC, and aggregate commercial catch averaged approximately 92% of TAC (since 1980). Overall, precautionary management ensures that TACs are well below ABC for AI and EBS Pacific cod. However, retrospective analyses suggest F target reference points were likely exceeded in a number of years from 1994 to 2017 for EBS Pacific cod, and therefore, BSAI Pacific cod fishing mortality receives a score of "moderate" concern.

Justification:

Similar to the GOA, EBS Pacific cod is harvested by multiple gear-types including: trawl, longline, pots, and jig. The breakdown of catch by major gear type from 2012 to 2016 is as follows: longline 54%, trawl 31%, pot gear 15%. Jig gear catches are negligible in the EBS in comparison to other gear types, averaging annually less than 200 t since 1992, and are not reviewed in this assessment (Thompson 2017). With regards to F, retrospective analyses and model changes made during the 2017 stock assessment cycle suggest that EBS

Pacific cod spawning biomass may have been overestimated, and therefore, F may have been underestimated in most years from 1994 to 2017. F_{OFL} may also have been exceeded in some years based on retrospective estimates (Thomson 2017) (Figure A).

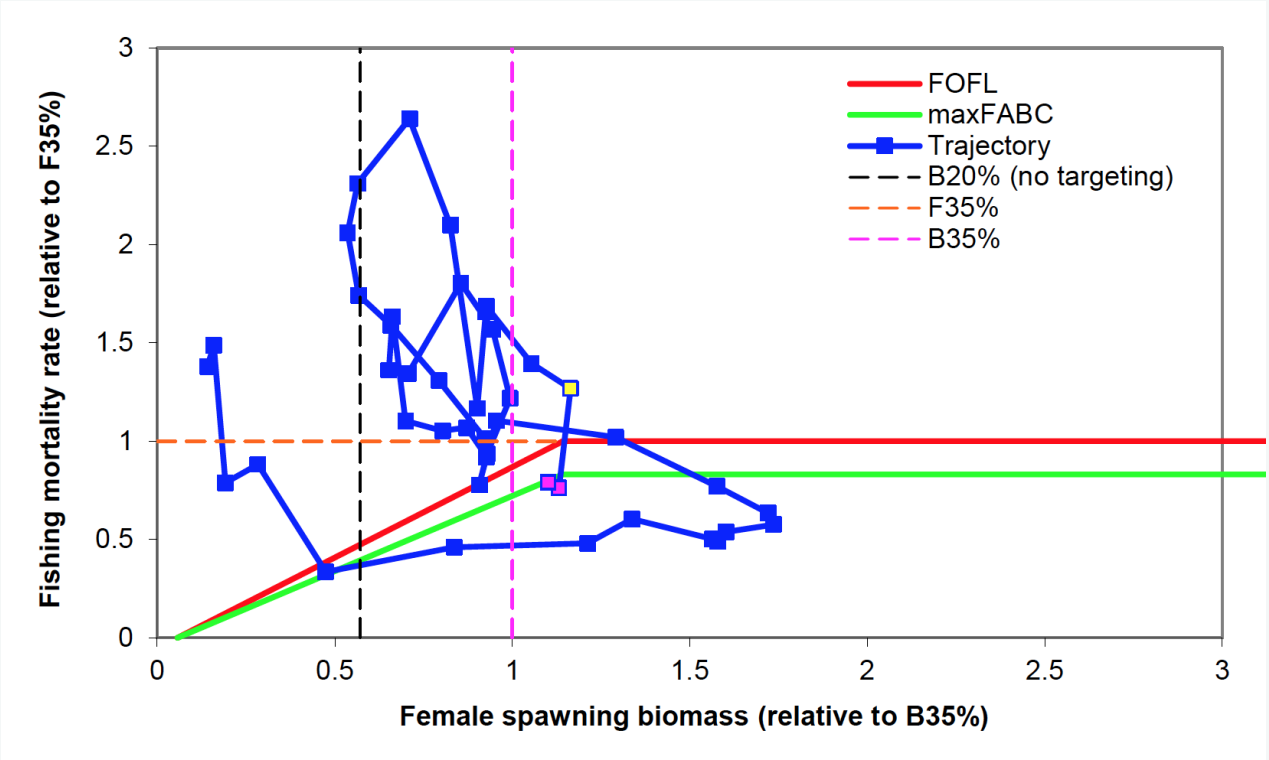

Figure 39 Trajectory of Pacific cod fishing mortality and spawning biomass based on the most current 2017 model, 1977-2019 (yellow square = 2018, magenta squares = 2019 and 2020)(Thompson 2017)..

AI Pacific cod catch is taken predominantly with trawl gear (approximately 80%), followed by longline gear. Pot gear is allowed but was not utilized in the AI in 2015 and 2016, and jig catches in the AI averaged less than 23 t annually since 1991 (Thomson and Palsson 2017). AI TAC is reduced to account for removals taken in the adjacent Alaska state Pacific cod fishery, and total catches (Federal + State) have been kept well below the overall AI ABC.

PACIFIC COD

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Moderate Concern

GOA Pacific Cod is assessed annually, and data inputs that inform the assessment include fishery independent data sources such as the annual longline survey and biennial trawl survey and fishery dependent data collected by on-board observers. Projected female SSB for 2018 decreased to 36,209 t or 21% of unfished SSB. This represents a 71% decline in abundance and a 58% decrease in biomass since 2015 (Barbeaux, NMFS, NPFMC presentation February 2018). For 2018, the projected SSB is approximately 61% of the target reference points $SB_{35\%}$. Recent declines in Pacific cod spawning biomass and abundance coupled with SSB values less than 70% of the target reference point $SB_{35\%}$ yield a score of "moderate" concern for abundance.

Justification:

Pacific cod is a transoceanic species found at depths from shoreline to approximately 500 m. Projected 2018 SSB is at its lowest level in the time series (Figure A) and is expected to continue declining through 2019 (Barbeaux, NMFS, NPFMC presentation February 2018). A number of factors have been discussed as potential mechanisms for the dramatic decline in Pacific cod abundance in the GOA. Anomalous warm temperatures 2014 to 2016 led to increases in sea surface temperature (SST) and seafloor temperatures in the GOA (Barbeaux et al. 2017). Research suggests a connection between water temperature and larval production, where warm SSTs are linked with low larval abundance (Doyle and Mier 2016). Additionally, warm temperatures may also negatively impact growth potential and metabollic efficiency of Pacific cod during various life history stages (Doyle and Mier 2016) (Barbeaux et al. 2017) (Figure B), and a substantial increase in natural mortality occurred in 2015 and 2016 (Barbeaux et al. 2017).

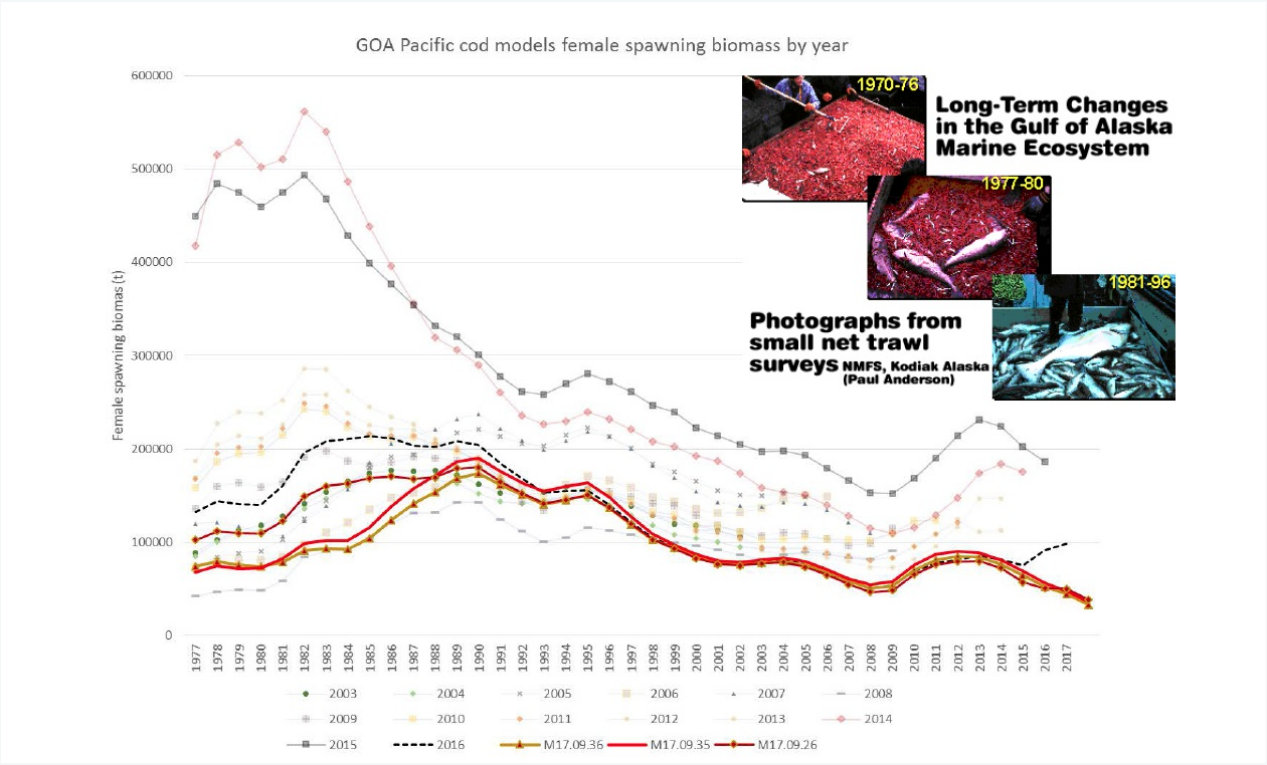

Figure 40 1977-2016 GOA Pacific cod female spawning biomass from the 2003 through the 2016 stock assessments with the authors's preferred models M17.09.35,36, 26, and (inset) images from the NMFS small net survey off Kodiak Alaska showing change in species composition over time (Barbeaux et al. 2017).

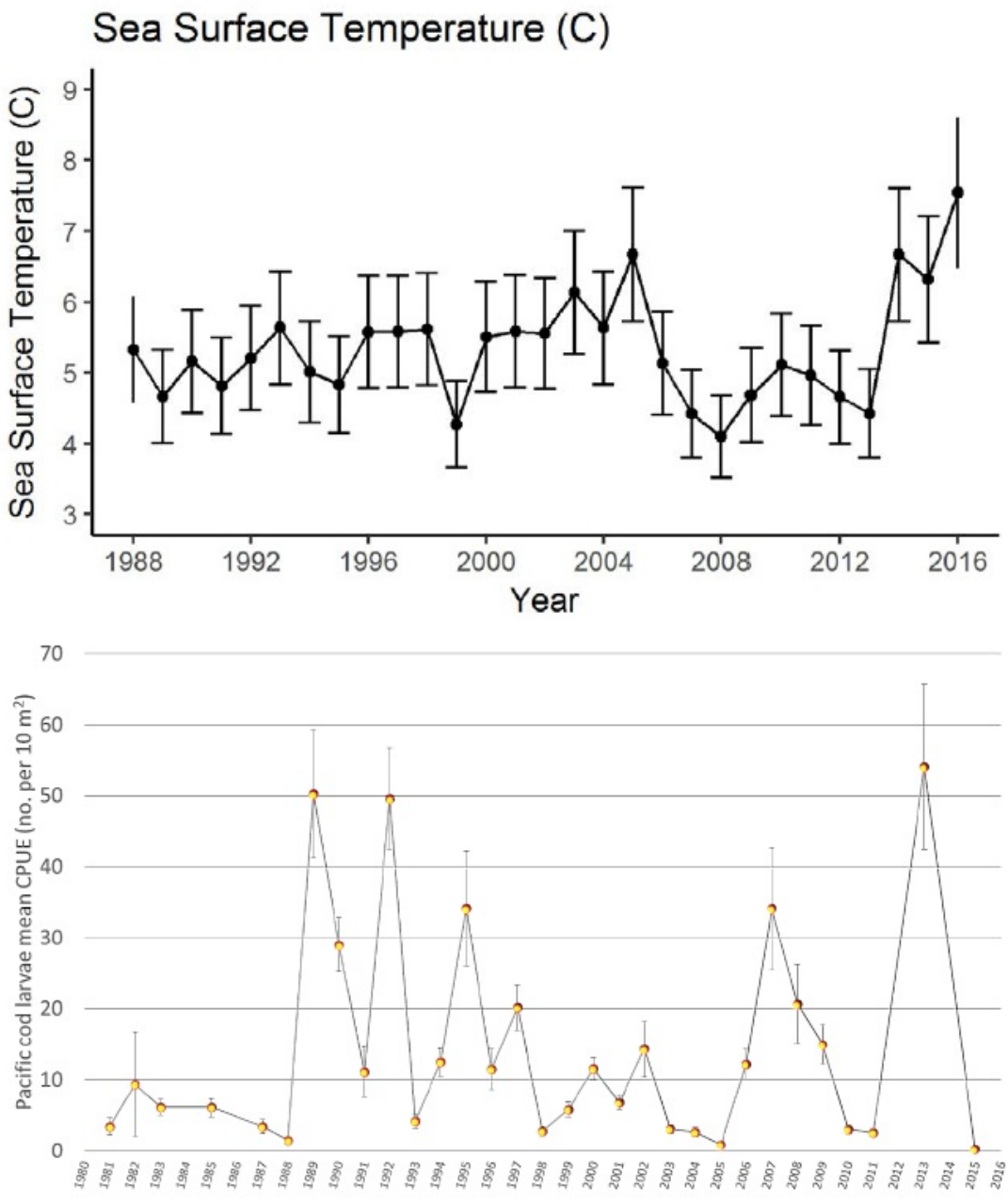

Figure 41 SST (top) and larval abundance from late spring icthyoplankton surveys in the GOA using all stations within a core area covering Shelikof Sea valley and Semidi bank area (Barbeaux et al. 2017).

ALASKA/BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Low Concern

Pacific cod in the BSAI is assessed annually. Beginning in 2014, the EBS and AI Pacific cod stocks were assessed and managed separately; TACs and ABCs are set independently (AI represents roughly 5% of the total BSAI biomass). The EBS Pacific cod projected female SSB for 2018 is 217,000 t or 40% of unfished SSB. For 2018, the projected SSB is approximately 113% of the target reference point $SB_{35\%}$ for Tier 3 stocks. AI Pacific cod are managed as a Tier 5 stock and assessed with a random effects model that estimates biomass and natural mortality. Estimated biomass in the AI has been stable to increasing despite declines seen in the GOA and EBS. The EBS Pacific cod stock B/B_{MSY} ratio is 1.56 (NMFS FSSI 2017). It is not overfished or

approaching overfishing (Thompson 2017) (Thomson and Palsson 2017); however, data are limited for the AI Pacific cod stock. Although the AI Pacific cod stock represents a small fraction of BSAI Pacific cod as whole, uncertainty remains for this subpopulation and, therefore, BSAI Pacific cod receives a score of "low" concern for abundance (Thompson 2017).

Justification:

The estimated biomass of EBS Pacific cod decreased in 2017 from a relatively high 2015 value; however, spawning biomass increased moderately through 2017 (Thompson 2017) (Figure A).

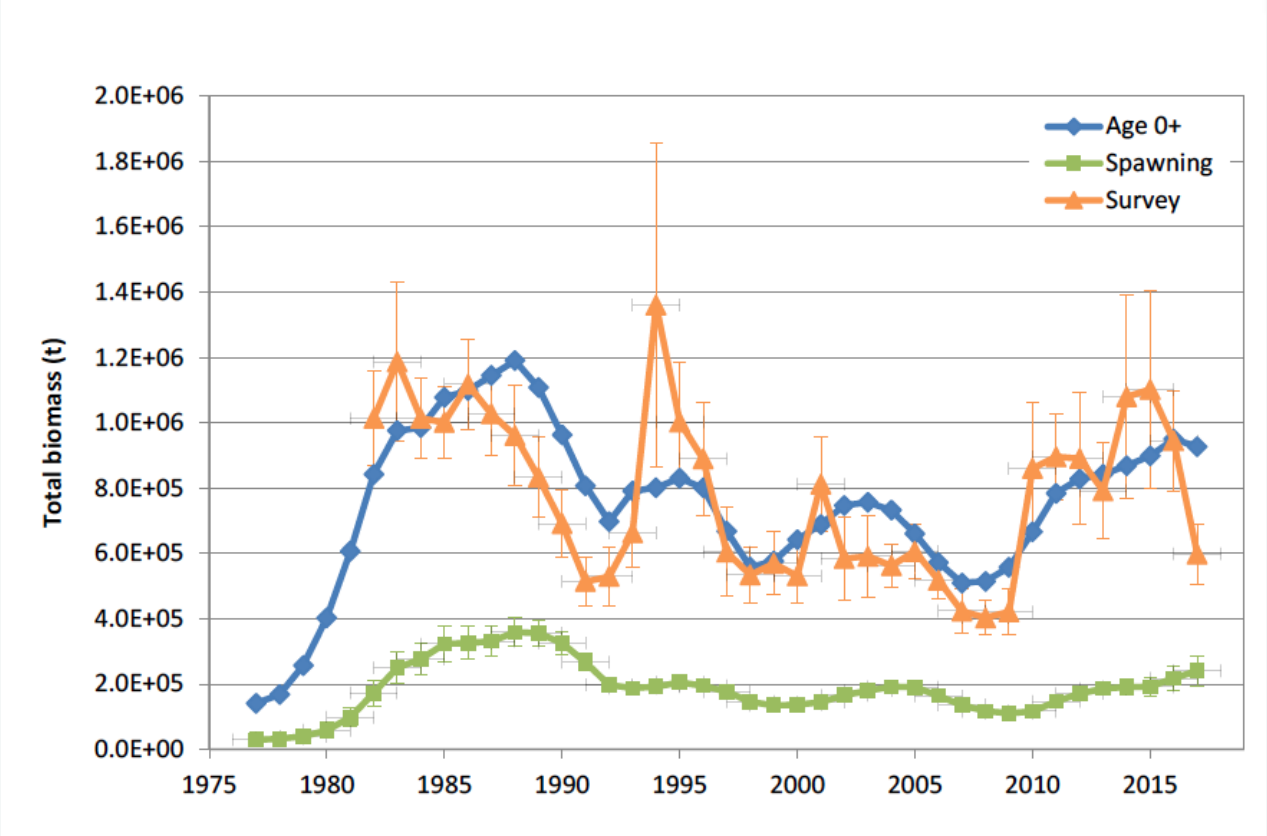

Figure 42 Time series of age 0+ and EBS female spawning biomass based on model estimates. Survey biomass is shown for comparison (Thompson 2017)..

AI Pacific cod biomass exhibited a moderate decline from 1990 to 2010 but has showed an increasing trend since 2010 (Thomson and Palsson 2017) (Figure B).

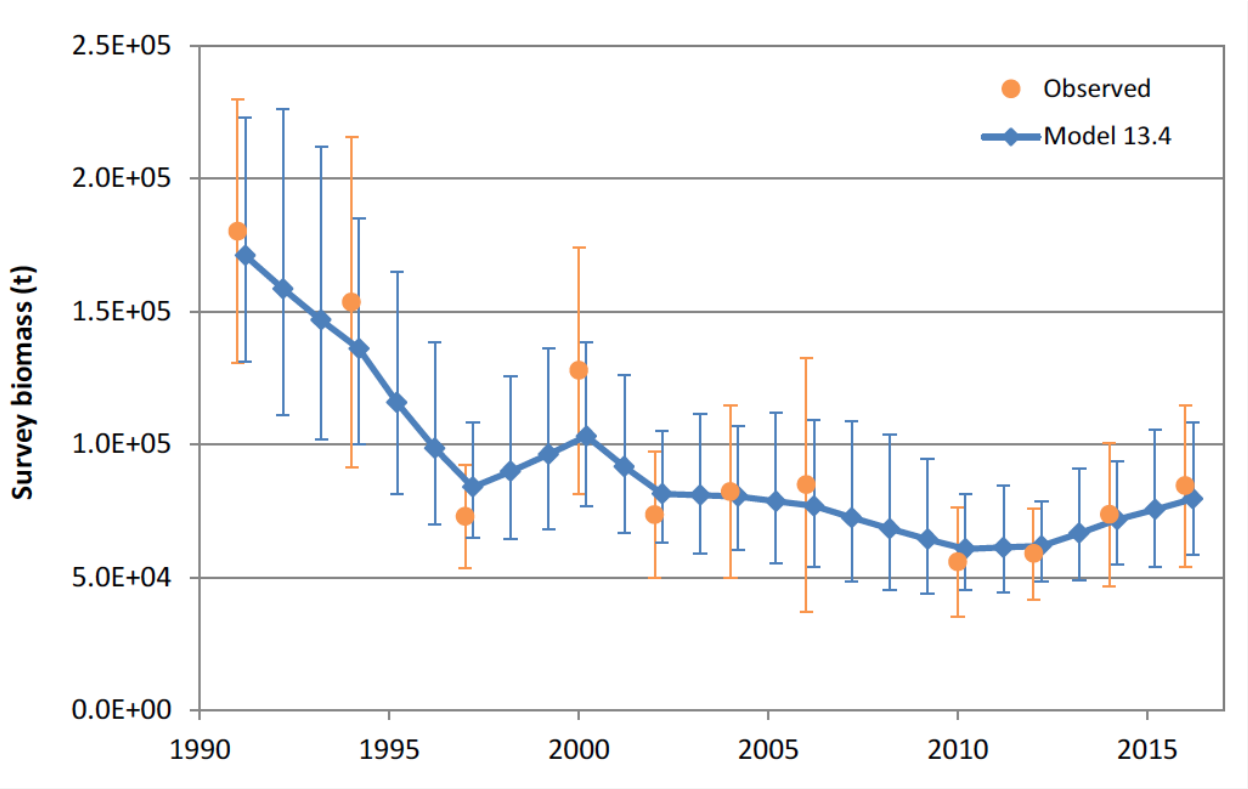

Figure 43 Fit of model to survey AI Pacific cod biomass time series, with 95% confidence intervals for the observations and estimates (Thomson & Palsson 2017).

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Moderate Concern

The estimated end of year catch of GOA Pacific cod in 2017 was 35,509 t, or 0.40 of the ABC (88,342 t). Low Pacific cod catches in 2017 were associated with recent declines in biomass seen in the GOA (Barbeaux et al. 2017). Since 2008, the Pacific cod ABC has been set at the maximum level per the Tier 3 status of the stock. However, in 2018 managers set the F_{ABC} below the maximum permissible F_{ABC} to increase the probability (to roughly 50%) that the stock will not fall below 20% of unfished spawning biomass for 2019 and 2020 (F_{ABC} = 0.53 and 0.31 for 2017 and 2018, respectively) (Barbeaux et al. 2017). The Pacific cod population is not classified as experiencing overfishing (Barbeaux et al. 2017). Model-estimated F increased steadily with the decline in abundance from 1990 to 2008, with continued high F through 2016, associated with increased catches and declining recruitment. GOA Pacific cod receives a score of "moderate" concern for fishing mortality because F is fluctuating around target reference points, F has been below control rule levels in all but two years (2008, 2017; still under $F_{35\%}$), and F has been increasing since the early 1990s.

Justification:

Fishing mortality has been relatively high and increasing in the GOA Pacific cod fishery since 2000. In four years (2007, 2008, 2015, 2017), $F/F_{MSY} > 1$ and above Tier 3 target reference points set by fishery managers (Figure A). During these years, F was still below the lower target reference point F35% (Barbeaux et al. 2017}.

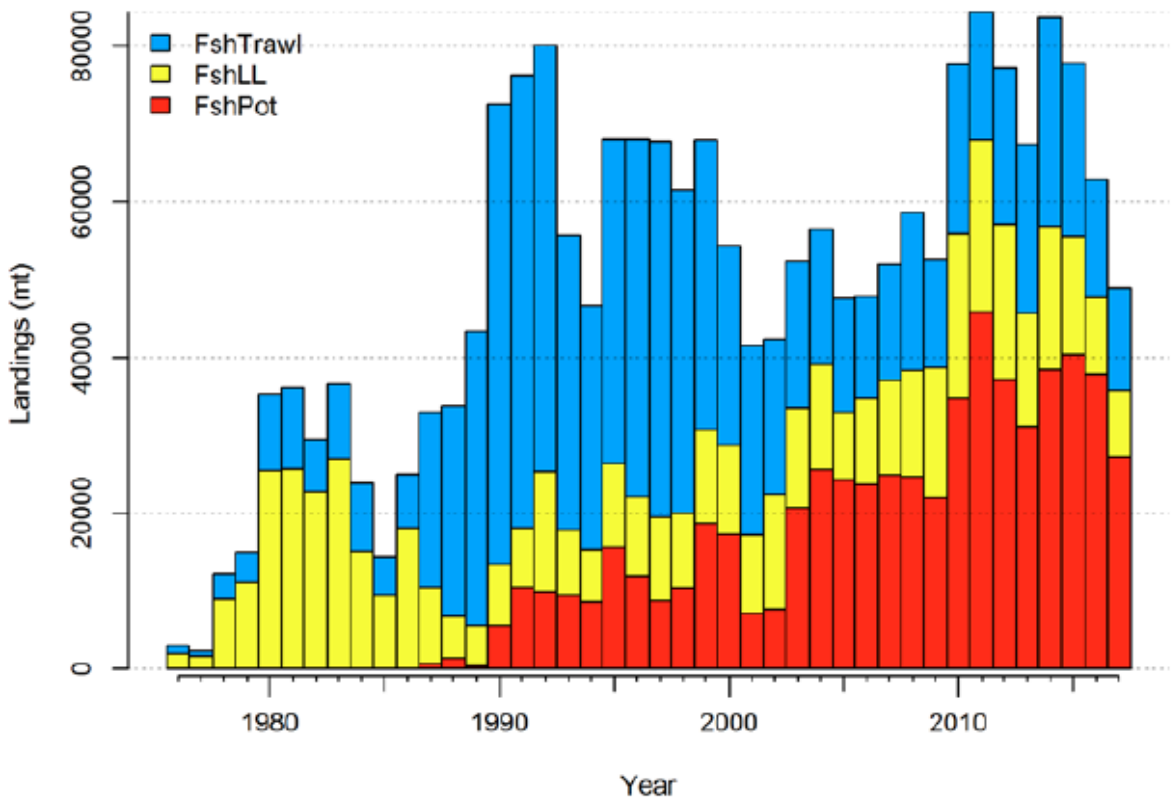

Figure 44 GOA Pacific cod catch from 1977-2017 (2017 estimated)(Barbeaux et al. 2017).

GOA Pacific cod is a multiple-gear fishery, including trawl, longline, pot, and jig components. Trawl gear historically took the largest share of catch from 1991 to 2002, although pot gear has taken the largest single-gear share of the catch in each year since 2003 (Barbeaux et al. 2017) (Figure C). F tends to higher for trawl and pot fisheries as compared to the longline fishery (Figure C). Pacific cod TAC is allocated in the Western and Central GOA among sectors as defined by gear type and processing capacity (CV and CP). The majority of landings (90%) occur by CVs delivering to shore-based processors. In most years, the fishery is fully exploited; however, in 2016 and 2017 the TAC was not fully taken, potentially due to poor fishing conditions (Barbeaux et al. 2017).

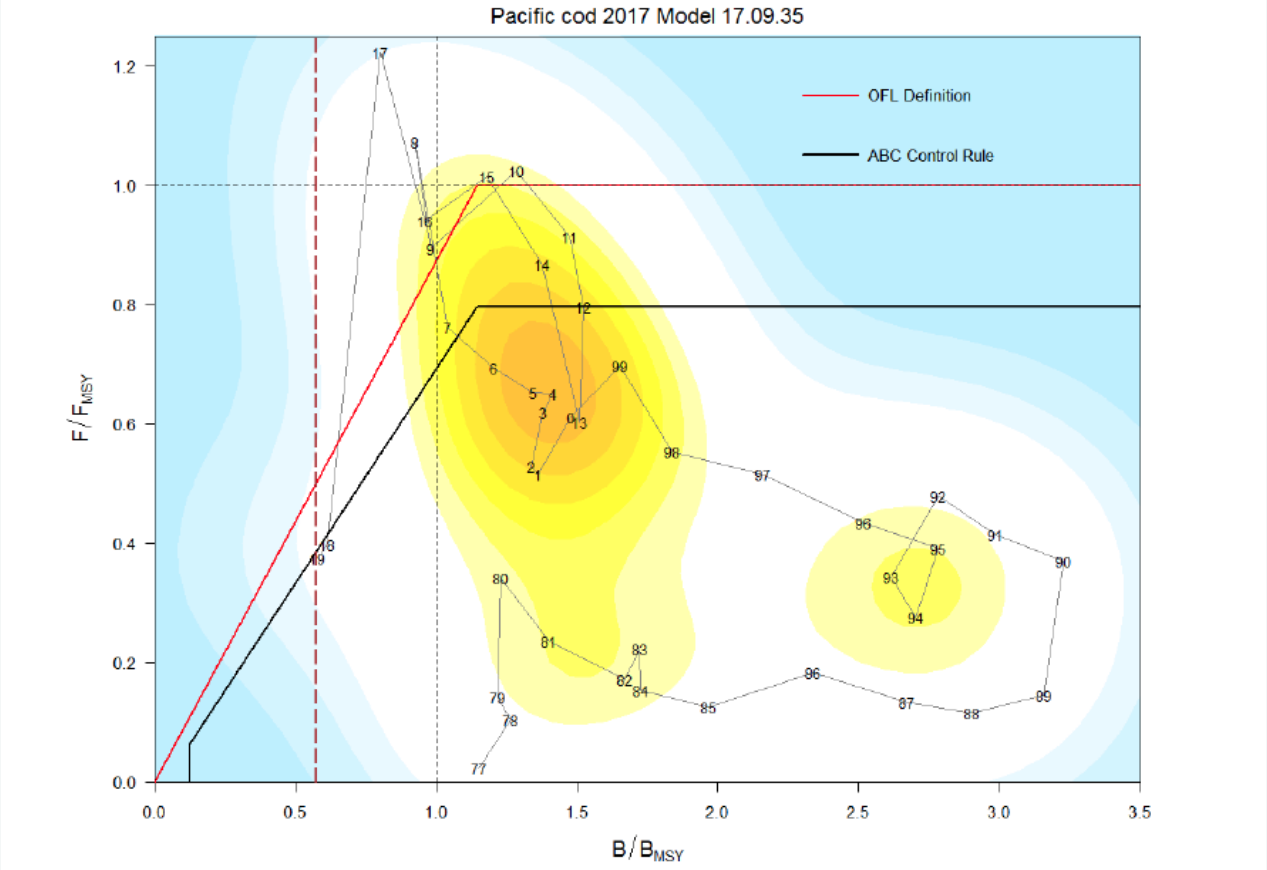

Figure 45 Ratio of historical F/FMSY verse female SSB/BMSY for GOA Pacific cod, 1977-2019. Note that proxies for FMSY and BMSY are F35% and B35%, respectively. The Fs presented here are the sum of the full Fs across fleets. Dashed line is at B20%, Steller sea lion closure rule for GOA Pacific cod (Barbeaux et al. 2017).

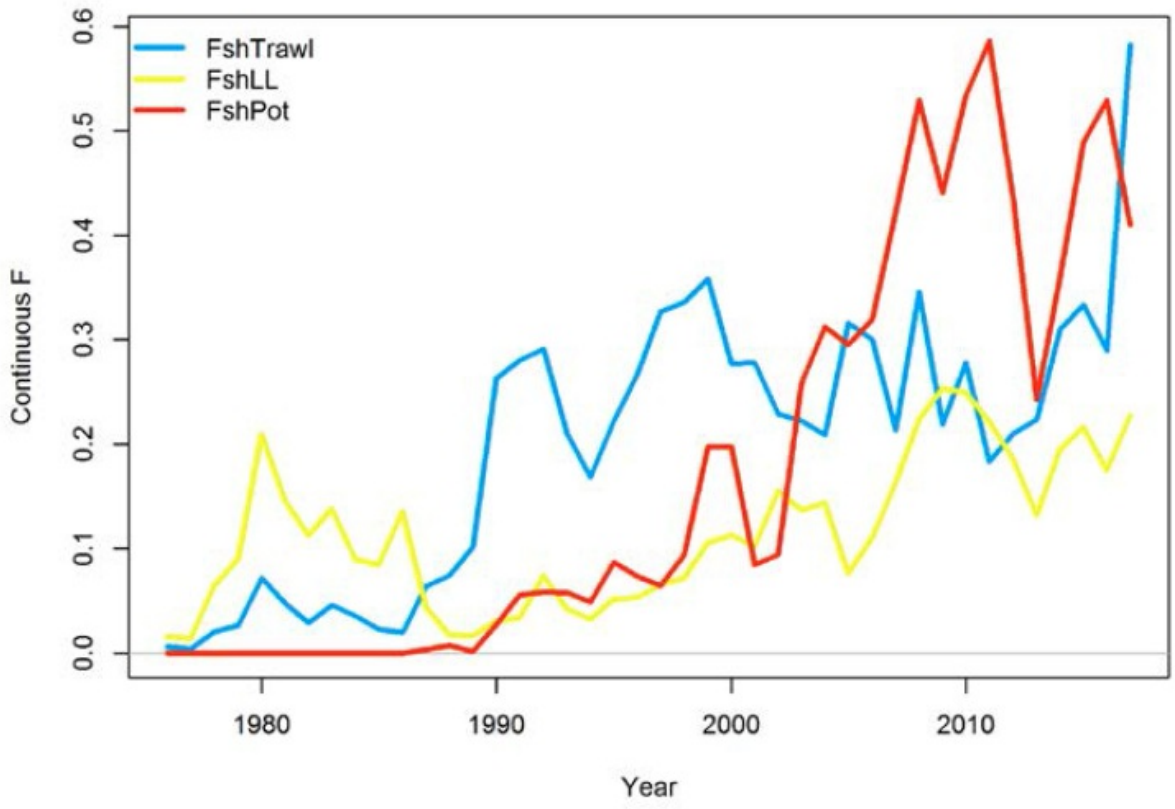

Figure 46 Estimated fishing mortality by trawl, longline, and pot GOA Pacific cod fisheries (Barbeax et al. 2017).

ALASKA/BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Moderate Concern

The estimated end of year catch of EBS Pacific cod in 2017 was 235,043 t or 0.90 of the ABC. As a Tier 3 stock, 2018 EBS Pacific cod was set at F_{ABC}= 0.31, which is well below the model-estimated F_{OFL} (0.38). Retrospective analyses suggest that F may have been underestimated from 1994 to 2017, and F_{OFL} may have been exceeded in some of these years {Thomson 2017).

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Justification:

Similar to the GOA, EBS Pacific cod is harvested by multiple gear-types including: trawl, longline, pots, and jig. The breakdown of catch by major gear type from 2012 to 2016 is as follows: longline 54%, trawl 31%, pot gear 15%. Jig gear catches are negligible in the EBS in comparison to other gear types, averaging annually less than 200 t since 1992, and are not reviewed in this assessment (Thompson 2017). With regards to F, retrospective analyses and model changes made during the 2017 stock assessment cycle suggest that EBS

Pacific cod spawning biomass may have been overestimated, and therefore, F may have been underestimated in most years from 1994 to 2017. F_{OFL} may also have been exceeded in some years based on retrospective estimates (Thomson 2017) (Figure A).

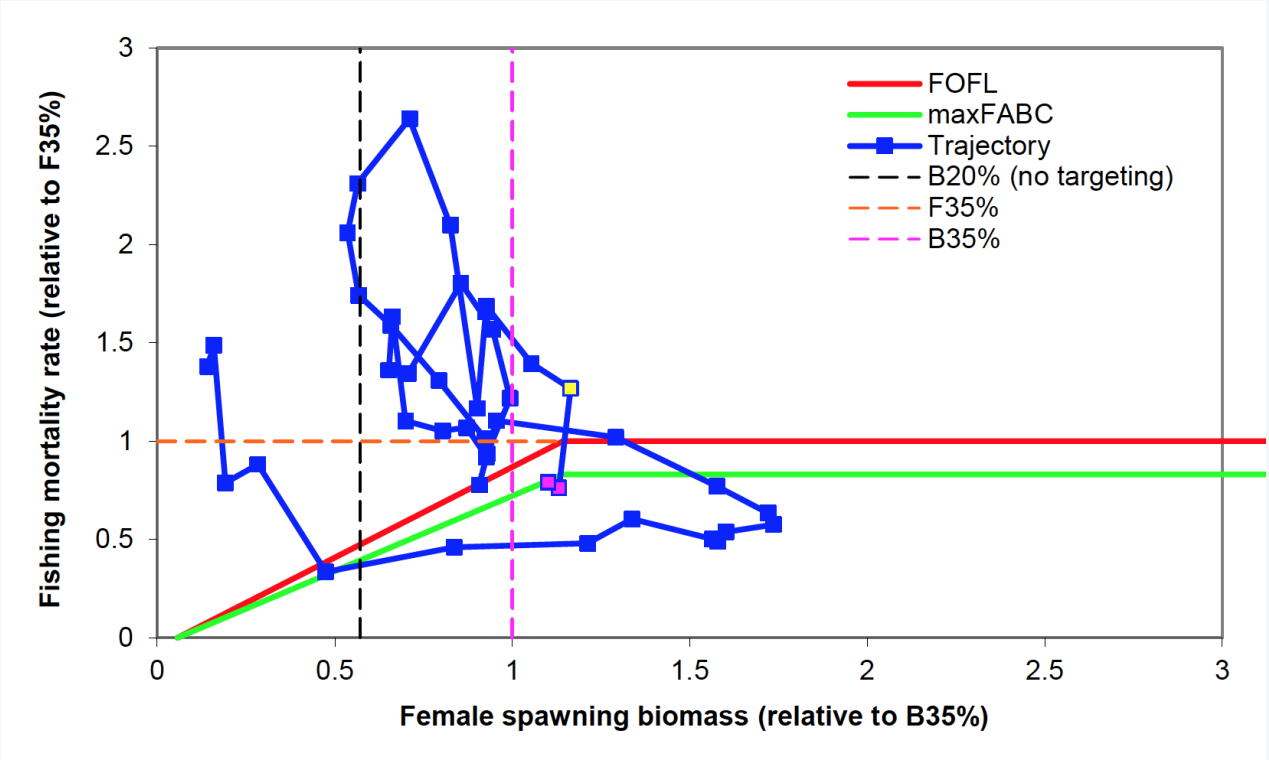

Figure 47 Trajectory of Pacific cod fishing mortality and spawning biomass based on the most current 2017 model, 1977-2019 (yellow square = 2018, magenta squares = 2019 and 2020)(Thompson 2017)..

AI Pacific cod catch is taken predominantly with trawl gear (approximately 80%), followed by longline gear. Pot gear is allowed but was not utilized in the AI in 2015 and 2016, and jig catches in the AI averaged less than 23 t annually since 1991 (Thomson and Palsson 2017). AI TAC is reduced to account for removals taken in the adjacent Alaska state Pacific cod fishery, and total catches (Federal + State) have been kept well below the overall AI ABC.

PACIFIC OCEAN PERCH

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Very Low Concern

BSAI Pacific Ocean Perch (POP) is assessed biennially. Projected POP SSB for 2018 is 305,804 t or 57% of unfished SSB. For 2018, the projected SSB is approximately 164% of the target reference point $SB_{35\%}$ (Spencer and Ianelli 2017). The estimated $B:B_{MSY}$ is 1.72 (NMFS FSSI 2017), and the BSAI POP population receives a score of "low" concern for abundance.

Justification:

POP inhabit the outer continental shelf and upper slope regions of the North Pacific Ocean and Bering Sea. Estimated biomass increased from 1980 to 2010 (Figure A). Considerable uncertainty remains regarding POP stock structure, and microsatellite loci research from six regions across Alaska suggest population structure on a relatively fine spatial scale (Spencer and Ianelli 2016).

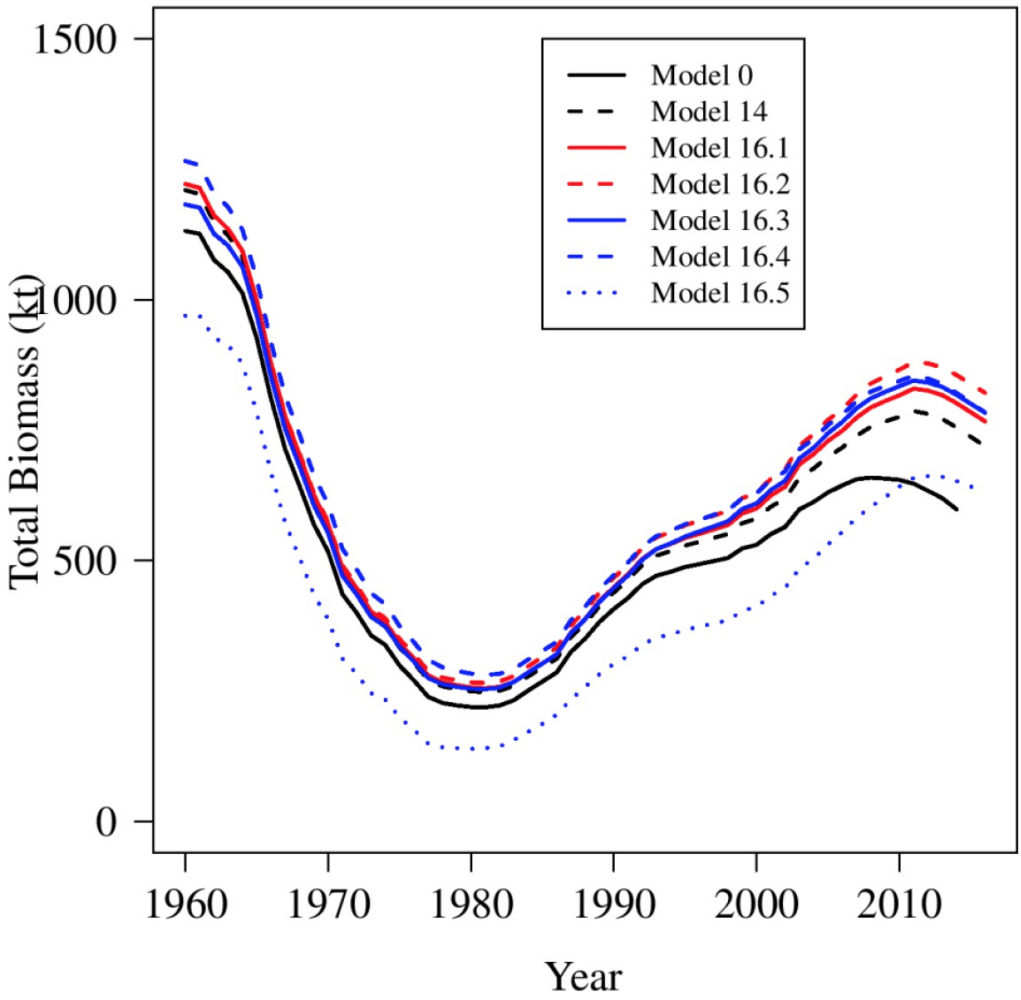

Figure 48 Estimated time series to total biomass for BSAI Pacific Ocean Perch across all models (Spencer & Ianelli 2016).

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Low Concern

The estimated catch of BSAI POP in 2017 was 32,543 t or 0.74 of the ABC (43723 t) (Ianelli and Spencer 2017). Fishing mortality from all sources is at or below target reference points, and the fishery receives a score of "low" concern for fishing mortality.

Justification:

POP were sought by Japanese and Soviet fisheries and supported a major trawl fishery throughout the 1960's; overexploitation occurred during that time. With the beginning of the domestic fishery by 1990, catches peaked in 1990 (~18,324 t), declined moderately through 2001 and then climbed again to a maximum of

32,381 t in 2014 (Spencer and Ianelli 2016}. The ABC for BSAI POP is caught primarily using trawl gear and is currently apportioned among four areas: the western, central, and eastern Aleutian Islands, and eastern Bering Sea. Roughly 50% of the current catch is now taken in the western Aleutians. Fishing mortality has been well below target reference points since since 1990 (Figure A).

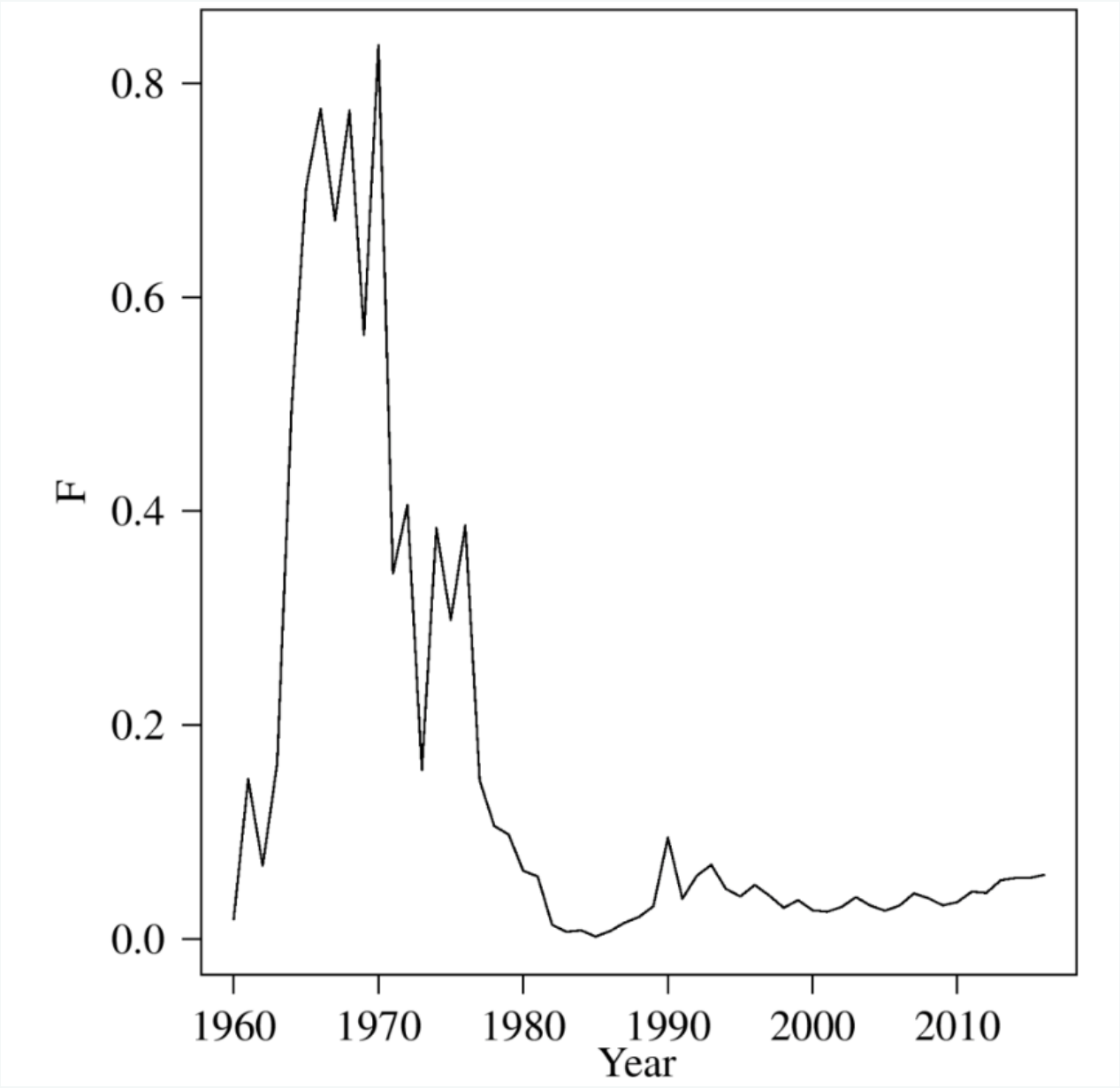

Figure 49 Estimated fully selected fishing mortality for BSAI POP (Spencer & Ianelli 2016).

PACIFIC OCEAN PERCH

Factor 1.1 - Abundance

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Very Low Concern

BSAI Pacific Ocean Perch (POP) is assessed biennially. Projected POP SSB for 2018 is 305,804 t or 57% of unfished SSB. For 2018, the projected SSB is approximately 164% of the target reference point $SB_{35\%}$

(Spencer and Ianelli 2017). The estimated B:B_{MSY} is 1.72 (NMFS FSSI 2017), and the BSAI POP population receives a score of "low" concern for abundance.

Justification:

POP inhabit the outer continental shelf and upper slope regions of the North Pacific Ocean and Bering Sea. Estimated biomass increased from 1980 to 2010 (Figure A). Considerable uncertainty remains regarding POP stock structure, and microsatellite loci research from six regions across Alaska suggest population structure on a relatively fine spatial scale (Spencer and Ianelli 2016).

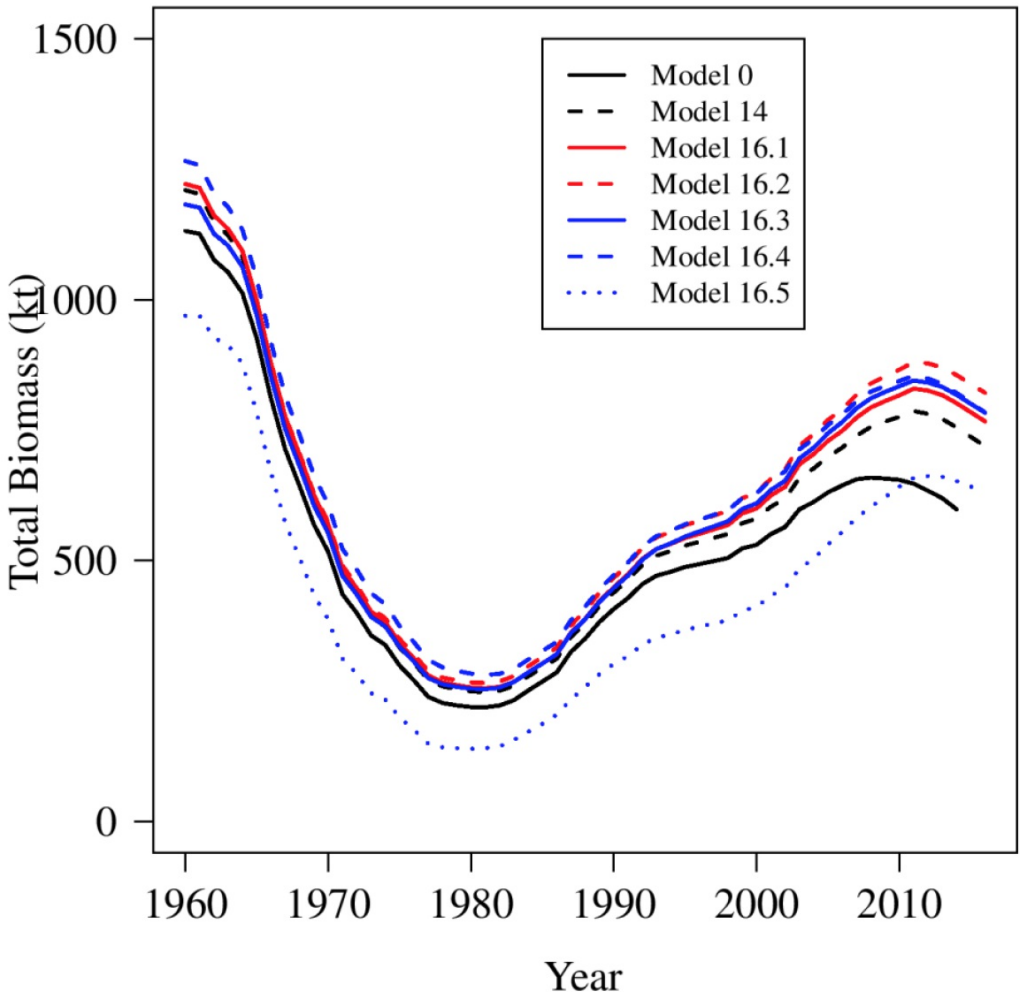

Figure 50 Estimated time series to total biomass for BSAI Pacific Ocean Perch across all models (Spencer & Ianelli 2016).

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Very Low Concern

Projected GOA POP SSB for 2018 is 180,150 t or 61.4% of unfished SSB. For 2018, the projected SSB is approximately 175% of the target reference point $SB_{35\%}$ (Hulson et al. 2017). Fishery dependent and fishery independent data suggest GOA POP biomass and abundance has been increasing steadily since the mid-1980s (Hulson et al. 2017). The 2017 GOA trawl survey POP biomass estimate was the largest on record; the last three consecutive survey biomass estimates were larger than 1 million t (Hulson et al. 2017). The estimated $B:B_{MSY}$ is 1.57 (NMFS FSSI 2017), and GOA POP receives a score of "very low" concern for abundance.

Factor 1.2 - Fishing Mortality

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of BSAI POP in 2017 was 32,543 t or 0.74 of the ABC (43723 t) (Ianelli and Spencer 2017). Fishing mortality from all sources is at or below target reference points, and the fishery receives a score of "low" concern for fishing mortality.

Justification:

POP were sought by Japanese and Soviet fisheries and supported a major trawl fishery throughout the 1960's; overexploitation occurred during that time. With the beginning of the domestic fishery by 1990, catches peaked in 1990 (~18,324 t), declined moderately through 2001 and then climbed again to a maximum of 32,381 t in 2014 (Spencer and Ianelli 2016}. The ABC for BSAI POP is caught primarily using trawl gear and is currently apportioned among four areas: the western, central, and eastern Aleutian Islands, and eastern Bering Sea. Roughly 50% of the current catch is now taken in the western Aleutians. Fishing mortality has been well below target reference points since since 1990 (Figure A).

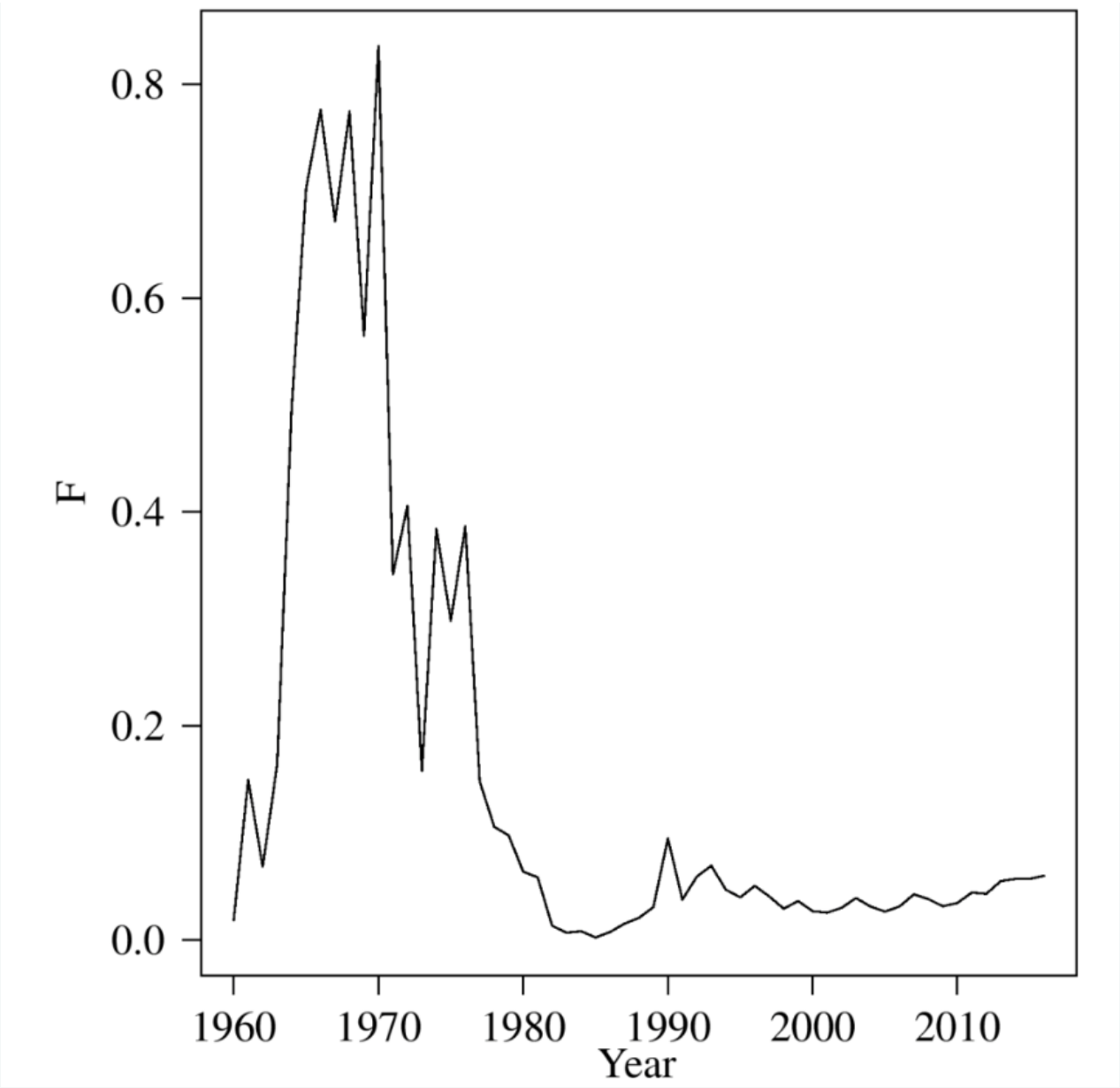

Figure 51 Estimated fully selected fishing mortality for BSAI POP (Spencer & Ianelli 2016).

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of GOA POP in 2017 was 23,880 t or 0.86 of the OFL (27826 t) and 0.998 of the TAC/ABC (23918 t) (NPFMC 2017). The GOA POP trawl fishery is generally fully prosecuted each year in all management areas except for Southeast Outside (trawling prohibited). Fully-selected fishing mortality decreased dramatically from historic rates, has been below the target reference point $F_{40\%}$ since 1999, and has leveled out in the last decade (Hulson et al. 2017). The fishery is neither overfished nor approaching an overfished condition, and the fishery receives a score of "low" concern for fishing mortality.

Justification:

POP were initially taken in the GOA by Russian and Japanese trawlers in the early 1960s, and the fishery developed rapidly during that time. Catches peaked in 1965, when a total of nearly 350,000 t was caught. This

apparent overfishing resulted in a precipitous decline in catches in the late 1960s and into the 1970s (Hulson et al. 2017). The domestic fishery first became important in the mid-1980s and expanded each year until 1991.

Historically, bottom trawls have accounted for nearly all the commercial harvest of POP. In recent years, however, the portion of the POP catch taken by pelagic trawls has increased. The percentage of the POP Gulf-wide catch taken in pelagic trawls increased from an average of 7% during 1990 to 1999 to an average of 10% and up to 23% after 2000. POP comprise one of the primary rockfish management groups harvested as part of the Central GOA Rockfish program, which was established in 2007 (Hulson et al. 2017). Fully selected fishing mortality has been stable since the early 1990s (Figure A).

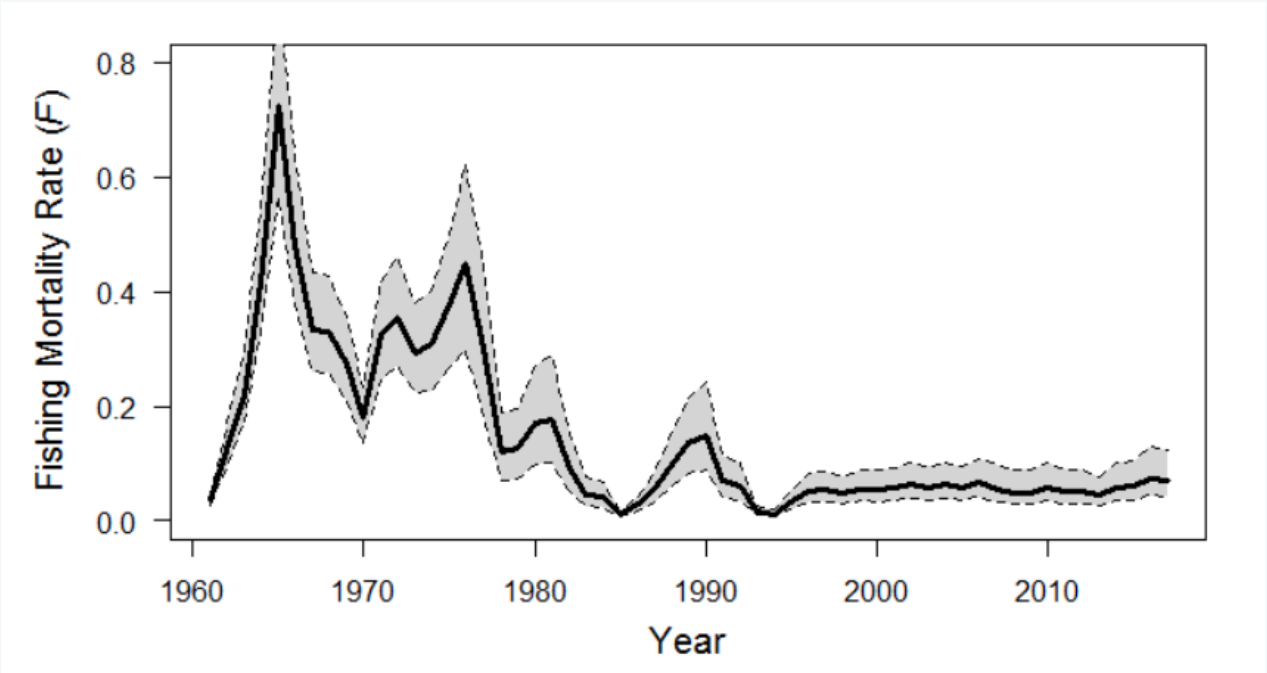

Figure 52 Estimated fully selected fishing mortality over time with 95% credible intervals determined by MCMC (light grey region) for GOA POP (Hulson et al. 2017).

ROUGHEYE ROCKFISH

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

GOA rougheye is caught primarily in rockfish trawl fisheries, and to a lesser extent, in sablefish longline fisheries. GOA rougheye is managed as part of the RE/BS complex due to its similarity in appearance with blackspotted rockfish (Spencer and Rooper 2016). GOA RE/BS are assessed bienially using an age-structured model as a Tier 3a species. Projected GOA RE/BS SSB_{2018} is 15,059 t or 66% of unfished SSB, and the ratio of SSB:SSB_{40} is 1.67. Recent recruitment has been steady and near the median of the recruitment time series, as evidenced by the young fish returns over time on the trawl survey (Shotwell et al. 2017). Two survey indices also suggest that GOA RE/BS biomass has been steady since the mid-1980s; the estimated B:B_{MSY} is 1.92 (NMFS FSSI 2017). RE/BS biomass is estimated to be above target reference points; however, due to issues with speciation of RE/BS rockfish and limited data regarding historical catches coupled with their high vulnerability status (Table 8), GOA rougheye receives a score of "moderate" concern for abundance in rockfish

trawl and longline fisheries.

Justification:

Table 8. Rougheye rockfish, Alaska/Gulf of Alaska trawl

Rougheye rockfish, Alaska, Gulf of Alaska trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference
Average age at maturity (years)	20	3	(AFSC 2018)	Areal overlap		3	(Shotwell et al. 2017)
Average maximum age (years)	205	3	(COSEWIC 2007)	Vertical overlap		3	(Shotwell et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Shotwell et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	97	1	fishbase.org	Post-capture mortality		3	(Shotwell et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	40	2	(DFO 1999)	Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3					
Trophic level	3.5	3	fishbase.org	Productivity-Susceptibility Score	3.24		

Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Shotwell et al. 2017)			
Productivity Subscore		2.25				

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

BSAI rougheye rockfish is managed as part of the RE/BS complex due to its similarity in appearance to blackspotted rockfish (Spencer and Rooper 2016), and the RE/BS complex is assessed biennially using an age-structured model as Tier 3b stock. Projected RE/BS SSB for 2018 is 8,208 t or 40% of unfished SSB. For 2018, the projected SSB is approximately 99% of the target reference points $SB_{40\%}$ and 112% $SB_{35\%}$ (Spencer and Rooper 2017). The estimated $B:B_{MSY}$ is 0.9 (NMFS FSSI 2017). The rougheye rockfish stock is near target reference points; however, data limitations by species and high rougheye vulnerability (Table 8) yield a score of "moderate" concern for abundance of BSAI rougheye rockfish.

Justification:

Table 8. Rougheye rockfish, Alaska, Bering Sea Aleutian Islands trawl

Rougheye rockfish, Alaska, BSAI trawl						
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference
Average age at maturity (years)	20	3	(AFSC 2018)	Areal overlap		3	(Shotwell et al. 2017)
Average maximum age (years)	205	3	(COSEWIC 2007)	Vertical overlap		3	(Shotwell et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Shotwell et al. 2017)

Average maximum size (cm) (not to be used when scoring invertebrate species)	97	1	fishbase.org	Post-capture mortality	3	(Shotwell et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	40	2	(DFO 1999)	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3				
Trophic level	3.5	3	fishbase.org	Productivity-Susceptibility Score	3.24	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Shotwell et al. 2017)			
Productivity Subscore		2.25				

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

GOA rougheye rockfish is a bycatch-only fishery, taken predominantly in targeted rockfish bottom-trawl fisheries and sablefish fisheries. Managed as the RE/BS complex, the 2017 catch of GOA RE/BS (522 t) was well below target reference points and was approximately 0.39 of the Tier 3a ABC (Shotwell et al. 2017). Since 2005, the TACs for RE/BS rockfish have not been fully taken, and catches are generally between 20 to 60% of TAC (Shotwell et al. 2017). RE/BS fishing mortality has been below the $F_{40\%}$ management reference point since 1990 and receives a score of "low" concern for fishing mortality.

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of BSAI RE/BS in 2017 was 204 t or 0.40 of the ABC (501 t) (Spencer and Rooper 2017). Fishing mortality from all sources is at or below target reference points, and the fishery receives a score of "low" concern for fishing mortality.

ROUGHEYE ROCKFISH

Factor 1.1 - Abundance

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Moderate Concern

GOA rougheye is caught primarily in rockfish trawl fisheries, and to a lesser extent, in sablefish longline fisheries. GOA rougheye is managed as part of the RE/BS complex due to its similarity in appearance with blackspotted rockfish (Spencer and Rooper 2016). GOA RE/BS are assessed bienially using an age-structured model as a Tier 3a species. Projected GOA RE/BS SSB_{2018} is 15,059 t or 66% of unfished SSB, and the ratio of SSB:SSB_{40} is 1.67. Recent recruitment has been steady and near the median of the recruitment time series, as evidenced by the young fish returns over time on the trawl survey (Shotwell et al. 2017). Two survey indices also suggest that GOA RE/BS biomass has been steady since the mid-1980s; the estimated B:B_{MSY} is 1.92 (NMFS FSSI 2017). RE/BS biomass is estimated to be above target reference points; however, due to issues with speciation of RE/BS rockfish and limited data regarding historical catches coupled with their high vulnerability status (Table 8), GOA rougheye receives a score of "moderate" concern for abundance in rockfish trawl and longline fisheries.

Justification:

Table 8. Rougheye rockfish, Alaska/Gulf of Alaska trawl

Rougheye rockfish, Alaska, Gulf of Alaska trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference
Average age at maturity (years)	20	3	(AFSC 2018)	Areal overlap		3	(Shotwell et al. 2017)
Average maximum age (years)	205	3	(COSEWIC 2007)	Vertical overlap		3	(Shotwell et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Shotwell et al. 2017)

Average maximum size (cm) (not to be used when scoring invertebrate species)	97	1	fishbase.org	Post-capture mortality	3	(Shotwell et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	40	2	(DFO 1999)	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3				
Trophic level	3.5	3	fishbase.org	Productivity-Susceptibility Score	3.24	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Shotwell et al. 2017)			
Productivity Subscore		2.25				

Factor 1.2 - Fishing Mortality

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Low Concern

GOA rougheye rockfish is a bycatch-only fishery, taken predominantly in targeted rockfish bottom-trawl fisheries and sablefish fisheries. Managed as the RE/BS complex, the 2017 catch of GOA RE/BS (522 t) was well below target reference points and was approximately 0.39 of the Tier 3a ABC (Shotwell et al. 2017). Since 2005, the TACs for RE/BS rockfish have not been fully taken, and catches are generally between 20 to 60% of TAC (Shotwell et al. 2017). RE/BS fishing mortality has been below the $F_{40\%}$ management reference point since 1990 and receives a score of "low" concern for fishing mortality.

SABLEFISH

Factor 1.1 - Abundance

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Very Low Concern

Alaska sablefish is assessed annually using an age-structured, split sex model. Target reference points are calculated using recruitment data from 1977 to 2013. The sablefish population is not classified as overfished or approaching an overfishing condition (Hanselman et al. 2017). Projected female SSB for 2018 is 88,928 t or 36% of unfished SSB. For 2018, the projected SSB is approximately 103% of the reference point $SB_{35\%}$ and the Alaska sablefish population receives a score of "very low" concern for abundance (Hanselman et al. 2017).

Justification:

While sablefish was traditionally assumed to belong to two separate populations or stocks (Alaska and northern BC; southern BC and CA/OR/WA), more recent genetic and stock structure research by Jasonowicz et al. (2016) suggests there is little population substructure throughout their range along the US West Coast to Alaska (Hanselman et al. 2017).

A number of abundance indices are used to inform the sablefish assessment annually including the longline survey, trawl survey, and fishery abundance index. Sablefish abundance has fluctuated over the last forty years in relation to environmental conditions, fishing effort and variations in recruitment (Figure A). More recently, although SSB generally declined since 2008, very large estimates of the 2014 year class resulted in rapidly increasing total biomass estimates beginning in 2017. There is high uncertainty surrounding the 2014 year class estimates, and data from surveys in subsequent years will be necessary to determine the reliability of the 2014 year class estimates. In 2017, the $B:B_{MSY}$ ratio for Alaska sablefish was 1.02 (NMFS FSSI 2017).

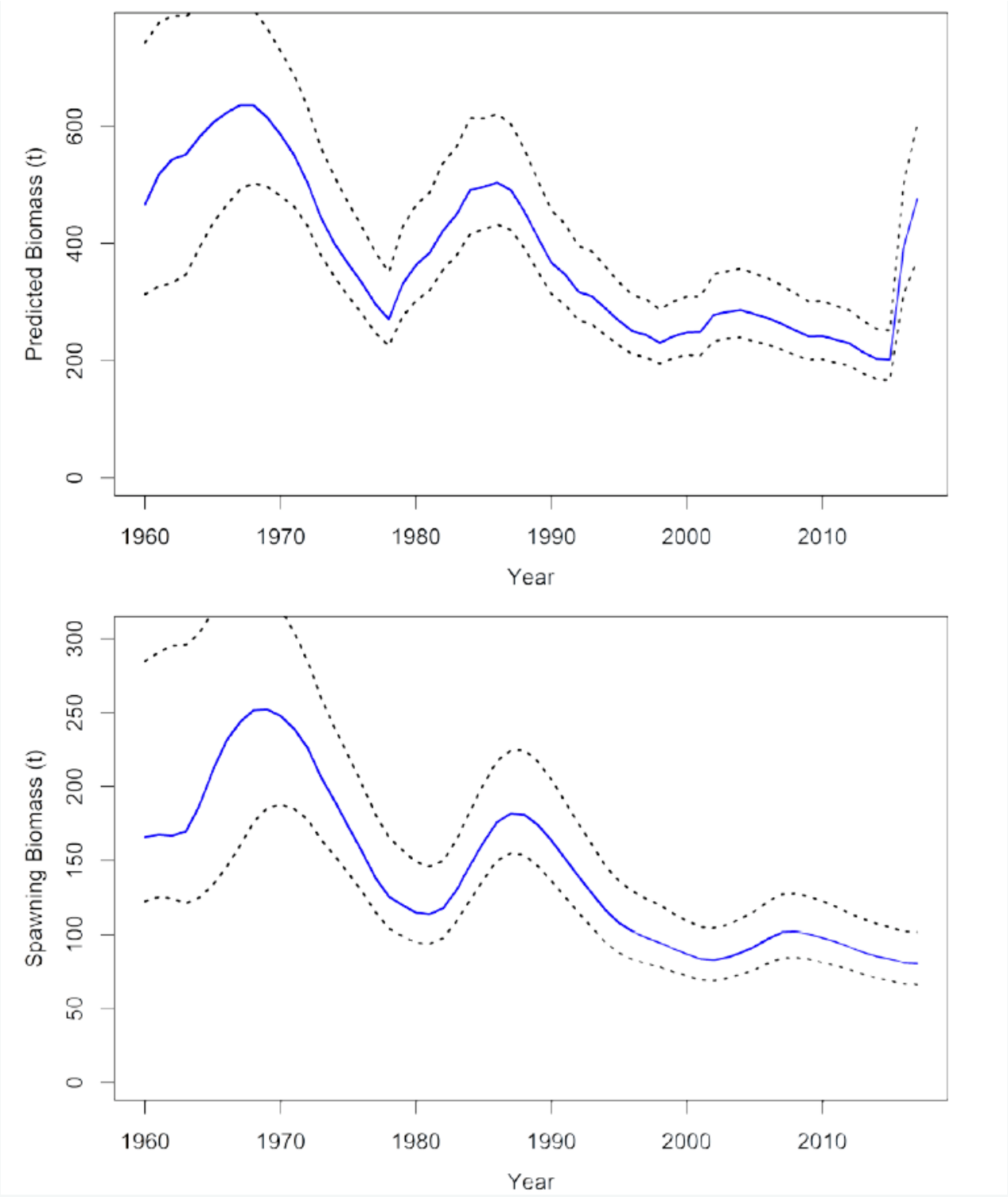

Figure 53 Estimated sablefish total biomass (thousands t) and spawning biomass (bottom) with 95% MCMC credible intervals (Haselman et al. 2017).

Factor 1.2 - Fishing Mortality

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Low Concern

The catch of Alaska sablefish in 2017 was 11,932 t or 0.91 of the ABC (13083 t). F_{ABC} is conservatively set at

a maximum of 0.081 per the Tier 3b management category (Hanselman et al. 2017). It is important to note that the TAC and ABC were exceeded in the GOA management area in 2017; however, Alaska catches were still well below Alaska-wide OFLs and and ABCs (NPFMC 2017). Despite regional variations in fishing effort and mortality, fishing mortality from all sources is at or below sustainable levels to ensure the viability and ecological role of the sablefish stock, and the sablefish fishery receives a score of "low" concern for fishing mortality.

Justification:

Sablefish have been harvested since the end of the 19th century by US and Canadian fishermen. Effort increased substantially with the introduction of foreign fisheries, and sablefish in the BS were harvested by Japanese longliners as early as 1958. With the introduction of foreign trawlers, the fishery expanded rapidly and peaked at 36,776 t overall in 1972. The US longline fishery began expanding in 1982 in the GOA, and by 1988, the US harvested nearly all sablefish taken in Alaska (Hanselman et al. 2017). Catches peaked again in the late 1980s and have generally declined since that time (Figure A). Fishing mortality was estimated to be high in the 1970s, suggesting overharvesting may have occurred. More recent management has generally constrained mortality below target levels (Figure B fishing mortality). Based on projected increasing biomass estimates, catches are expected to increase in the following years (Hanselman et al. 2017).

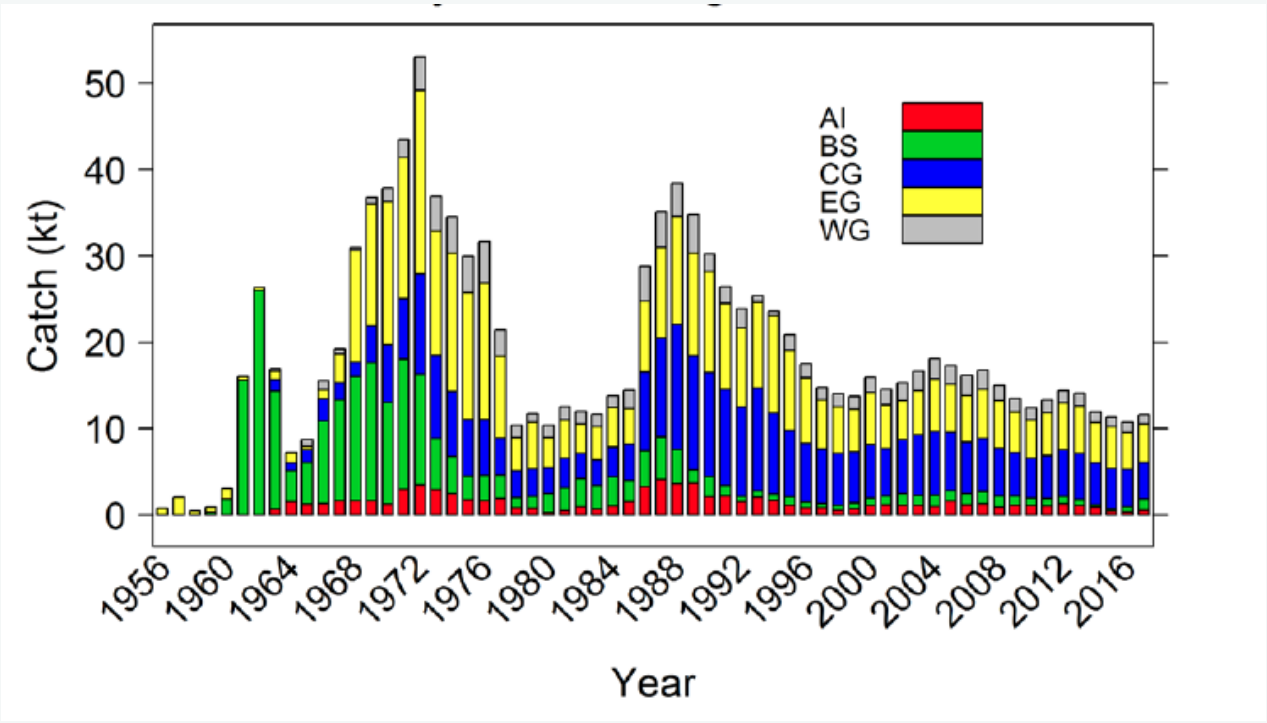

Figure 54 Sablefish fishery total reported catch (kt) by North Pacific Fishery Management Council area and year (Hanselman et al. 2017).

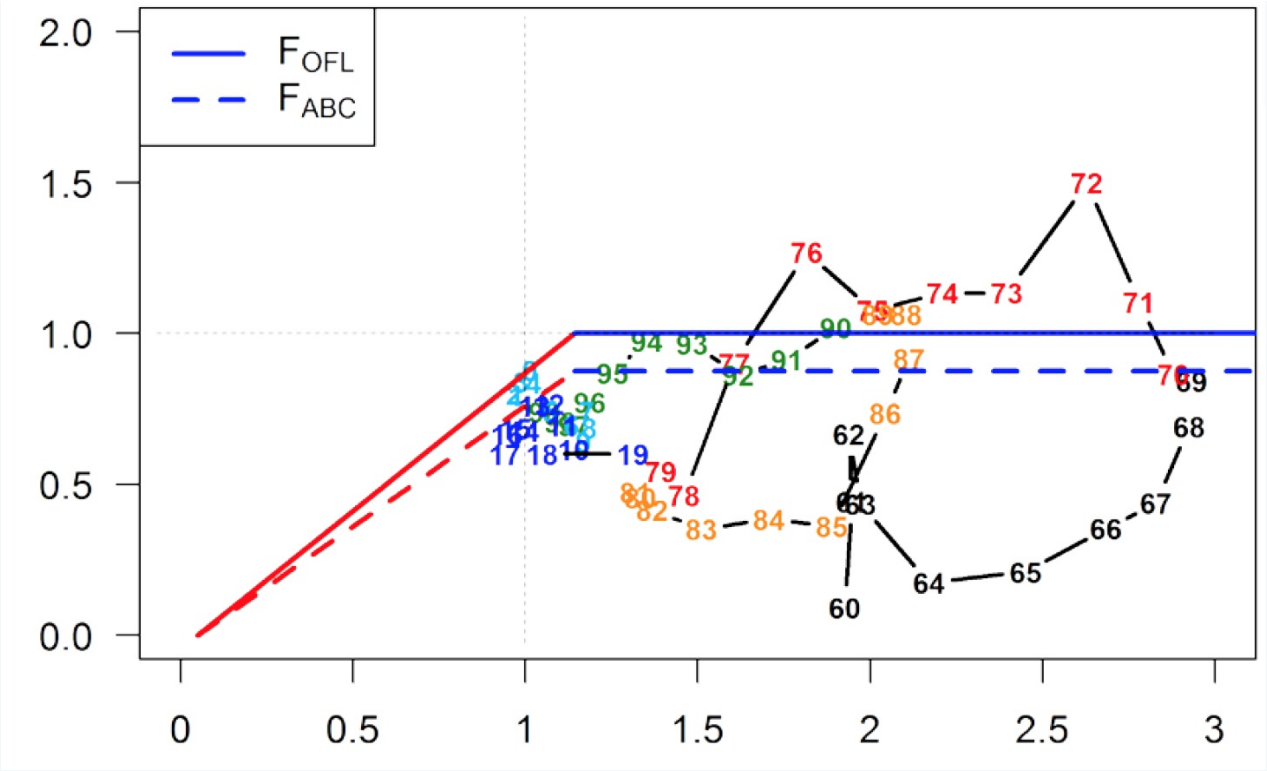

Figure 55 Phase-plane diagram of time series of sablefish estimated spawning biomass relative to the unfished level and fishing mortality relative to FOFL for author recommended model. Y-axis represents F/F35%. X-axis represents SSB/B35% (Hanselman et al. 2017).

Alaska sablefish OFLs and ABCs are apportioned between the GOA, the BS, and the AI management areas. Sablefish are harvested by longline or pot (fixed gear) and trawl gear (sablefish typically landed as bycatch in trawl fisheries). Fixed gear has comprised roughly 80 to 85% of total sablefish catches since the early 2000s (Figure C catches gear). Although pot fishiing gear is now legal in all FMPs (legalized/utilized in the GOA beginning in 2017), the BS and AI have a more longstanding history with this gear type targeting sablefish. And since 2004, pot gear has accounted for over 50% of the BS fixed gear IFQ catch and up to 34% of the fixed gear catch in the AI (Hanselman et al. 2017). Though sablefish in the GOA are generally harvested to the full extent allowable under the ABC, the BS and AI FMPs are not prosecuted to the full extent in most years (Hanselman et al. 2017). Sablefish are also harvested in state fisheries, and the Alaska Department of Fish and Game has expressed concern at the high proportion of juvenile sablefish taken in state-managed Southeast Alaska Inside waters' longline and pot fisheries (ADFG 2018).

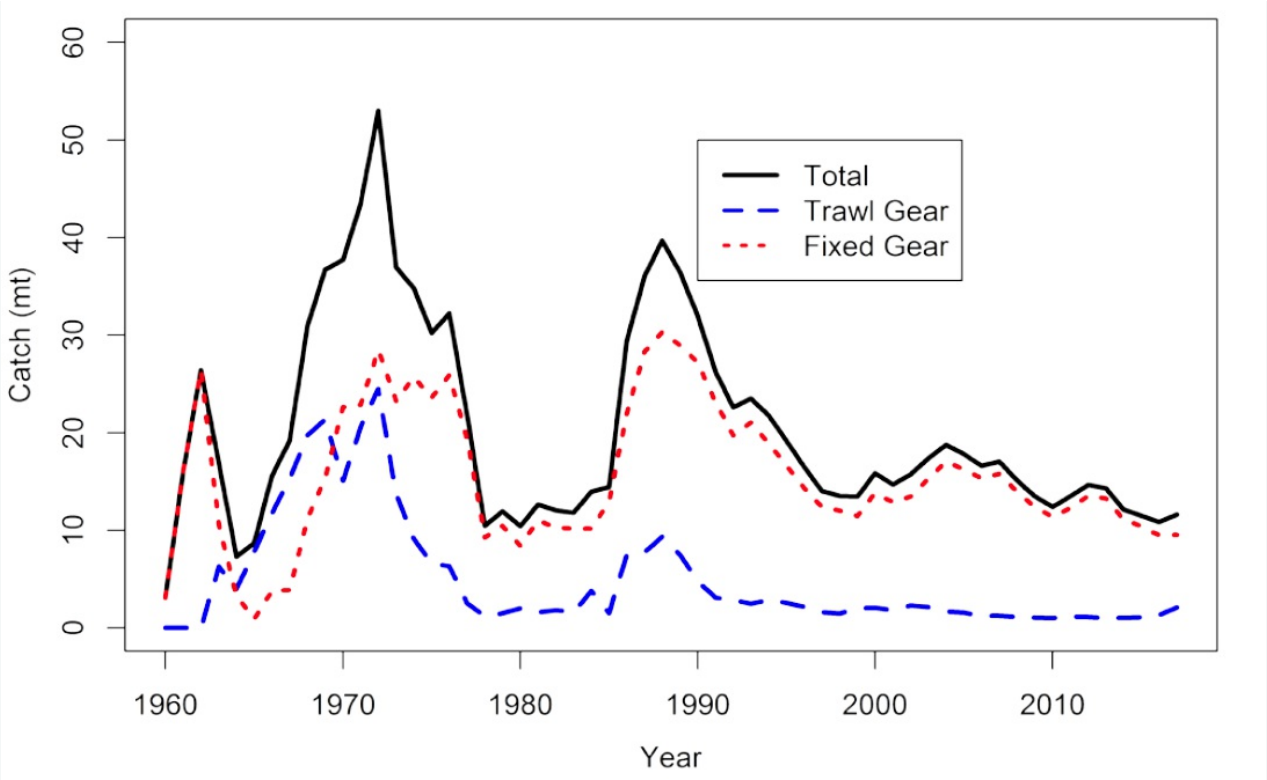

Figure 56 Sablefish catch by gear type (Hanselman et al. 2017).

SABLEFISH

Factor 1.1 - Abundance

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT

Very Low Concern

Alaska sablefish is assessed annually using an age-structured, split sex model. Target reference points are calculated using recruitment data from 1977 to 2013. The sablefish population is not classified as overfished or approaching an overfishing condition (Hanselman et al. 2017). Projected female SSB for 2018 is 88,928 t or 36% of unfished SSB. For 2018, the projected SSB is approximately 103% of the reference point $SB_{35\%}$ and the Alaska sablefish population receives a score of "very low" concern for abundance (Hanselman et al. 2017).

Justification:

While sablefish was traditionally assumed to belong to two separate populations or stocks (Alaska and northern BC; southern BC and CA/OR/WA), more recent genetic and stock structure research by Jasonowicz et al. (2016) suggests there is little population substructure throughout their range along the US West Coast to Alaska (Hanselman et al. 2017).

A number of abundance indices are used to inform the sablefish assessment annually including the longline survey, trawl survey, and fishery abundance index. Sablefish abundance has fluctuated over the last forty years in relation to environmental conditions, fishing effort and variations in recruitment (Figure A). More recently, although SSB generally declined since 2008, very large estimates of the 2014 year class resulted in rapidly increasing total biomass estimates beginning in 2017. There is high uncertainty surrounding the 2014 year class estimates, and data from surveys in subsequent years will be necessary to determine the reliability

of the 2014 year class estimates. In 2017, the B:B_{MSY} ratio for Alaska sablefish was 1.02 (NMFS FSSI 2017).

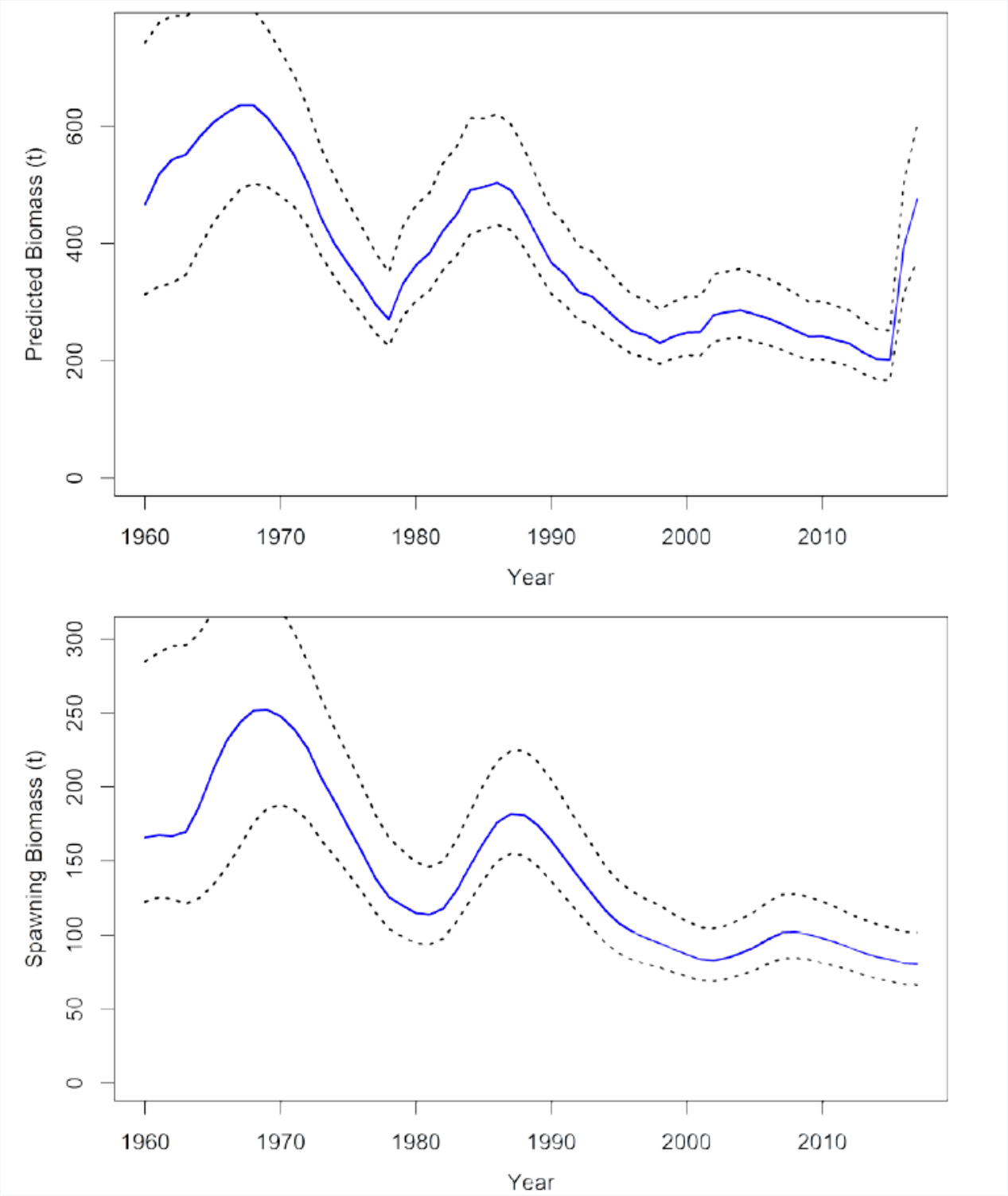

Figure 57 Estimated sablefish total biomass (thousands t) and spawning biomass (bottom) with 95% MCMC credible intervals (Haselman et al. 2017).

Factor 1.2 - Fishing Mortality

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT

Low Concern

The catch of Alaska sablefish in 2017 was 11,932 t or 0.91 of the ABC (13083 t). F_{ABC} is conservatively set at a maximum of 0.081 per the Tier 3b management category (Hanselman et al. 2017). It is important to note that the TAC and ABC were exceeded in the GOA management area in 2017; however, Alaska catches were still well below Alaska-wide OFLs and and ABCs (NPFMC 2017). Despite regional variations in fishing effort and mortality, fishing mortality from all sources is at or below sustainable levels to ensure the viability and ecological role of the sablefish stock, and the sablefish fishery receives a score of "low" concern for fishing mortality.

Justification:

Sablefish have been harvested since the end of the 19th century by US and Canadian fishermen. Effort increased substantially with the introduction of foreign fisheries, and sablefish in the BS were harvested by Japanese longliners as early as 1958. With the introduction of foreign trawlers, the fishery expanded rapidly and peaked at 36,776 t overall in 1972. The US longline fishery began expanding in 1982 in the GOA, and by 1988, the US harvested nearly all sablefish taken in Alaska (Hanselman et al. 2017). Catches peaked again in the late 1980s and have generally declined since that time (Figure A). Fishing mortality was estimated to be high in the 1970s, suggesting overharvesting may have occurred. More recent management has generally constrained mortality below target levels (Figure B fishing mortality). Based on projected increasing biomass estimates, catches are expected to increase in the following years (Hanselman et al. 2017).

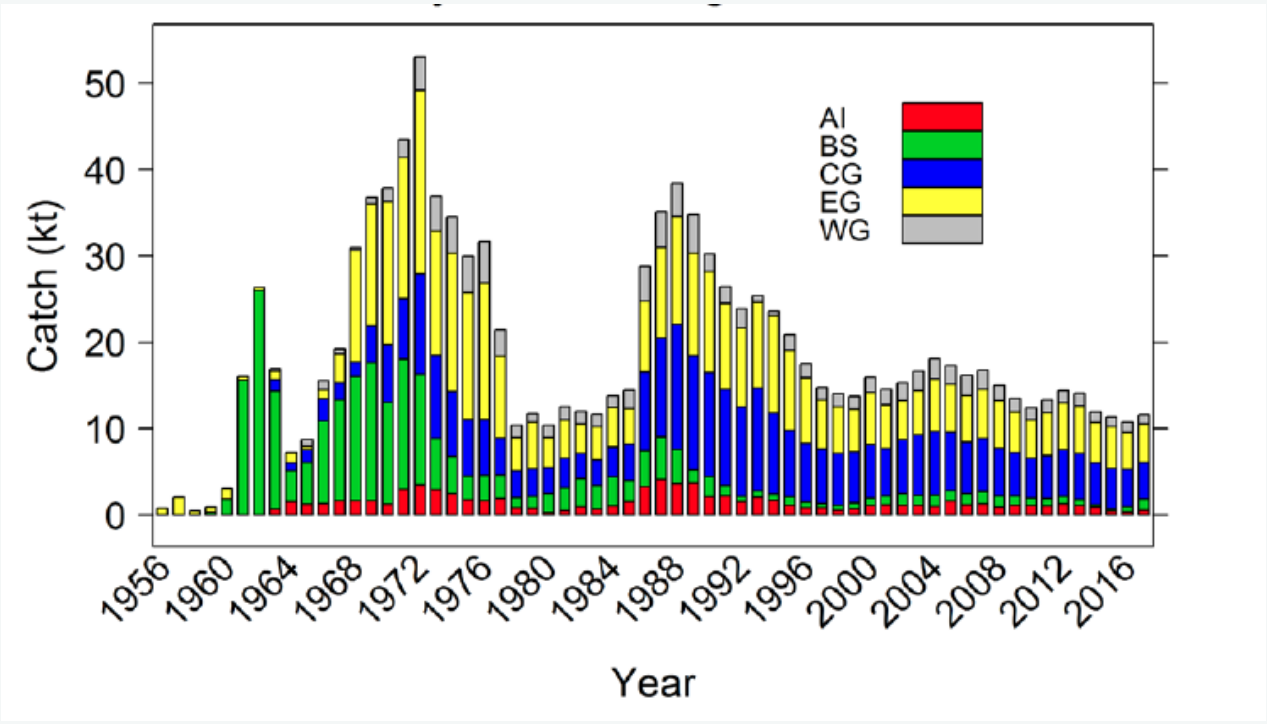

Figure 58 Sablefish fishery total reported catch (kt) by North Pacific Fishery Management Council area and year (Hanselman et al. 2017).

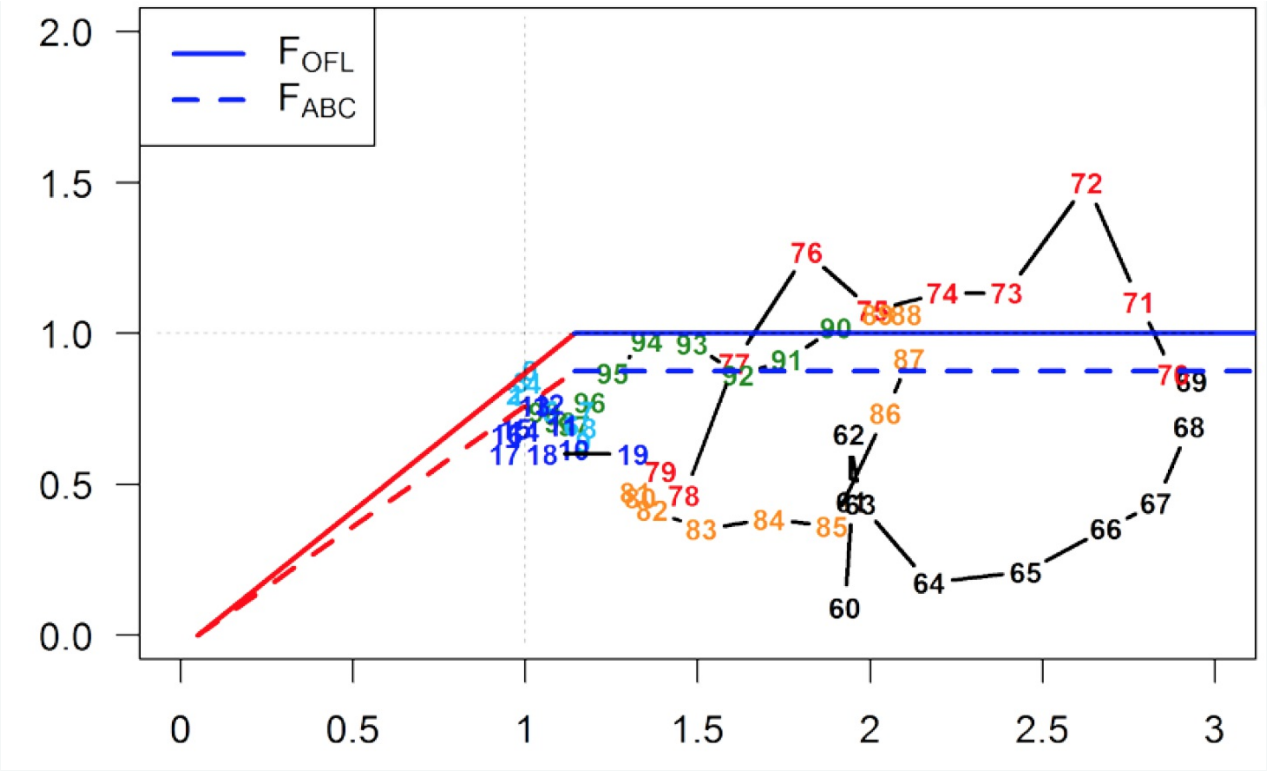

Figure 59 Phase-plane diagram of time series of sablefish estimated spawning biomass relative to the unfished level and fishing mortality relative to FOFL for author recommended model. Y-axis represents F/F35%. X-axis represents SSB/B35% (Hanselman et al. 2017).

Alaska sablefish OFLs and ABCs are apportioned between the GOA, the BS, and the AI management areas. Sablefish are harvested by longline or pot (fixed gear) and trawl gear (sablefish typically landed as bycatch in trawl fisheries). Fixed gear has comprised roughly 80 to 85% of total sablefish catches since the early 2000s (Figure C catches gear). Although pot fishiing gear is now legal in all FMPs (legalized/utilized in the GOA beginning in 2017), the BS and AI have a more longstanding history with this gear type targeting sablefish. And since 2004, pot gear has accounted for over 50% of the BS fixed gear IFQ catch and up to 34% of the fixed gear catch in the AI (Hanselman et al. 2017). Though sablefish in the GOA are generally harvested to the full extent allowable under the ABC, the BS and AI FMPs are not prosecuted to the full extent in most years (Hanselman et al. 2017). Sablefish are also harvested in state fisheries, and the Alaska Department of Fish and Game has expressed concern at the high proportion of juvenile sablefish taken in state-managed Southeast Alaska Inside waters' longline and pot fisheries (ADFG 2018).

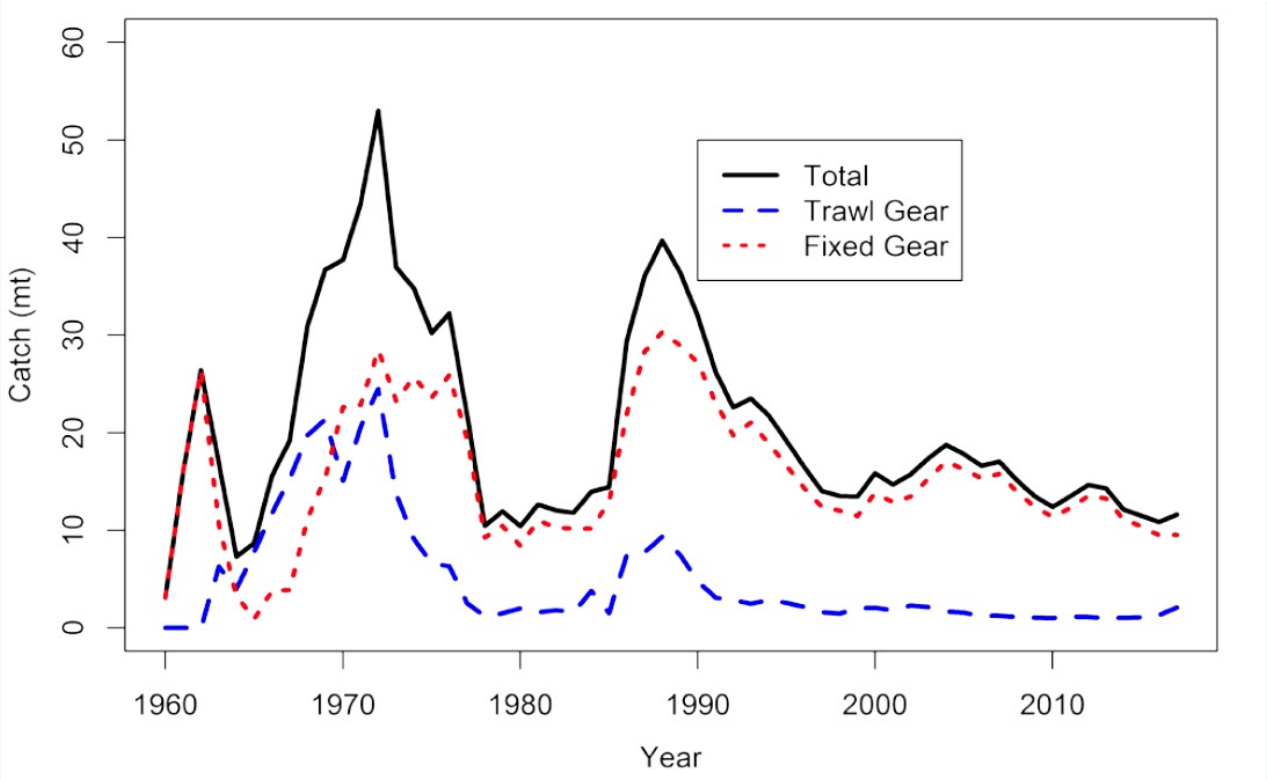

Figure 60 Sablefish catch by gear type (Hanselman et al. 2017).

SHORTRAKER ROCKFISH

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

High Concern

GOA shortraker rockfish has been assessed biennially as a single species since 2010, using a random effects model to estimate biomass. As a Tier 5 stock, there are no target reference points against which to assess the current status of GOA shortraker. Projected shortraker biomass for 2018 is 38,361 t, and overall GOA biomass estimates suggest a decline from 2013 to 2017. However, long-term GOA biomass estimates suggest the population is stable (Echave and Hulson 2017a). In summary, shortraker rockfish is vulnerable (Table 10), and there are no target reference points for this Tier 5 species; therefore, shortraker rockfish receives a score of "high" concern for abundance in the GOA.

Justification:

Table 10. Shortraker rockfish, Alaska/Gulf of Alaska trawl

Shortraker rockfish, Alaska, Gulf of Alaska trawl

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 11 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 11 = high risk)	Reference
Average age at maturity (years)	21	3	(Echave & Hulson 2017)	Areal overlap		3	(Echave & Hulson 2017)
Average maximum age (years)	157	3	(Echave & Hulson 2017a); fishbase.org	Vertical overlap		3	(Echave & Hulson 2017a)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Echave & Hulson 2017a)
Average maximum size (cm) (not to be used when scoring invertebrate species)	108	2	fishbase.org	Post-capture mortality		3	(Echave & Hulson 2017a)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	47	2	(Echave & Hulson 2017a)	Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3	(Echave & Hulson 2017a)				
Trophic level	4.3	3	fishbase.org	Productivity-Susceptibility Score	3.32		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High		
Quality of Habitat	Moderately altered	2	(Echave & Hulson 2017)				

Productivity Subscore	2.375

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

High Concern

BSAI shortraker rockfish have been assessed a single species since 2008 using a random effects model to estimate biomass. As a Tier 5 stock, there are no target reference points against which to assess the current status of BSAI shortraker. Projected shortraker biomass for 2018 is 22,191 t, representing a moderate decline since 2011 (Spies et al. 2017c). Overall, survey-based biomass estimates have been relatively stable since 2002; however, shortraker rockfish are vulnerable (Table 10), and therefore shortraker receives a score of "high" concern for abundance.

Justification:

Shortraker rockfish are distributed along the continental slope in the north Pacific from southern California to Japan, and are commonly found between eastern Kamchatka and British Columbia. Shortraker are slow-growing and are one of the longest-lived animal species in the world, reaching ages > 150 years (Spies et al. 2016). This slow growth life history strategy may render shortraker vulnerable to fishing activities or environmental perturbations. Population structure research suggests that current management boundaries (AI, BS, GOA) are appropriate, and survey estimates suggest that shortraker biomass has been stable since 2002 (Spies et al. 2016).

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of GOA shortaker in 2017 was 552 t or 0.43 of the ABC (1286 t) (NPFMC 2017) (Echave and Hulson 2017). The shortraker fishery is not subject to overfishing, but it is uknown whether it is approaching an overfishing condition (NMFS 2017). Overall, catches have been hovering around 50% of OFL, and the GOA shortaker fishery receives a score of "low" concern for fishing mortality.

Justification:

Shortaker rockfish are caught primarily with longline and trawl fishing gear, caught in relatively equal amounts by each gear type since 2004. More specifically, shortraker rockfish are taken mostly in fisheries targeting rockfish, sablefish, and Pacific halibut, with lesser amounts taken in the walleye pollock and other groundfish fisheries. Exploitation rates for GOA shortraker are typically low and vary by management area and gear types and year. The highest exploitation rates typically occur in the western GOA management area for both hook and line and trawl gear types (Echave and Hulson 2017).

ALASKA/BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The estimated catch of BSAI shortraker in 2017 was 160 t or 0.32 of the ABC (499 t) (NPFMC 2017) (Spies et al. 2016). The shortraker fishery is not subject to overfishing, but it is unknown whether it is approaching an overfishing condition (NMFS 2017) (AFSC 2017). Overall, catches have been well below target ABC and TACs since 2004 (except in 2013; 7 t overage), and the shortraker fishery receives a score of "low" concern for fishing mortality.

Justification:

Shortraker catches generally occur in rockfish and flatfish bottom trawl fisheries, although shortraker are also taken incidentally in sablefish and Greenland turbot longline fisheries (Spies et al. 2016). The catches of shortraker by BSAI management area from 1994 to 2016 have been variable, with the largest catches generally occurring in the EBS. Exploitation rates by management area were assessed by dividing yearly catch by biomass estimates in order to compare against F_{ABC} and F_{OFL}. The exploitation rate for the entire BSAI has remained below F_{ABC} and F_{OFL} since 2002; however, exploitation rates do vary by region and may have been exceeded in the Southern Bering Sea in recent years (Spies et al. 2016).

SHORTSPINE THORNYHEAD

Factor 1.1 - Abundance

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Moderate Concern

Shortspine thornyhead rockfish (SST) is managed as part of the Other Rockfish complex in the BSAI and is managed individually in the GOA. In both regions, SST is assessed as a Tier 5 species using a biennial stock assessment. Projected BSAI SST biomass for 2018 is 52,761 t, representing a general increasing trend since 2002 (Conners et al. 2016) (Conners et al. 2017). Projected biomass in the GOA for 2018 is 90,570 t, also representing an increasing trend since the early 2000s in the GOA (Echave and Hulson 2017). SST are not highly vulnerable (Table 11), and biomass estimates in the separately managed BSAI and GOA are both at or near time trend highs. However, SST is listed as IUCN "Threatened" due to long-term declines since the 1960s. More recent stable biomass trends conflict with the IUCN "Threatened" listing yield, and SST in Alaska receives a score of "moderate" concern for abundance.

Justification:

Table 11. Shortspine thornyhead, Alaska longline

Shortspine thornyhead, Alaska longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference

Average age at maturity (years)	12	2	(Echave & Hulson 2015)	Areal overlap	3	(Echave & Hulson 2015)
Average maximum age (years)	100	3	(Echave & Hulson 2015)	Vertical overlap	3	(Echave & Hulson 2015)
Fecundity (eggs/yr)	300,000	1	(Cooper et al. 2005)	Selectivity of fishery	2	(Echave & Hulson 2015)
Average maximum size (cm) (not to be used when scoring invertebrate species)	80	1	(Echave & Hulson 2015)	Post-capture mortality	3	(Echave & Hulson 2015)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	22	1	(Echave & Hulson 2015)	Susceptibility Subscore	2.325	
Reproductive strategy	Demersal egg layer or brooder	2	fishbase.org			
Trophic level	3.6	3	fishbase.org	Productivity-Susceptibility Score	2.99	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium	
Quality of Habitat	Moderately altered	2				
Productivity Subscore		1.875				

Factor 1.2 - Fishing Mortality

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Low Concern

The average catch of SST in the BSAI from 2004 to 2016 was 147.2 t; the majority of these landings occur in the EBS. The estimated catch of BSAI SST in 2016 was 314.4 t, which was approximately 0.29 of the ABC

(1050 t) (Conners et al. 2016). GOA SST catches tend to be higher than BSAI catches; GOA SST 2016 catch was 1119 t or 0.57 of the ABC/TAC (Echave and Hulson 2017). The exploitation rate (catch/biomass) for BSAI SST in recent years has remained less than 0.015 (Conners et al. 2016), and the exploitation rate for GOA SST is well below the time trend average (1992 to 2017) and has decreased since 2013 to roughly 0.01 (Echave and Hulson 2017). Low exploitation rates coupled with catches within management reference points yield a score of "low" concern for SST fishing mortality in the sablefish and rockfish trawl fisheries.

SHORTSPINE THORNYHEAD

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

Shortspine thornyhead rockfish (SST) is managed as part of the Other Rockfish complex in the BSAI and is managed individually in the GOA. In both regions, SST is assessed as a Tier 5 species using a biennial stock assessment. Projected BSAI SST biomass for 2018 is 52,761 t, representing a general increasing trend since 2002 (Conners et al. 2016) (Conners et al. 2017). Projected biomass in the GOA for 2018 is 90,570 t, also representing an increasing trend since the early 2000s in the GOA (Echave and Hulson 2017). SST are not highly vulnerable (Table 11), and biomass estimates in the separately managed BSAI and GOA are both at or near time trend highs. However, SST is listed as IUCN "Threatened" due to long-term declines since the 1960s. More recent stable biomass trends conflict with the IUCN "Threatened" listing yield, and SST in Alaska receives a score of "moderate" concern for abundance.

Justification:

Table 11. Shortspine thornyhead, Alaska longline

Shortspine thornyhead, Alaska longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 12 = high risk)	Reference
Average age at maturity (years)	12	2	(Echave & Hulson 2015)	Areal overlap		3	(Echave & Hulson 2015)
Average maximum age (years)	100	3	(Echave & Hulson 2015)	Vertical overlap		3	(Echave & Hulson 2015)
Fecundity (eggs/yr)	300,000	1	(Cooper et al. 2005)	Selectivity of fishery		2	(Echave & Hulson 2015)

Average maximum size (cm) (not to be used when scoring invertebrate species)	80	1	(Echave & Hulson 2015)	Post-capture mortality	3	(Echave & Hulson 2015)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	22	1	(Echave & Hulson 2015)	Susceptibility Subscore	2.325	
Reproductive strategy	Demersal egg layer or brooder	2	fishbase.org			
Trophic level	3.6	3	fishbase.org	Productivity-Susceptibility Score	2.99	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium	
Quality of Habitat	Moderately altered	2				
Productivity Subscore		1.875				

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

The average catch of SST in the BSAI from 2004 to 2016 was 147.2 t; the majority of these landings occur in the EBS. The estimated catch of BSAI SST in 2016 was 314.4 t, which was approximately 0.29 of the ABC (1050 t) (Conners et al. 2016). GOA SST catches tend to be higher than BSAI catches; GOA SST 2016 catch was 1119 t or 0.57 of the ABC/TAC (Echave and Hulson 2017). The exploitation rate (catch/biomass) for BSAI SST in recent years has remained less than 0.015 (Conners et al. 2016), and the exploitation rate for GOA SST is well below the time trend average (1992 to 2017) and has decreased since 2013 to roughly 0.01 (Echave and Hulson 2017). Low exploitation rates coupled with catches within management reference points yield a score of "low" concern for SST fishing mortality in the sablefish and rockfish trawl fisheries.

YELLOWEYE ROCKFISH

Factor 1.1 - Abundance

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

High Concern

Yelloweye rockfish is managed as part of the Demersal Shelf Rockfish (DSR) complex in the GOA; however yelloweye comprises the majority of catch of this complex, so the species stock status is assessed individually as a Tier 4 species on a biennial schedule using an age-structured model. Projected GOA yelloweye biomass for 2018 is 11,508 t. Estimates suggest that yelloweye rockfish biomass increased moderately from 2015 to 2018. Despite a recent stable trend, long-term biomass estimates indicate significant yelloweye rockfish biomass declines since the mid-1990s (Figure A) (Olson et al. 2017). Yelloweye rockfish exhibits high vulnerability (Table 17). Abundance data reference points are lacking (two data limited sources suggesting stock stability are not available); therefore, GOA yelloweye rockfish receives a score of "high" concern for abundance.

Justification:

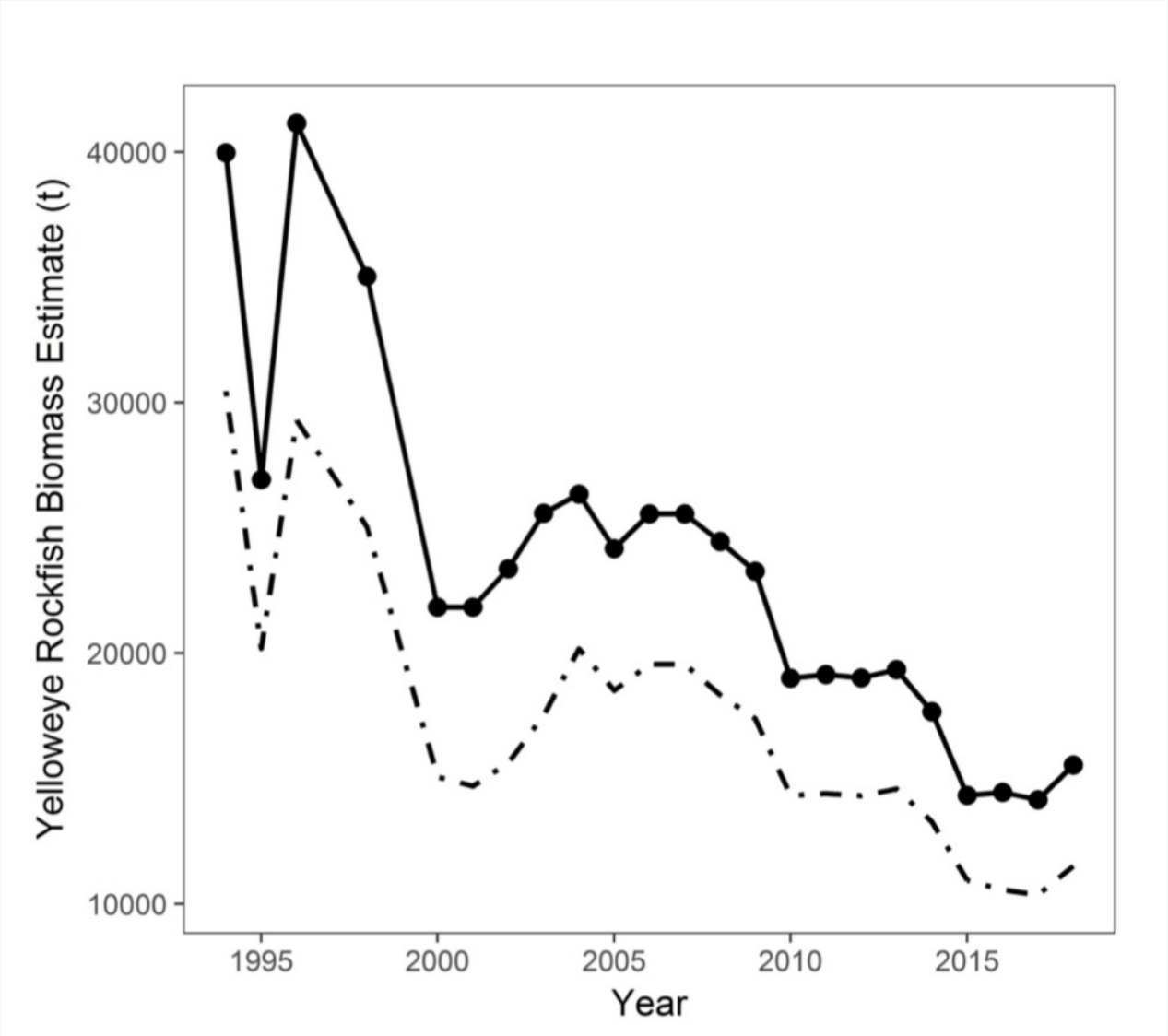

Figure 61 1994–2017 yelloweye rockfish biomass estimate (t) (solid line) and 90% lower confidence interval (dashed line) for the Southeast Outside (SEO) Subdistrict (Olson et al. 2017),

Yelloweye rockfish, Alaska, Gulf of Alaska longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Average age at maturity (years)	20	3	(ADFG 2019)	Areal overlap		3	(Olson et al. 2017)
Average maximum age (years)	121	3	(ADFG 2019)	Vertical overlap		3	(Olson et al. 2017)
Fecundity (eggs/yr)	2,700,000	1	(ADFG 2019)	Selectivity of fishery		2	(Olson et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	91	1	(ADFG 2019)	Post-capture mortality		3	(Olson et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	50	2	(ODFW 2009)	Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3	fishbase.org				
Trophic level	4.4	3	fishbase.org	Productivity-Susceptibility Score	3.24		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High		
Quality of Habitat	Moderately altered	2	(Olson et al. 2017)				
Productivity Subscore		2.25					

Table 17.
Yelloweye
rockfish, Alaska,
Gulf of Alaska
longline

Factor 1.2 - Fishing Mortality

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Low Concern

Yelloweye rockfish in the GOA are primarily taken incidentally in Pacific cod longline, sablefish longline, and rockfish trawl fisheries. The estimated commercial catch of GOA DSR was 119 t or 0.52 of the ABC (227 t) (Olson et al. 2017). Yelloweye rockfish are not subject to overfishing (Olson et al. 2017). Incidental yelloweye takes in the reviewed fisheries are low, and the fisheries are not substantial contributors to yelloweye rockfish fishing mortality. Therefore, yelloweye rockfish receives a score of "low" concern for fishing mortality in the GOA Pacific cod longline, sablefish longline, and GOA rockfish trawl fisheries.

YELLOWEYE ROCKFISH

Factor 1.1 - Abundance

ALASKA/GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

High Concern

Yelloweye rockfish is managed as part of the Demersal Shelf Rockfish (DSR) complex in the GOA; however yelloweye comprises the majority of catch of this complex, so the species stock status is assessed individually as a Tier 4 species on a biennial schedule using an age-structured model. Projected GOA yelloweye biomass for 2018 is 11,508 t. Estimates suggest that yelloweye rockfish biomass increased moderately from 2015 to 2018. Despite a recent stable trend, long-term biomass estimates indicate significant yelloweye rockfish biomass declines since the mid-1990s (Figure A) (Olson et al. 2017). Yelloweye rockfish exhibits high vulnerability (Table 17). Abundance data reference points are lacking (two data limited sources suggesting stock stability are not available); therefore, GOA yelloweye rockfish receives a score of "high" concern for abundance.

Justification:

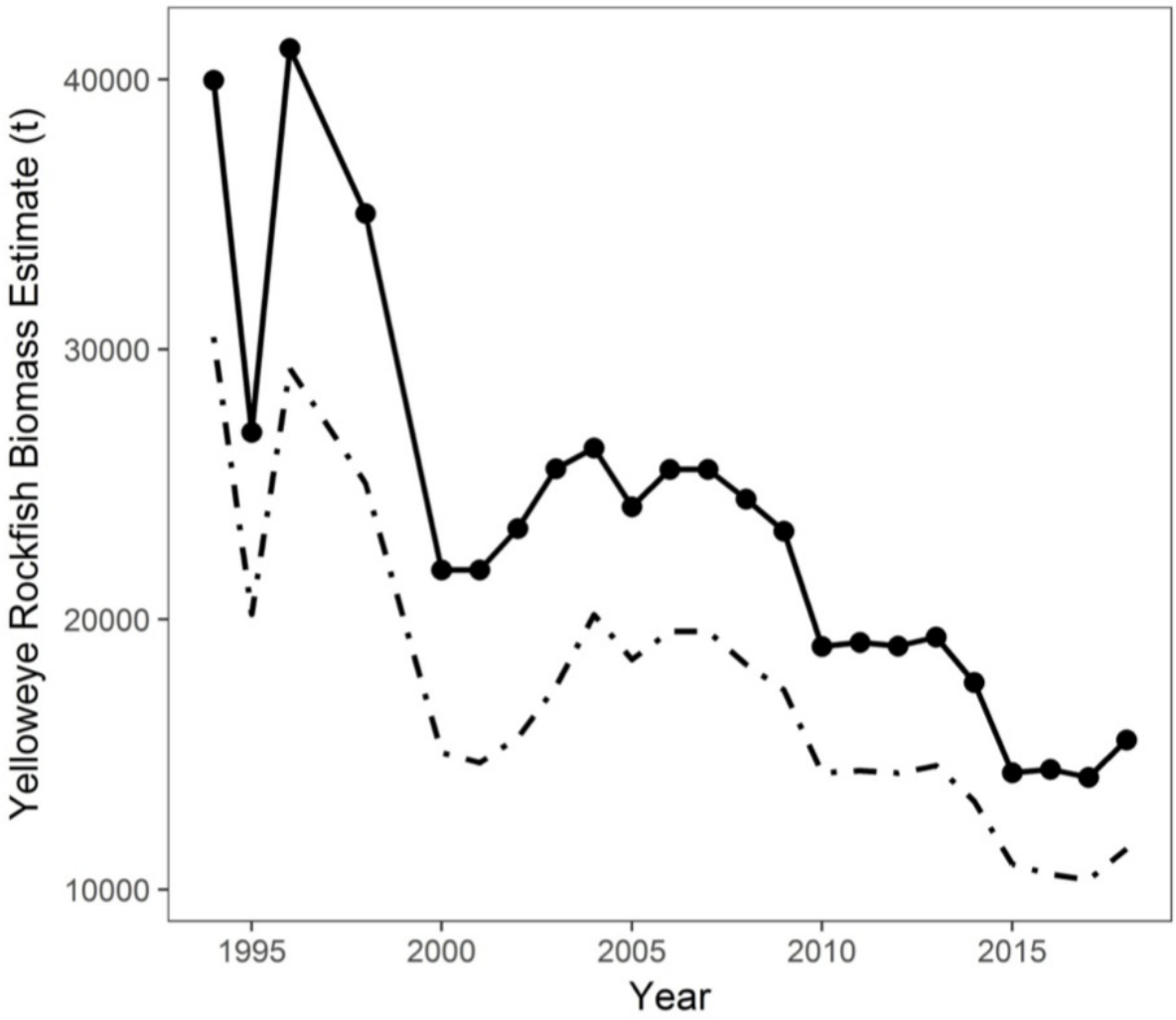

Figure 62 1994–2017 yelloweye rockfish biomass estimate (t) (solid line) and 90% lower confidence interval (dashed line) for the Southeast Outside (SEO) Subdistrict (Olson et al. 2017),

Yelloweye rockfish, Alaska, Gulf of Alaska longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Average age at maturity (years)	20	3	(ADFG 2019)	Areal overlap		3	(Olson et al. 2017)

Average maximum age (years)	121	3	(ADFG 2019)	Vertical overlap	3	(Olson et al. 2017)
Fecundity (eggs/yr)	2,700,000	1	(ADFG 2019)	Selectivity of fishery	2	(Olson et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	91	1	(ADFG 2019)	Post-capture mortality	3	(Olson et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	50	2	(ODFW 2009)	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3	fishbase.org			
Trophic level	4.4	3	fishbase.org	Productivity-Susceptibility Score	3.24	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Olson et al. 2017)			
Productivity Subscore		2.25				
Table 17. Yelloweye rockfish, Alaska, Gulf of Alaska longline						

Factor 1.2 - Fishing Mortality

ALASKA/GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Low Concern

Yelloweye rockfish in the GOA are primarily taken incidentally in Pacific cod longline, sablefish longline, and rockfish trawl fisheries. The estimated commercial catch of GOA DSR was 119 t or 0.52 of the ABC (227 t)

(Olson et al. 2017). Yelloweye rockfish are not subject to overfishing (Olson et al. 2017). Incidental yelloweye takes in the reviewed fisheries are low, and the fisheries are not substantial contributors to yelloweye rockfish fishing mortality. Therefore, yelloweye rockfish receives a score of "low" concern for fishing mortality in the GOA Pacific cod longline, sablefish longline, and GOA rockfish trawl fisheries.

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. 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. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait 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 is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding Principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

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 A.

ARROWTOOTH FLOUNDER - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - GREENLAND TURBOT TRAWL					
Subscore:	**4.284**	**Discard Rate:**	**1.00**	**C2 Rate:**	**4.284**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Greenland turbot	3.67:Low Concern	5.00:Low Concern	Green (4.284)		
Kamchatka flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		
Walleye pollock	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		
Flathead sole	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		

ATKA MACKEREL - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ATKA MACKEREL TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		

Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

BLACKSPOTTED ROCKFISH - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Killer whale / Alaska Resident	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Killer whale / Transient	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Atka mackerel	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

BLACKSPOTTED ROCKFISH - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Light dusky rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

FLATHEAD SOLE - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - GREENLAND TURBOT TRAWL					
Subscore:	**4.284**	**Discard Rate:**	**1.00**	**C2 Rate:**	**4.284**

Species	Abundance	Fishing Mortality	Subscore
Greenland turbot	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Arrowtooth flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Kamchatka flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Walleye pollock	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

GREENLAND TURBOT - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - GREENLAND TURBOT TRAWL

Subscore:	5.000	Discard Rate:	1.00	C2 Rate:	5.000

Species	Abundance	Fishing Mortality	Subscore
Arrowtooth flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Kamchatka flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Walleye pollock	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Flathead sole	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

GREENLAND TURBOT - ALASKA/BERING SEA - SET LONGLINES - UNITED STATES OF AMERICA - GREENLAND TURBOT LONGLINE

Subscore:	2.236	Discard Rate:	0.75	C2 Rate:	1.677

Species	Abundance	Fishing Mortality	Subscore
short-tailed albatross	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Skates (unspecified)	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Giant rattail	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Kamchatka flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

KAMCHATKA FLOUNDER - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - GREENLAND TURBOT TRAWL

Subscore:	4.284	Discard Rate:	1.00	C2 Rate:	4.284

Species	Abundance	Fishing Mortality	Subscore
Greenland turbot	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Arrowtooth flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Walleye pollock	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Flathead sole	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

LIGHT DUSKY ROCKFISH - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL

Subscore:	2.236	Discard Rate:	1.00	C2 Rate:	2.236

Species	Abundance	Fishing Mortality	Subscore
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

NORTHERN ROCKFISH - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ATKA MACKEREL TRAWL

Subscore:	2.236	Discard Rate:	1.00	C2 Rate:	2.236

Species	Abundance	Fishing Mortality	Subscore
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Atka mackerel	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

NORTHERN ROCKFISH - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL

Subscore:	2.236	Discard Rate:	1.00	C2 Rate:	2.236

Species	Abundance	Fishing Mortality	Subscore
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)

Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Light dusky rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

PACIFIC COD - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - PACIFIC COD TRAWL

Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
ringed seal	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Pacific halibut	5.00:Very Low Concern	3.00:Moderate Concern	Green (3.873)
Walleye pollock	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

PACIFIC COD - ALASKA/BERING SEA - POTS - UNITED STATES OF AMERICA - PACIFIC COD POT

Subscore:	**3.413**	**Discard Rate:**	**1.00**	**C2 Rate:**	**3.413**

Species	Abundance	Fishing Mortality	Subscore
Southern tanner crab	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Red King crab	3.67:Low Concern	5.00:Low Concern	Green (4.284)

PACIFIC COD - ALASKA/BERING SEA - SET LONGLINES - UNITED STATES OF AMERICA - PACIFIC COD LONGLINE

Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Killer whale / Alaska Resident	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
short-tailed albatross	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Skates (unspecified)	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Pacific halibut	5.00:Very Low Concern	3.00:Moderate Concern	Green (3.873)
Red King crab	3.67:Low Concern	5.00:Low Concern	Green (4.284)

Bigmouth sculpin	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Alaska skate	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

PACIFIC COD - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - PACIFIC COD TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Pacific halibut	5.00:Very Low Concern	3.00:Moderate Concern	Green (3.873)		
Arrowtooth flounder	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		

PACIFIC COD - ALASKA/GULF OF ALASKA - POTS - UNITED STATES OF AMERICA - PACIFIC COD POT					
Subscore:	**5.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**5.000**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
No other main species caught					

PACIFIC COD - ALASKA/GULF OF ALASKA - SET LONGLINES - UNITED STATES OF AMERICA - PACIFIC COD LONGLINE					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Skates (unspecified)	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		
Quillback rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		
Pacific halibut	5.00:Very Low Concern	3.00:Moderate Concern	Green (3.873)		

PACIFIC OCEAN PERCH - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ATKA MACKEREL TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		
Atka mackerel	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		

PACIFIC OCEAN PERCH - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Killer whale / Alaska Resident	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Killer whale / Transient	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Atka mackerel	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

PACIFIC OCEAN PERCH - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Light dusky rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

ROUGHEYE ROCKFISH - ALASKA - SET LONGLINES - UNITED STATES OF AMERICA - SABLEFISH LONGLINE					
Subscore:	**2.236**	**Discard Rate:**	**0.75**	**C2 Rate:**	**1.677**

Species	Abundance	Fishing Mortality	Subscore
Sperm whale	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)

Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Giant rattail	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sablefish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

ROUGHEYE ROCKFISH - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL

Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Killer whale / Alaska Resident	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Killer whale / Transient	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Atka mackerel	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

ROUGHEYE ROCKFISH - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL

Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Light dusky rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

SABLEFISH - ALASKA - POTS - UNITED STATES OF AMERICA - SABLEFISH POT					
Subscore:	**5.000**	**Discard Rate:**	**1.00**	**C2 Rate:**	**5.000**

Species	Abundance	Fishing Mortality	Subscore
No other main species caught			

SABLEFISH - ALASKA - SET LONGLINES - UNITED STATES OF AMERICA - SABLEFISH LONGLINE					
Subscore:	**2.236**	**Discard Rate:**	**0.75**	**C2 Rate:**	**1.677**

Species	Abundance	Fishing Mortality	Subscore
Sperm whale	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Giant rattail	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)

SHORTRAKER ROCKFISH - ALASKA/BERING SEA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Killer whale / Alaska Resident	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Killer whale / Transient	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Atka mackerel	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

SHORTRAKER ROCKFISH - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)

Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)
Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Light dusky rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

SHORTSPINE THORNYHEAD - ALASKA - SET LONGLINES - UNITED STATES OF AMERICA - SABLEFISH LONGLINE

Subscore:	**2.236**	**Discard Rate:**	**0.75**	**C2 Rate:**	**1.677**

Species	Abundance	Fishing Mortality	Subscore
Sperm whale	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Giant rattail	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sablefish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

SHORTSPINE THORNYHEAD - ALASKA/GULF OF ALASKA - BOTTOM TRAWLS - UNITED STATES OF AMERICA - ROCKFISH TRAWL

Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**

Species	Abundance	Fishing Mortality	Subscore
Shortraker rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Yelloweye rockfish	1.00:High Concern	5.00:Low Concern	Yellow (2.236)
Widow rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)
Harlequin rockfish	3.67:Low Concern	3.00:Moderate Concern	Green (3.318)
Redstripe rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Silvergray rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Blackspotted rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)
Sharpchin rockfish	3.67:Low Concern	5.00:Low Concern	Green (4.284)

Pacific Ocean perch	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Northern rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)
Light dusky rockfish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)

YELLOWEYE ROCKFISH - ALASKA - SET LONGLINES - UNITED STATES OF AMERICA - SABLEFISH LONGLINE					
Subscore:	**2.236**	**Discard Rate:**	**0.75**	**C2 Rate:**	**1.677**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Sperm whale	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Shortspine thornyhead	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)		
Giant rattail	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)		
Rougheye rockfish	2.33:Moderate Concern	5.00:Low Concern	Green (3.413)		
Sablefish	5.00:Very Low Concern	5.00:Low Concern	Green (5.000)		

YELLOWEYE ROCKFISH - ALASKA/GULF OF ALASKA - SET LONGLINES - UNITED STATES OF AMERICA - PACIFIC COD LONGLINE					
Subscore:	**2.236**	**Discard Rate:**	**1.00**	**C2 Rate:**	**2.236**
Species	**Abundance**	**Fishing Mortality**	**Subscore**		
Steller sea lion	1.00:High Concern	5.00:Low Concern	Yellow (2.236)		
Pacific cod	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		
Skates (unspecified)	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		
Quillback rockfish	2.33:Moderate Concern	3.00:Moderate Concern	Yellow (2.644)		
Pacific halibut	5.00:Very Low Concern	3.00:Moderate Concern	Green (3.873)		

Main species added to the Alaska groundfish assessment were determined based on the 2018 Seafood Watch standard: 1) species that constitute over 5% of the catch; 2) are categorized as overfished, undergoing overfishing, endangered, threatened, or otherwise a species of concern caught regularly in the target fishery; 3) species for which a fisheries total species catch constitutes greater than 20% of the cumulative fishing mortality AND the catch of the species was greater than 10 t; 4) if the fishery is responsible on average for >5% of the total PSC limit by management region; or 5) the species was reviewed in the 2014 report as a main species. Catch data were available through the NMFS Catch Accounting System (CAS), which utilizes information collected from industry reports and through the Observer Program to assess the amount of catch and bycatch occurring in each groundfish fishery. CAS data for 2013 to 2017 were used to determine main species.

Steller sea lions (western stock) limit the C2 score for a number of Alaska groundfish fisheries including: sablefish, BSAI Atka mackerel trawl, BSAI Pacific cod trawl, and GOA Pacific cod trawl and GOA Pacific cod longline. Western stock Steller sea lions are endangered under the ESA and the IUCN. Western stock Steller sea lions were included as main species due to their endangered status and potential to interact with trawl and

longline gear fisheries in Alaska (each of the fisheries listed above have been involved with at least one serious injury or mortality with western stock Steller sea lions since 2010).

Short-tailed albatross limit the C2 score for BSAI Greenland turbot longline and Pacific cod longline fisheries due to their high vulnerability potential to interact with longline gear in the BSAI. For the sablefish longline fishery in Alaska, sperm whales also limit the C2 score due to their high vulnerability (ESA listed "Endangered"), unknown stock status, and interactions with longline gear. A number of serious injuries and/or mortalities have been reported for sperm whales in the GOA sablefish longline fishery since 2012.

For the BSAI rockfish trawl fishery, transient killer whales limit the C2 score due to their high vulnerability, unknown stock status (most recent stock assessment conducted in 2000), and their potential to interact with trawl gear. It's important to note that only one killer whale was taken in the BSAI rockfish fishery in 2010. At that time observers could not identify the whale ecotype (resident or transient), so the mortality was assigned to both ecotypes. Data on transient killer whales in Alaska are limited and outdated.

For the GOA rockfish trawl fishery, shortraker and widow rockfish limit the C2 score due to their high vulnerability, data limited stock status (widow rockfish are managed as part of a complex with no species-specific biomass estimates or target reference points), and bycatch in the GOA rockfish trawl fishery. Catches of widow rockfish are low (~200 t from 2013 to 2017), however, the GOA rockfish trawl fishery accounts for roughly 40% of the total fishing mortality for widow rockfish. Shortraker rockfish constitutes a small percentage of GOA rockfish trawl (~484 t in 2017) landings but has a high vulnerability rating.

EBS Tanner crab limit the C2 score for the BSAI Pacific cod pot fishery due to their variable stock status (low values of mature male and female biomass relative to Minimum Size Stock Threshold values in recent years have resulted in fishery closures in 2016/17 and partial closure in 2017/2018). The BSAI Pacific cod pot fishery takes greater than 5% of the PSC limit for EBS tanner crabs (crab PSC limits legally apply to trawl fisheries only). No other main species were identified for Sablefish and GOA Pacific cod pot fisheries.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance

(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality

(same as Factor 1.2 above)

ARROWTOOTH FLOUNDER

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Very Low Concern

GOA arrowtooth flounder is assessed annually, and data inputs that inform the assessment include fishery independent data such as annual longline and trawl surveys and fishery dependent data collected by on-board observers. The GOA arrowtooth population is not classified as overfished (Spies et al. 2017). Projected female SSB for 2018 decreased to 873,789 t or 95% of unfished SSB. The projected estimate of total biomass for 2018 was down by 32% from the 2016 assessment of 2,079,029 t, to 1,421,306 t (Spies et al 2017). For 2018, the projected SSB is approximately 270% of the target reference point $SB_{35\%}$, and the B/B_{MSY} ratio is 3.38 (NMFS 2017 FSSI); therefore, GOA arrowtooth flounder receives a score of "very low" concern for abundance.

Justification:

Arrowtooth flounder ranges from central California to the GOA and BSAI, Aleutian Islands. Arrowtooth flounder is considered the most abundant groundfish species in the GOA, and trophic studies suggest they are an important component in the dynamics of the GOA benthic ecosystem (Spies et al. 2017).

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Low Concern

The estimated catch GOA arrowtooth flounder in 2017 was approximately 26,862 t, or 0.14 of the ABC (186,093 t). Model estimates of cumulative fishing mortality have been well below target reference points since 1961 (the highest fishing mortality was 0.036 in 2014)(Spies et al. 2017), and GOA arrowtooth flounder receives a "low concern" for fishing mortality in GOA Pacific cod and sablefish fisheries.

Justification:

Catches of arrowtooth flounder are well below the TACs, and the catch/TAC averaged 39% from 2008-2017 (average catch during that time period was 24,697 t). Average catches have increased moderately since the 1990s, and the the highest recorded catch was 34,327 t in 2014 (corresponds with the highest fishing mortality; Figure A). Markets for arrowtooth flounder are still nascent, and arrowtooth flounder was not a directed fishery until viable product forms were developed in 2008 (Spies et al. 2016).

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the GOA typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.2.

STELLER SEA LION

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

High Concern

The western Steller sea lion stock is listed as an "endangered" DPS under the ESA, and therefore scored "high" concern for abundance per the Seafood Watch Criteria.

Justification:

Steller sea lions range along the North Pacific Rim from northern Japan to California, with centers of abundance and distribution in the AI and GOA. The delineation between the eastern and western stocks is based on distribution, genetic, population dynamic, and phenotypic data differences between the two groups (NMFS Eume SAR 2017). The western stock of Steller sea lions decreased from an estimated 220,000 to 265,000 animals in the late 1970s to less than 50,000 in 2000. Since 2003, the abundance of the western stock has increased, but there are considerable regional variations in trends (e.g., some western regions still declining) (NMFS Eume SAR 2017). The reason for the lack of recovery of some western stock Steller sea lions is unknown but has been linked to a number of factors including: bottom-up pressures such as competitive fishing effects (prey base), changing oceanographic conditions, and top down pressures including predation from killer whales (NMFS Eume SAR 2017).

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Low Concern

Western Steller sea lions have been taken in four separate Category III fisheries including: the BSAI Atka mackerel and Pacific cod trawl fisheries and the GOA Pacific cod trawl and longline fisheries, and two Category II fisheries: BSAI Pacific cod longline and GOA sablefish. The minimum cumulative fisheries mortality per year is 40 Steller sea lions and is broken out annually 2012 to 2016 for the above-mentioned Category-listed fisheries: 0.4 BSAI Pacific cod trawl, 1.3 BSAI Pacific cod longline, 2.2 GOA Pacific cod trawl, 0.2 GOA Pacific cod longline, 2.1 GOA sablefish longline (1 mortality attributed to Atka Mackerel in 2010) (NMFS Eume SAR 2016) (NMFS Eume SAR 2017). It's important to note that there is a high degree of uncertainty around serious injury and mortality estimates, especially for partially observed fisheries. No individual fishery take

accounts for >50% of the PBR (326 individuals), and cumulative fisheries mortality is well below the PBR. Therefore, the western stock of Steller sea lions receives a score of "low" concern for fisheries mortality for BSAI Atka mackerel, BSAI and GOA Pacific cod trawl, BSAI and GOA Pacific cod longline, and GOA sablefish fisheries (NMFS Eume SAR 2017).

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the GOA typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.2.

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the GOA typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.25. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.6.

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Sablefish longline vessels have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the sablefish longline fishery discard/landings ratio during that time was estimated to be 1.05. Giant grenadier are caught in high numbers in this fishery; they are not retained, and discard mortality is presumed to be 100% (Rodgveller and Hulson 2016). Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. BSAI Atka Mackerel trawl vessels in the BSAI typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Atka mackerel trawl fishery discard/landings ratio during that time was estimated to be less than 0.05.

WALLEYE POLLOCK

Factor 2.1 - Abundance

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Very Low Concern

EBS pollock is assessed as a Tier 1a species. Projected EBS pollock SSB for 2018 is 3,678,000 t or 68% of unfished SSB, and the SSB/SSB_{MSY} is 1.80 (Ianelli et al. 2017). The estimated B/B_{MSY} is 1.02 (NMFS FSSI 2017), and EBS pollock receives a score of "very low" concern for abundance.

Justification:

Estimated EBS pollock biomass increased moderately from 2010 to 2015 (Figure A) (Ianelli et al. 2017).

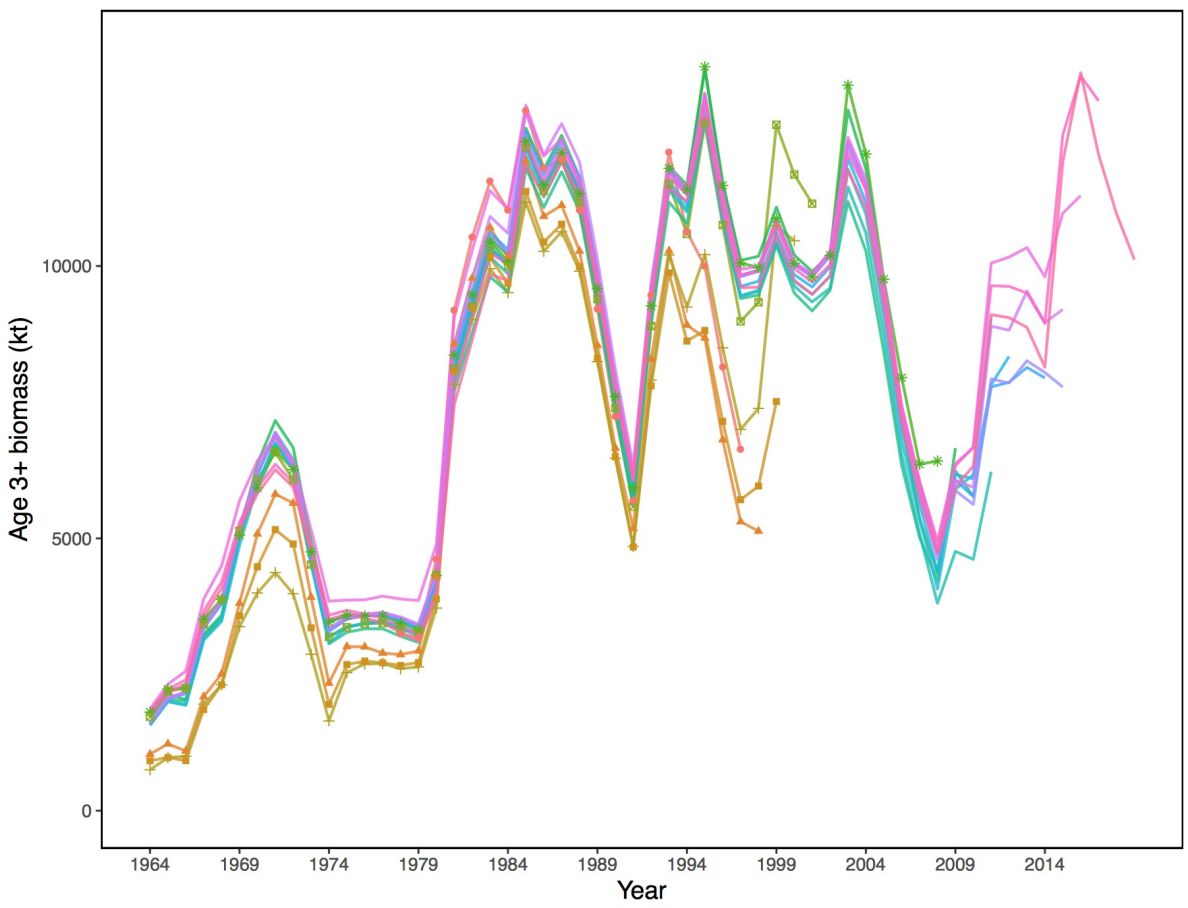

Figure 63 Comparison of the current assessment results with past assessments of begin-year EBS age-3+ pollock biomass (Ianelli et al. 2017).

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

The estimated catch of EBS pollock in 2017 was 1.36 million t or 0.49 of the ABC (2.8 million t), representing one of the largest and most lucrative fisheries in the world. Pollock are primarily taken in directed fisheries, however, minimal bycatch occurs in other groundfish fisheries, including Greenland turbot trawl fisheries. F_{ABC} is conservatively set at a maximum of 0.36 per the Tier 1a management category criteria (Ianelli et al. 2017). Pollock removals in the Greenland turbot and Pacific cod fisheries are negligible relative to the directed BSAI pollock fishery (<0.01% in 2017). Fishing mortality from all sources is at or below sustainable levels to ensure the viability and ecological role of EBS pollock, and EBS pollock receives a "low concern" score for fishing mortality in the Greenland turbot and Pacific cod trawl fisheries.

Justification:

Pollock is targeted exclusively with pelagic trawl gear. Since the late 1970s, the average EBS pollock catch has been about 1.2 million t, ranging from 0.815 million t in 2009 to nearly 1.5 million t during the period from 2003-2006. Since 1980, fishing mortality levels have averaged about 35% of the F_{MSY} level or target reference point (Ianelli et al. 2017). At times of high abundance, the pollock fishery TACs are constrained by the overall 2 million t catch limit in the BSAI.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.6.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. BSAI Greenland turbot trawl vessels typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Greenland turbot trawl fishery discard/landings ratio during that time was less than 0.3.

RINGED SEAL

Factor 2.1 - Abundance

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

High Concern

Ringed seals are listed as threatened under the ESA, and therefore scored "high" concern for abundance per the Seafood Watch criteria.

Justification:

Ringed seals have a circumpolar distribution and are found in all seasonally ice-covered seas of the Northern Hemisphere. Although abundance data are limited, the Alaska Chukchi and Beaufort sea population minimum estimate is roughly 300,000 ringed seals, and the US portion of the Bering Sea esimate is at a minimum 170,000 ringed seals (NMFS Pusa SAR 2016). There are no recent population trend analyses; however, certain portions of the ringed seal stock exhibited moderate to significant declines in abundance in the late 1980s to 1999 (Frost et al. 2002). A primary concern about the conservation status of ringed seals stems from the likelihood that their preferred sea-ice and snow habitats are being modified by the warming climate

(NMFS Pusa SAR 2016).

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

Low Concern

The BSAI Pacific cod longline fishery is listed as a Category II fishery under the MMPA, and the BSAI Pacific cod trawl fishery is listed as Category III. The relative contributions of the fisheries to total ringed seal fishing mortality from 2010 to 2014 was approximately 0.3 and 0.2 takes per year, respectively. The percentage of ringed seals taken in the Pacific cod trawl and longline fisheries is less than 50% of the PBR (5100 ringed seals) (NMFS Pusa SAR 2016). The cumulative fisheries mortality (3.7 takes per year) is well under the PBR, and ringed seals therefore score "low" concern for fisheries mortality in the BSAI Pacific cod longline and trawl fisheries.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.6.

KILLER WHALE / ALASKA RESIDENT

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

High Concern

Although reported in tropical and offshore waters, resident (fish-specialist) killer whales occur at the highest densities in colder and more productive waters of both hemispheres, such as the Alaska region (NMFS Orci SAR 2016). The Alaska resident stock includes killer whales from southeastern Alaska to the AI and BS. Trend data are limited and outdated (regional count surveys from 1999 to 2012); the minimum population estimate is 2,084 individuals (NMFS Orci SAR 2016). Alaska resident killer whales are not listed under the ESA or

MMPA. Killer whales are a vulnerable species, quantitative stock assessment data are outdated, and Alaska resident killer whales receive a score of "high" concern for abundance.

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Alaska resident killer whales have been taken in the Category II BSAI Pacific cod longline and BSAI rockfish trawl fisheries. The relative contribution of the fisheries to Alaska resident killer whale fishing mortality from 2010 to 2014 was approximately 0.2 takes per year for both fisheries (NMFS Orci SAR 2016) (total cumulative fisheries mortality was 1 for the same period). The percentage of killer whales taken in the BSAI Pacific cod longline and BSAI rockfish trawl fisheries is less than 50% of the PBR (24 killer whales), and the cumulative fisheries mortality is well under the PBR. Therefore, Alaska resident killer whales receive score of "low" concern for fisheries mortality in the BSAI Pacific cod longline and rockfish trawl fisheries.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. BSAI rockfish trawl vessels typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the rockfish trawl fishery discard/landings ratio during that time was less than 0.05.

KAMCHATKA FLOUNDER

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Very Low Concern

Kamchatka flounder is assessed biennially as a Tier 3 stock with an age-structured model, relying on fishery dependent and fishery independent data sources. Projected female SSB for 2018 was 63,718 t or 50% of unfished SSB (Bryan and Wilderbuer 2017). For 2018, the projected SSB is approximately 143% of the target reference point $SB_{35\%}$. The Kamchatka flounder fishery is not classified as overfished (NMFS FSSI 2017) (Bryan and Wilderbuer 2017), and Kamchatka flounder receives a score of "very low" concern for abundance.

Justification:

Estimated total biomass of Kamchatka flounder has increased moderately since 1990 (Figure A) (Bryan and Wilderbuer 2017).

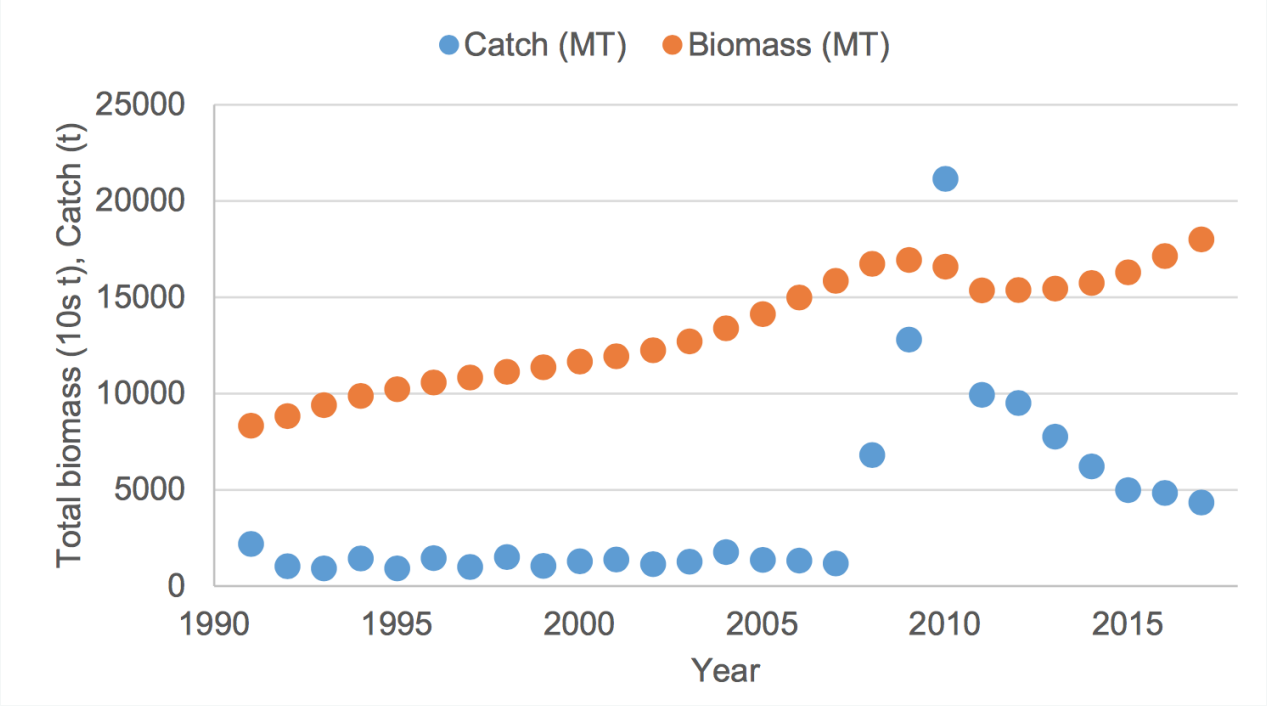

Figure 64 Time series of total biomass (10s of tons), catch (tons) of kamchatka flounder (Bryan & Wilderbuer 2017).

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

Low Concern

Kamchatka flounder is caught in directed BSAI flatfish trawl fisheries and as bycatch, primarily in Greenland turbot fisheries. The estimated catch of BSAI Kamchatka flounder in 2017 was 4,501 t or 0.51 of the ABC. Fully selected fishing mortality averaged 0.045 from 2011 to 2016 and remains well below the $F_{40\%}$ value of

0.066 (Wilderbauer et al. 2016). Catches and fishing mortality values are below target management reference points, and Kamchatka flounder receives a score of "low" concern for fishing mortality in the Greenland turbot hook and line and trawl fisheries.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Greenland turbot vessels may have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Greenland turbot longline fishery discard/landings ratio during that time was estimated to be 1.37. Giant Grenadier are caught in high numbers in this fishery, they are not retained, and discard mortality is presumed to be 100%. Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

SOUTHERN TANNER CRAB

Factor 2.1 - Abundance

ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Moderate Concern

EBS tanner crab is assessed annually as a Tier 3 species. The assessment model is structured by crab size, sex, shell condition, and maturity, using available data on quantity and size-composition from: the NMFS trawl survey, landings and discards by the directed fishery, bycatch in the Bristol Bay red king crab, EBS snow crab, and groundfish fisheries. The Mature Male Biomass (MMB), the proxy for B_{MSY} ($B_{35\%}$) for this stock, has been variable over time but declined from the 2016/17 estimate (77.96 thousand t) to 43.31 thousand t in 2017/18 (highest estimates were seen in the early 1970s at approximately 300,000 t)(Bush et al. 2017). Estimates of recruitment since 1999 have been generally low relative to the peaks estimated for the period prior to 1990.

The MMB was estimated to be below the Minimum Size Stock Threshold (MSST; $0.5B_{MSY}$) in February 2010, and NMFS declared the stock overfished and closed the directed fishery from 2010 to 2012. NMFS determined the stock was not overfished in 2012 based on a new assessment model with a revised estimate of B_{MSY} (Bush et al. 2017). However, in 2016/2017 the Alaska Department of Fish and Game (ADF&G) set the EBS tanner crab TAC to zero due to concerns about mature female biomass. This decision was based on ADF&G harvest control guidelines, not federal management protocols (Stockhausen, NMFS, 2018 pers. comm). In light of biomass estimate uncertainties and recent variability in MMB relative to MSST and mature

female biomass, EBS tanner crab receives a "moderate" concern for abundance.

Justification:

There was a relatively strong recruitment estimated for 2017, but this estimate is very uncertain and will need to be confirmed by subsequent assessments (Bush et al. 2017). The 2017/18 B/B_{MSY} ratio was 1.49, reflecting the stronger recruitment seen in 2017. And because MMB>MSST, the stock is not overfished (Stockhausen 2017). Tanner crab male pre-recruit abundance was down relative to 2016; however, levels are still above the average over the past 20 years. The most recent BS trawl data suggests a 2017 biomass estimate for legal male Tanner crab east of 166°W was 36,963 t (± 95% CI) (Lang et al. 2017).

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Low Concern

EBS Tanner crab is caught in directed Tanner crab fisheries, as bycatch in the groundfish fisheries, scallop fisheries, as bycatch in the directed Tanner crab fishery (mainly as nonretained females and sublegal males), and other crab fisheries (Bush et al. 2017). Total catches of tanner crab in non-pollock groundfish trawl and hook and line fisheries are well-below PSC limits. Total catch mortality (retained + discard mortality in all fisheries) in 2016/17 was 1.14 thousand t, which was less than the OFL for 2016/17 (25.61 thousand t); consequently overfishing did not occur during this time (Stockhausen 2017). Although pot fisheries are not subject to crab PSC limits, the BSAI Pacific cod pot fishery removals would account for <15% of the overall PSC limits, and therefore tanner crab receives a score of "low" concern for fishing mortality in the BSAI Pacific cod pot fishery.

Justification:

The directed fishery was open from 2013/14 to 2015/16 seasons with a TAC and catches that peaked in 2015/16 (8,910 t), which represented the largest take in the fishery since 1992/93. In 2016, ADF&G determined that mature female biomass did not meet the criteria for opening a fishery according to the regulatory harvest strategy, and the TAC was set at zero (Bush et al. 2017). Consequently, there was no directed harvest in 2016/17. The fishery was reopened in the Western zone in 2017/18, and the ABC was set 25% lower than the OFL to buffer for model uncertainty and stock productivity.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Vessels fishing Pacific pots in the BSAI typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the BSAI Pacific cod pot fishery discard/landings ratio during that time was less than 0.05. Bait use in this fishery is unknown, and the discard mortality rate for much of the bycatch (invertebrates, snails, etc.) is likely less than 100% (Alverson et al. 1994); however, neither of these factors would alter the score for this criteria.

SPERM WHALE

Factor 2.1 - Abundance

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

High Concern

Sperm whales are classified as endangered under the ESA, and therefore scored "high" concern for abundance per the Seafood Watch Criteria.

Justification:

Sperm whales are one of the most widely distributed marine mammal species, with individuals found in nearly all ocean basins in tropical and temperate waters (NMFS Physeter SAR 2017). Sperm whales were depleted by extensive commercial whaling for over a hundred years, and they were listed as endangered under the ESA in 1973. There is currently no abundance estimate available for sperm whales in the North Pacific and/or Alaskan waters. Stock structure data are also deficient; however, recent research suggests that sperm whales found in Alaskan waters are primarily mature solitary males, and the presence of sperm whales is greater in the summer than in winter months (NMFS Physeter SAR 2017).

Factor 2.2 - Fishing Mortality

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Low Concern

The relative contribution of the GOA sablefish longline fishery to total sperm whale fishing mortality from 2012 to 2016 was approximately 2.7 takes per year (cumulative fisheries mortality is 4.4). Due to data limitations, it is not possible to calculate a PBR for the North Pacific sperm whale stock (NMFS Physeter SAR 2017). However, in 2018 the sablefish fishery was listed as a Category II fishery under the MMPA. Category II fisheries are defined as commercial fisheries that occasionally cause mortality or serious injury of marine mammals and: 1) are collective with other fisheries responsible for the annual removal of more than 10% of a stock's PBR, and/or 2) that are by themselves responsible for the annual removal of between 1% to 50%, exclusive, of any stock's potential biological removal level (LII 2018).”

Fisher knowledge data suggest the sperm whale population may be stable to increasing in the GOA (Peterson and Carothers 2013); however, survey-based abundance estimates and time trend data are unavailable. The sablefish fleet and fishery managers are actively researching deterrent and/or fishing operational changes to minimize fishery interactions with sperm whales (Peterson et al. 2014). Also, pot fishing gear for sablefish was legalized in the GOA in 2016, largely as a result of sperm whale interactions with longline gear (NPFMC 2018). Sperm whale abundance data and PBR information are limited, and the recent Category II designation confirms that interactions and mortality events with the sablefish longline fishery are an issue. However, the Category II status, coupled with fisher reports showing that sperm whales are common in the GOA (Peterson and Carothers 2013), also suggests that sperm whale mortality in the sablefish fishery most likely meets the "low" concern Seafood Watch Criteria (<50% of the PBR taken by the sablefish fishery and cumulative

fisheries mortality does not exceed PBR).

Justification:

Sperm whales have been observed depredating (removing fish caught on gear) halibut and sablefish longline fisheries, primarily in the GOA. This depredation behavior and increasing number of fishery interactions renders sperm whales more vulnerable to mortality and/or serious injury if hooking or entanglement occurs. It is important to note that there was limited observer coverage prior to 2012, especially in the GOA, and the historic number of interactions or injuries is likely an underestimation (NMFS Physeter SAR 2017). Restructured observer coverage in the longline fleet will ensure that future annual sperm whale stock assessments track interaction rates and serious injury/mortality events within the sablefish fishery. If serious injury/mortality events increase in frequency, the fishing mortality score for sperm whales in the sablefish fishery would likely be increased to "moderate" or "high" concern.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Sablefish longline vessels have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the sablefish longline fishery discard/landings ratio during that time was estimated to be 1.05. Giant grenadier are caught in high numbers in this fishery; they are not retained, and discard mortality is presumed to be 100% (Rodgveller and Hulson 2016). Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

KILLER WHALE / TRANSIENT

Factor 2.1 - Abundance

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

High Concern

Alaska transient (marine mammal-specialist) killer whales, as defined per the MMPA, are currently thought to be part of the Eastern North Pacific (ENP) transient stock. The ENP transient killer whale stock range extends from Alaska to California, and there are no current abundance or trend data available for this stock (NMFS Orci SAR 2000). Based on their highly vulnerable status and significant data deficiencies, ENP transient killer whales receive a score of "high" concern for abundance.

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

One ENP transient killer whale fishery mortality occurred in the BSAI rockfish trawl fishery (Category II) between 2007 and 2011 (killer whale stock was not determined at the time so the take was attributed to both ENP transient and Alaska resident killer whale stocks). Although the ENP transient SAR does estimate a PBR (2.8 whales per year), this value is likely conservative and is based on data from the 1990s (NMFS Orci SAR 2000). The BSAI rockfish trawl fishery-related mortality is less than 50% of the formal PBR (which is likely biased low and does not represent the entire stock). Thus, ENP transient killer whales receive a score of "low" concern for fishing mortality associated with the BSAI rockfish trawl fishery.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. BSAI rockfish trawl vessels typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the rockfish trawl fishery discard/landings ratio during that time was less than 0.05.

SHORT-TAILED ALBATROSS

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

High Concern

Short-tailed albatross is listed as an IUCN vulnerable species that is "Endangered" under the ESA, therefore scoring a "high" concern for abundance per the Seafood Watch Criteria.

Justification:

In 1970, the short-tailed albatross was listed as "Endangered" under the ESA, and they were listed throughout their entire range in 2000. Despite dramatic declines in short-tailed albatross abundance through the 1950s, recovery efforts have yielded a 7% to 8% annual growth rate for the species across their range. For 2016 and

2017, the world population of short-tailed albatross was estimated at approximately 5,144 individuals (Eich et al. 2016).

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Low Concern

Short-tailed albatross have been taken in a number of longline fisheries, primarily in the BS. Since 2010, four short-tailed albatross were taken in Pacific cod longline fisheries, and two were taken in the Greenland turbot longline fishery. Observed mortalities are extrapolated to the entire fleets to generate estimates of overall "takes by fishery." In response to recent albatross fishery mortality estimates, in 2015 NMFS requested a formal consultation on the effects of groundfish fisheries on short-tailed albatross. In the subsequent 2015 biological opinion, the USFWS determined groundfish fisheries off Alaska are not likely to jeopardize short-tailed albatross continued existence (Eich et al. 2016) (USFWS 2015). "Given that the population has increased at a rapid rate while this fishery has been operating, and that the current estimated annual mortality is three birds per year, it is the USFWS's opinion that the proposed action will not appreciably reduce the likelihood of the short-tailed albatross recovery (USFWS 2015)"

The biological opinion established incidental take limits for short-tailed albatross, and these limits have not been exceeded within specified periods for over 26 years (Eich et al. 2016). Longline fisheries in the BSAI can adversely impact short-tailed albatross (USFWS 2015); however, cumulative fishing mortality is below formal incidental take limits; the most recent USFWS found no jeopardy, and short-tailed albatross receive a score of "low" concern for fishing mortality in the BSAI Pacific cod and Greenland turbot longline fisheries.

Justification:

Groundfish fishery interactions with short-tailed albatross were recently reviewed by NMFS and USFWS in 2015. The 2015 biological opinion included an incidental take limit of six short-tailed albatross every two years in the groundfish fisheries by longline and trawl gear.

Based on standard observer sampling protocols, Alaska longline groundfish fisheries (includes Pacific halibut, which is not reviewed here) accounted for 87% of the estimated total seabird mortality in 2015, which is similar to the average estimated seabird mortality for 2007 through 2015 (88% range 80% to 96%). From 2007 through 2015, most of the longline gear estimated seabird bycatch occurred in the BS (~77%) versus the AI (~6%) and the GOA (12%) (Eich et al. 2015). On average, 68% of the total (all gear types) seabird bycatch off Alaska occurred in the BS longline from 2007 through 2015 (Eich et al. 2015). From 2007 to 2015, 80% of the longline seabird bycatch in Alaska was from trips targeting Pacific cod.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1

>=100	0.75

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Greenland turbot vessels may have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Greenland turbot longline fishery discard/landings ratio during that time was estimated to be 1.37. Giant Grenadier are caught in high numbers in this fishery, they are not retained, and discard mortality is presumed to be 100%. Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

YELLOWEYE ROCKFISH

Factor 2.1 - Abundance

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

High Concern

Yelloweye rockfish is managed as part of the Demersal Shelf Rockfish (DSR) complex in the GOA; however yelloweye comprises the majority of catch of this complex, so the species stock status is assessed individually as a Tier 4 species on a biennial schedule using an age-structured model. Projected GOA yelloweye biomass for 2018 is 11,508 t. Estimates suggest that yelloweye rockfish biomass increased moderately from 2015 to 2018. Despite a recent stable trend, long-term biomass estimates indicate significant yelloweye rockfish biomass declines since the mid-1990s (Figure A) (Olson et al. 2017). Yelloweye rockfish exhibits high vulnerability (Table 17). Abundance data reference points are lacking (two data limited sources suggesting stock stability are not available); therefore, GOA yelloweye rockfish receives a score of "high" concern for abundance.

Justification:

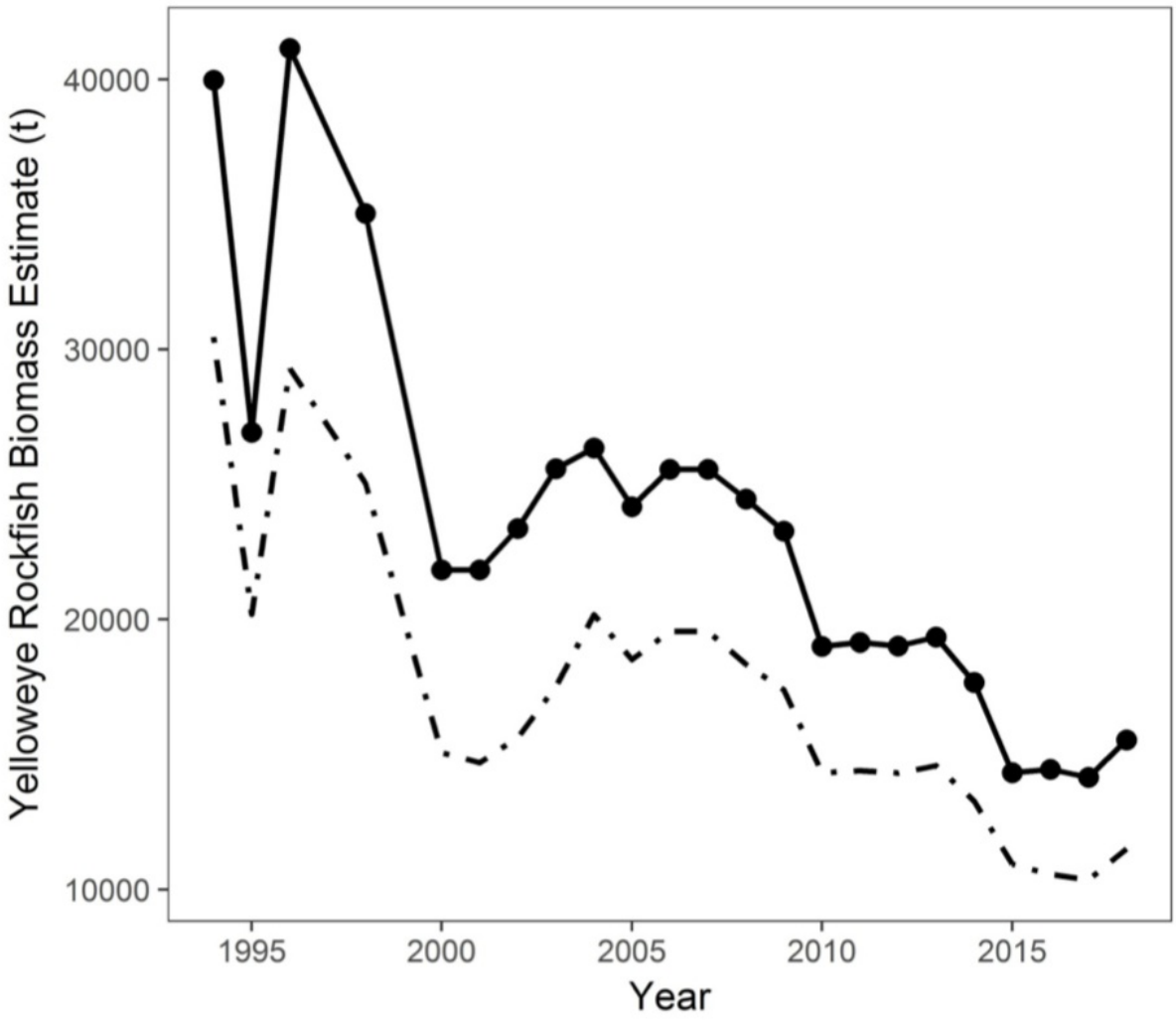

Figure 65 1994–2017 yelloweye rockfish biomass estimate (t) (solid line) and 90% lower confidence interval (dashed line) for the Southeast Outside (SEO) Subdistrict (Olson et al. 2017),

Yelloweye rockfish, Alaska, Gulf of Alaska longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 3 = high risk)	Reference
Average age at maturity (years)	20	3	(ADFG 2019)	Areal overlap		3	(Olson et al. 2017)

Average maximum age (years)	121	3	(ADFG 2019)	Vertical overlap	3	(Olson et al. 2017)
Fecundity (eggs/yr)	2,700,000	1	(ADFG 2019)	Selectivity of fishery	2	(Olson et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	91	1	(ADFG 2019)	Post-capture mortality	3	(Olson et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	50	2	(ODFW 2009)	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3	fishbase.org			
Trophic level	4.4	3	fishbase.org	Productivity-Susceptibility Score	3.24	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Olson et al. 2017)			
Productivity Subscore		2.25				
Table 17. Yelloweye rockfish, Alaska, Gulf of Alaska longline						

Factor 2.2 - Fishing Mortality

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Yelloweye rockfish in the GOA are primarily taken incidentally in Pacific cod longline, sablefish longline, and

rockfish trawl fisheries. The estimated commercial catch of GOA DSR was 119 t or 0.52 of the ABC (227 t) (Olson et al. 2017). Yelloweye rockfish are not subject to overfishing (Olson et al. 2017). Incidental yelloweye takes in the reviewed fisheries are low, and the fisheries are not substantial contributors to yelloweye rockfish fishing mortality. Therefore, yelloweye rockfish receives a score of "low" concern for fishing mortality in the GOA Pacific cod longline, sablefish longline, and GOA rockfish trawl fisheries.

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

RATIO OF BAIT + DISCARDS/LANDINGS	FACTOR 2.3 SCORE
<100%	1
>=100	0.75

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. GOA Rockfish trawl vessels have partial observer coverage through the North Pacific Observer Program. Vessels fishing in the central GOA as part of the Alaska Rockfish program have 100% observer coverage. Data were analyzed 2013 to 2017, and the GOA rockfish trawl fishery discard/landings ratio during that time was less than 0.1.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective,' 'moderately effective,' 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

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 = Red or High Concern*

Rating is Critical if Management Strategy and Implementation is Critical.

GUIDING PRINCIPLE

- The fishery is managed to sustain the long-term productivity of all impacted species.

Criterion 3 Summary

Fishery	Management Strategy	Bycatch Strategy	Research and Monitoring	Enforcement	Stakeholder Inclusion	Score
Fishery 1: Alaska | Pots | United States of America | Sablefish pot	Highly Effective	Highly Effective	Moderately Effective	Highly Effective	Highly Effective	Green (4.000)
Fishery 2: Alaska | Set longlines | United States of America | Sablefish longline	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 3: Alaska / Bering Sea | Bottom trawls | United States of America | Atka mackerel trawl	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 4: Alaska / Bering Sea | Bottom trawls | United States of America | Greenland turbot trawl	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)

Fishery 5: Alaska / Bering Sea | Bottom trawls | United States of America | Pacific cod trawl	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 6: Alaska / Bering Sea | Bottom trawls | United States of America | Rockfish trawl	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 7: Alaska / Bering Sea | Pots | United States of America | Pacific cod pot	Highly Effective	Highly Effective	Moderately Effective	Highly Effective	Highly Effective	Green (4.000)
Fishery 8: Alaska / Bering Sea | Set longlines | United States of America | Greenland turbot longline	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 9: Alaska / Bering Sea | Set longlines | United States of America | Pacific cod longline	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 10: Alaska / Gulf of Alaska | Bottom trawls | United States of America | Pacific cod trawl	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 11: Alaska / Gulf of Alaska | Bottom trawls | United States of America | Rockfish trawl	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)
Fishery 12: Alaska / Gulf of Alaska | Pots | United States of America | Pacific cod pot	Highly Effective	Highly Effective	Moderately Effective	Highly Effective	Highly Effective	Green (4.000)
Fishery 13: Alaska / Gulf of Alaska | Set longlines | United States of America | Pacific cod longline	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Highly Effective	Green (5.000)

Criterion 3 Assessment

Factor 3.1 - 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? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Highly Effective

Management strategy and implementation is scored "highly effective" for all fisheries in this assessment. Appropriate management and conservation targets have been defined for the majority of C1 species, and precautionary principles are in place that incorporate uncertainty. Long-term sustainability of stock biomass across groundfish fisheries confirms these management strategies are being implemented successfully over time. See justification below for more detail.

Justification:

1. Appropriate reference points:

Each managed stock is placed into one of six tiers based upon the information available for the stock (see introductory summary for more detail). Stocks in Tiers 1 to 3 have biomass reference points (B_{MSY} for Tiers 1 and 2, $B_{35\%}$ for Tier 3. There are reliable estimates of B for Tiers 4 and 5, F for Tier 4 and M for Tier 5; these values are used to determine OFL/ABC values each year. Reliable biomass estimates for Tier 6 species are unavailable. The OFL for Tier 6 stocks is generated from estimates of historical catch. Nearly all fisheries and C1 species assessed in this review utilize a Tier 3 management approach. The only non-Tier 3 C1 fisheries included in this review were AI Pacific cod, shortraker and yelloweye rockfish (NPFMC 2017). C2 species caught in the fisheries are also primarily Tier 3, with a few exceptions (the Other Skates and grenadier complexes are Tier 5 as well as silvergray, harlequin, redstripe, and SST rockfish. Quillback and widow rockfish are the only Tier 6 C2 species caught in the GOA rockfish trawl fishery).

2. Harvest control rules that adjust for declining biomass:

The harvest control rules for stocks managed under Tiers 1 to 3 incorporate measures that automatically reduce fishing mortality when the stock's biomass passes beneath a threshold, and which set fishing mortality to zero if the biomass falls below a minimum threshold. Stocks in Tiers 4 and 5 lack biomass reference points, and as such the fishing mortality rates used to calculate OFL are not affected by stock status and are instead driven by F (Tier 4) or M (Tier 5) (NPFMC 2017). The OFL for Tier 6 stocks is generated from estimates of historical catch (there are no C1 Tier 6 species in this review).

3. Risk aversion and buffering against uncertainty:

The differences between OFL, ABC, and TAC offer a buffer against scientific and management uncertainty and help fishery managers avoid the risk of accidental over-exploitation. The first degree of buffering occurs when ABCs are set at less than OFLs. Management uncertainty may be further buffered by reducing the TAC below the ABC. For instance, in 2017 and 2018 the sum of the TACs or quotas for all BSAI groundfish is 2 million t

for 2017 and 2018, while the sum of the recommended ABCs for 2017 and 2018 are 4,013,993 t and 4,214,648 t, respectively.

Finally, the sum of all species' TACs in the BSAI is also subject to the cumulative OY rule. If the sum of target species' TACs is outside of the OY range for a given year, the TACs are adjusted accordingly. By serving as a maximum cap on the sum of TACs, the OYs can act to prevent risky, yield-maximizing decisions during times when TACs and biomass estimates are high.

4. Management efficacy:

The NPFMC has a long-standing track record of effective management. Annual or biennial stock assessments ensure biomass estimates are current and ecosystem considerations are addressed. In 2018, estimated abundances of all BSAI and GOA stocks (with the exception of GOA Pacific cod) are projected to be above B_{MSY} or the B_{MSY} proxy of $B_{35\%}$ in 2016 (Figure A, Figure B) (NPFMC 2017a) (NPFMC 2017). Overall, the status of the stocks continues to appear favorable. Nearly all stocks are above their target biomass size (B_{MSY}).

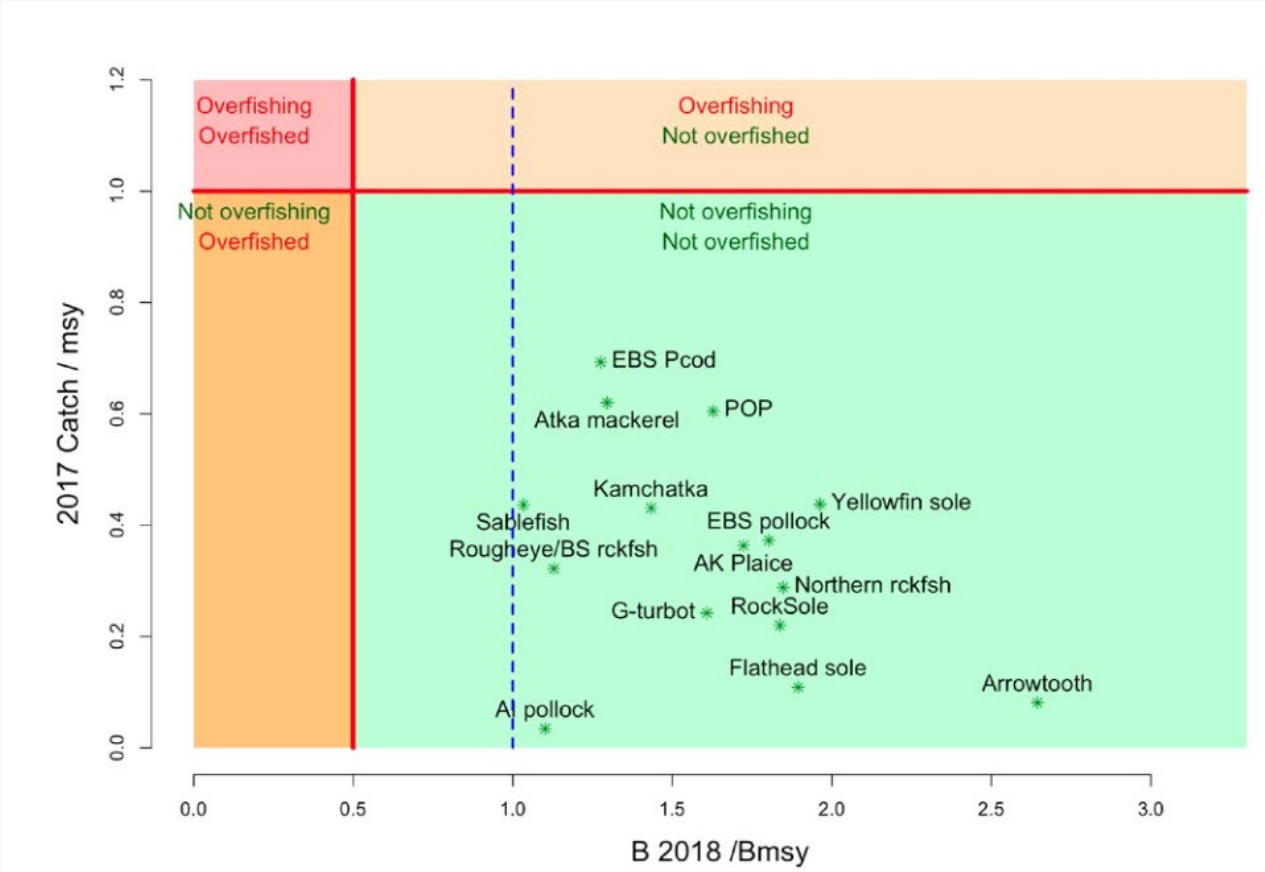

Figure 70 Summary of Bering Sea stock status next year (spawning biomass relative to Bmsy; horizontal axis) and current year catch relative to fishing at Fmsy (vertical axis) where FOFL is taken to equal Fmsy (NPFMC 2017).

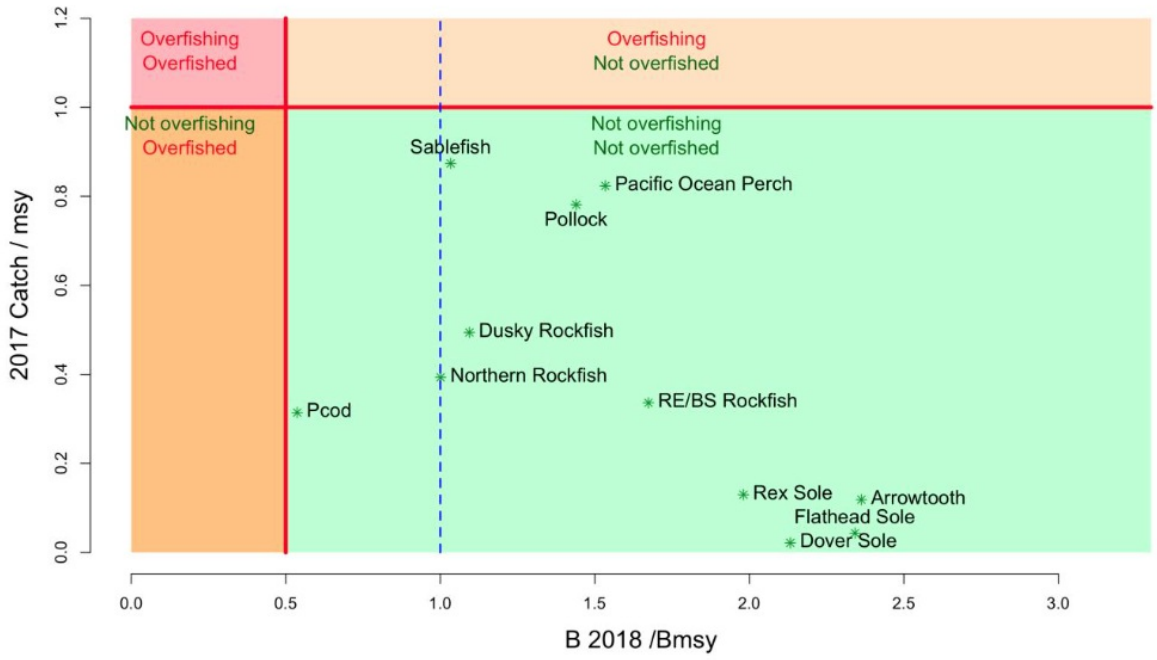

Figure 71 Summary of Gulf of Alaska stock status next year (spawning biomass relative to BMSYy; horizontal axis) and current year catch relative to fishing at Fmsy (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches (NPFMC 2017a).

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT

Highly Effective

The sablefish pot fishery has a relatively low bycatch rates (<10%). Non-target species are returned to the water, and mortality rates for released invertebrates are presumed to be relatively low (Alverson et al. 1999) (NPMFC 2017b). Pot fishing gear is required to have: 1) biodegradable panels to prevent lost pots from ghost fishing; and 2) tunnel opening or escape panels to reduce bycatch of unwanted species. All pot and pot-and-line marker buoys carried on board or used must be identifiable by a federal or state registration number. It's important to note that groundfish pot gear can entangle marine mammals, and with potential increases in pot fishing in the GOA, it will be important to ensure marine mammal interactions with pot gear are sufficiently monitored. Per the Magnuson Stevens Act requirement to minimize bycatch while allowing for optimum yield, the sablefish pot fishery receives a "highly effective" score for bycatch strategy associated with low bycatch rates and effective strategies to minimize bycatch.

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Highly Effective

The sablefish longline fishery has relatively high bycatch rates (~50%), mostly due to high catches of grenadiers spp. throughout the BSAI and GOA. The sablefish fishery is subject to crab PSC restrictions in the BSAI; and pending NPFMC legislation may establish new halibut PSC limits in the sablefish fishery should additional PSC reductions be necessary (Evans 2015). The sablefish fishery is not highly selective; however, no species of concern are regularly caught in this Category II fishery. Bycatch reduction measures in legislation since 2002 have reduced seabird bycatch in the sablefish longline fishery, and total fishing mortality of grenadiers has been well below estimated ABCs since 2014 (e.g. 2017 grenadier catch/ABC was <10% in the BSAI and <50% in the GOA), and the sablefish longline fishery receives a "highly effective" score for bycatch strategy.

Justification:

Seabird bycatch in Alaskan groundfish demersal longline fisheries sharply declined after the introduction of streamer lines in 2002. All longline vessels >55' length must use paired streamer lines, while vessels from 26' to 55' have to use single streamer lines or a buoy bag. Additionally, offal is required to be discharged in a manner that distracts the seabirds from baited hooks (Eich et al. 2016). Interactions with endangered sperm whales have increased in the GOA in recent years. Avoidance measures are being taken by the fleet to minimize interactions including changing fishing practices and moving fishing grounds; research toward minimizing interactions (Southeast Alaska Sperm Whale Avoidance Program) is underway (Peterson et al. 2014).

In order to address bycatch of grenadier in Alaska groundfish fisheries, Amendments 100/91 were established in 2015 to add grenadier as an Ecosystem Component to the BSAI and GOA FMPs. Prior to this rule, grenadier were not in the FMPs (i.e., "nonspecified"). Under this rule grenadier are not allowed to be targeted, and there is an 8% Maximum Retainable Allowance (MRA) (Rodgveller and Hulson 2016). As an Ecosystem Component, a grenadier stock assessment is not required, and there is no ABC or OFL; however, a full unofficial assessment report has been prepared for grenadiers in even years since 2006. Although grenadier removals in the sablefish and Greenland turbot longline fisheries are substantial, catches are well under ABCs, and biomass data suggest the grenadier populations are not being negatively impacted (Rodgveller and Hulson 2016).

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

Highly Effective

The BSAI Atka mackerel fishery has a relatively low bycatch rate, since the three primary species (Atka mackerel, POP, and Northern Rockfish) constitute the majority of the catch (~90%), and the discard rate is less than 4%. The Atka mackerel fishery has effective strategies to minimize the impacts of the fishery on other species, and the fishery is not a leading cause of mortality for species of concern. Therefore, the Atka mackerel fishery receives a "highly effective" score for bycatch strategy.

Justification:

The Magnuson Stevens Act requires the NPFMC and the Atka mackerel fishery to minimize bycatch while allowing for optimum yield. Bycatch rates in the Atka mackerel fishery are low, and they are subject to PSC limits for halibut, red king crab, tanner and snow crab.

The Atka mackerel fishery was responsible for the take of one ESA-listed western stock Steller sea lion in 2010; however, the fishery remains Category III because no more mortalities have been observed, and western stock Steller sea lion removals are well below PBR limits for the stock.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Highly Effective

Bycatch rates (discards/catch) for 2013 to 2017 vary for bottom trawl fisheries for rockfish (~5%), Pacific cod (~35%), and Greenland turbot (20%), and trawl gear is typically not highly selective (retention is high in the rockfish fishery). A number of management measures are in place including PSC limits, cooperatives, and rolling area closures that have proven effective at reducing bycatch; the bottom trawl fisheries in the BSAI receive a "highly effective" rating for bycatch strategy.

Justification:

The NPFMC initiated the Amendment 80 cooperative in 2006 in order to improve retention, primarily in BSAI flatfish and rockfish trawl fisheries (some Pacific cod). Pacific cod are also taken by non-AFA catcher vessels (NPFMC 2012).

Limits on the bycatch of PSC have been established in all BSAI trawl fisheries. When bycatch limits are reached, fisheries responsible for the bycatch are closed for the rest of the season, or are prohibited from fishing in areas with historically high bycatch rates. Area closures have also been implemented throughout the BSAI to protect crab (NPFMC 2017). Management efficacy is demonstrated via lowered PSC catches of a number of species in the BSAI, including Pacific halibut (Figure A), and overall bycatch reductions for the trawl fleets as a whole (Figure B).

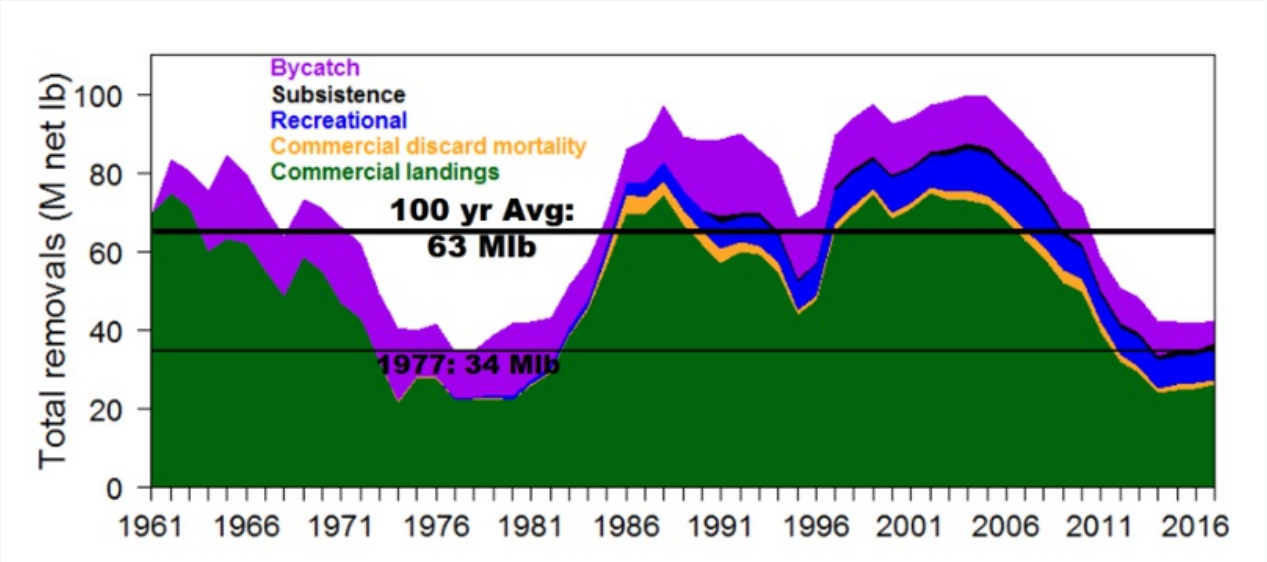

Figure 72 Total removals coastwide for the period 1961-2016 (IPHC 2017).

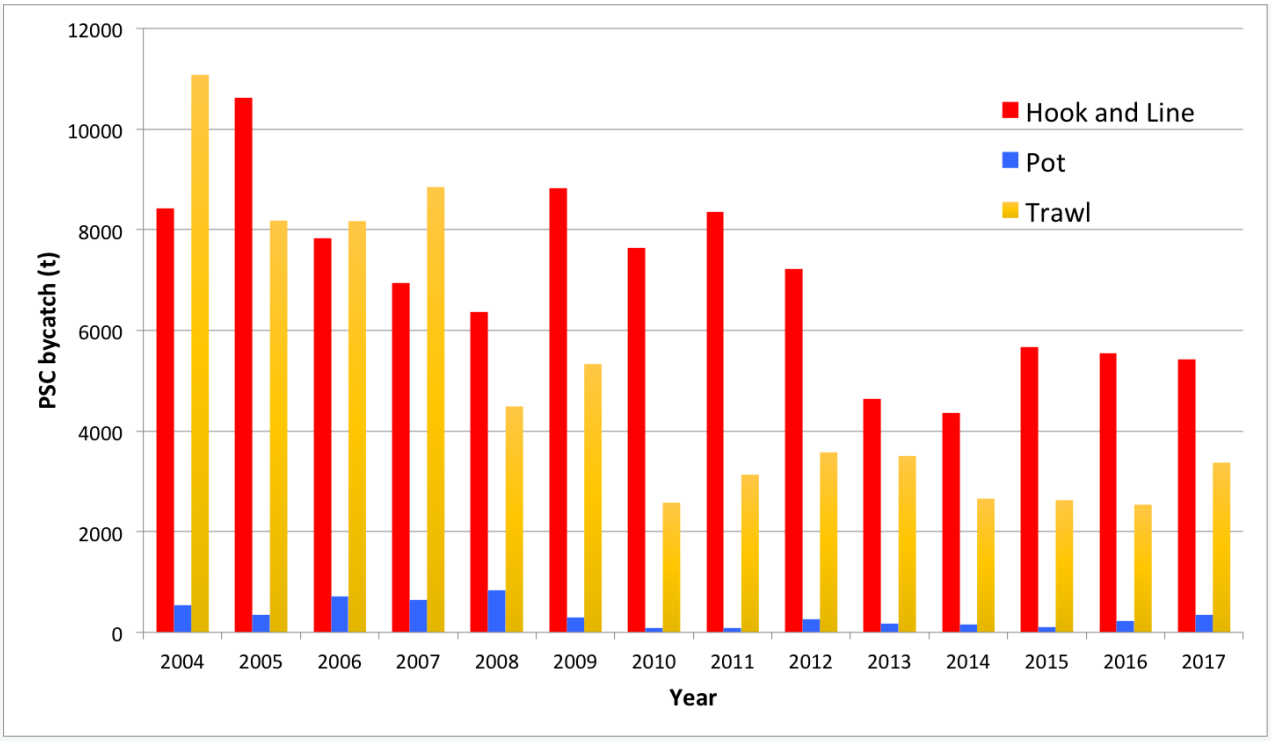

Figure 73 Total PSC catch in trawl, pot, and hook and line fisheries in the BSAI 2004-2017 (NMFS CAS data 2018). *Catch by weight graphed here does not include crab and salmon (which are tracked by count).

In June 2015, the Council took final action to reduce halibut PSC mortality limits in the BSAI groundfish fisheries overall from 4,426 mt to 3,515 mt, a 21% reduction. PSC limits in the BSAI groundfish fisheries are apportioned among sectors and gear types (except IFQ sablefish), and a different reduction was applied to each sector.

Some non-pelagic trawl catcher processors have elected to be part of a multi-year Experimental Fishing Permit (EFP) to test deck sorting measures and safe handling practices to reduce Pacific halibut mortality in trawl fisheries. Early results from these EFPs demonstrate significant halibut mortality savings (NPFMC 2018).

ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Highly Effective

The BSAI Pacific cod pot fishery has low bycatch rates for non-PSC species (<5%), however bycatch of king and tanner crabs in the BSAI Pacific cod pot fishery is relatively high. Pot fisheries are not subject to PSC limits, and the species count (number of individuals caught) of king crab bycatch actually exceeds the PSC allowance (which applies to trawl gear only for crabs) in aggregate from 2013 to 2017. Retention of crabs is not allowed with this fishery. Fishery managers conservatively estimate crab PSC landings using a 100% discard mortality rate (the actual discard mortality rate is estimated to be roughly 20% to 50%) (Thompson, NMFS, personal communication 2018) (NPFMC 2017b). It's important to note that bycatch of PSC in BSAI pot fisheries has declined since 2007 (NMFS CAS data 2018). An additional conservation concern stems from potential entanglement of marine mammals, especially in light of limited to no observer coverage in this fishery.

Non-target species are returned to the water, and mortality rates for released other invertebrates are presumed to be relatively low (Alverson et al. 1999) (NPMFC 2017b). Pot fishing gear is required to have: 1)

biodegradable panels to prevent lost pots from ghost fishing; and 2) a tunnel opening or escape panels to reduce bycatch of unwanted species. All pot and pot-and-line marker buoys carried on board or used must be identifiable by a federal or state registration number. Measures are in place to minimize bycatch to the extent practicable, PSC catch has declined since 2007, and most crab returned to the water survive. Although the PSC allowance (assigned to the trawl fisheries) is exceeded, and the Pacific cod pot fishery takes a significant number of crabs, managers confirm this is not a concerning issue because the majority of crabs caught are returned to the water alive. Therefore, the Pacific cod pot fishery receives a "highly effective" score for bycatch strategy.

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

Highly Effective

Similar to the sablefish longline fishery, the Greenland turbot longline fishery also experiences high bycatch rates (~57% from 2013 to 2017), largely due to catch of grenadiers that share the same depth distribution as Greenland turbot. Vessels targeting Greenland turbot are subject to BSAI PSC limits, and the fishery is not a leading cause of mortality for any species of concern. Gear is required to be marked with registration information to ensure limited issues with derelict or lost fishing gear. Seabird bycatch reduction measures have been in legislation since 2002, and total fishing mortality of BSAI grenadiers has been well below estimated ABCs since 2014 (e.g., 2017 grenadier catch/ABC was <10% in the BSAI), and the Greenland turbot longline fishery receives a "highly effective" score for bycatch strategy.

Justification:

Seabird bycatch in Alaskan groundfish demersal longline fisheries sharply declined after the introduction of streamer lines in 2002 . All longline vessels >55' length must use paired streamer lines, while vessels from 26' to 55' have to use single streamer lines or a buoy bag. Additionally, offal is required to be discharged in a manner that distracts the seabirds from baited hooks (Eich et al. 2016). Bycatch of short-tailed albatross in demersal longline fisheries is a matter of particular concern, and it should be noted that there were two observed mortalities of short-tailed albatross during the period in 2014 (Eich et al. 2016).

In June 2015, the Council took final action to reduce halibut PSC mortality limits in the BSAI groundfish fisheries overall from 4,426 mt to 3,515 mt, a 21% reduction. PSC limits in the BSAI groundfish fisheries are apportioned among sectors and gear types (except IFQ sablefish), and a different reduction was applied to each sector.

In order to address bycatch of grenadier in Alaska groundfish fisheries, Amendments 100/91 were established in 2015 to add grenadier as an Ecosystem Component to the BSAI and GOA FMPs. Prior to this rule, grenadier were not in the FMPs (i.e., "nonspecified"). Under this rule grenadier are not allowed to be targeted, and there is an 8% Maximum Retainable Allowance (MRA) (Rodgveller and Hulson 2016). As an Ecosystem Component, a grenadier stock assessment is not required, and there is no ABC or OFL; however, a full unofficial assessment report has been prepared for grenadier in even years since 2006.
Although grenadier removals in the sablefish and Greenland turbot longline fisheries are substantial, catches are well under ABCs, and biomass data suggest the grenadier populations are not being negatively impacted (Rodgveller and Hulson 2016).

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Highly Effective

The 2013 to 2017 bycatch rate (discards/catch) for the BSAI and GOA Pacific cod longline fisheries was approximately 16% and 19%, respectively. A number of management measures are in place, including PSC limits and seabird bycatch reduction measures, that have proven effective at reducing bycatch, and the BSAI and GOA Pacific cod longline fisheries receive a "highly effective" score for bycatch strategy.

Justification:

Limits on the bycatch of PSC have been established in the BSAI and GOA Pacific cod longlinefisheries. When bycatch limits are reached, fisheries responsible for the bycatch are closed for the rest of the season, or are prohibited from fishing in areas with historically high bycatch rates. Management efficacy is demonstrated via lowered PSC catches of a number of species in the BSAI and GOA, including Pacific halibut.

Seabird bycatch in Alaskan groundfish demersal longline fisheries sharply declined after the introduction of streamer lines in 2002. All longline vessels >55' length must use paired streamer lines, while vessels from 26' to 55' have to use single streamer lines or a buoy bag. Additionally, offal is required to be discharged in a manner that distracts the seabirds from baited hooks (Eich et al. 2016). Bycatch of short-tailed albatross in demersal longline fisheries is a matter of particular concern, and it should be noted that there were two observed mortalities of short-tailed albatross during the period in 2014 (Eich et al. 2016).

In June 2015, the Council took final action to reduce halibut PSC mortality limits in the BSAI groundfish fisheries overall from 4,426 mt to 3,515 mt, a 21% reduction. And in June 2012, the Council submitted Amendment 95 to the Gulf of Alaska Groundfish FMP in order to reduce occurrence of halibut bycatch in GOA groundfish fisheries. This resulted in a 15% reduction for GOA longline catcher processor and a 15% reduction for GOA Pacific cod longline catcher vessels.

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Highly Effective

Bycatch rates (discards/catch) for 2013 to 2017 are relatively low for the Pacific cod trawl (~11%) and GOA rockfish trawl (~8%) fisheries. A number of management measures are in place including PSC limits, the GOA rockfish cooperative, and rolling area closures that have proven effective at reducing bycatch. The Pacific cod and rockfish trawl fisheries in the GOA receive a "highly effective" rating for bycatch strategy.

Justification:

GOA area closures have been adopted by the Council to protect both red king crab and Tanner crab in the GOA, and bycatch of crabs in the GOA is very low (NPFMC 2018}. In June 2012, the Council submitted Amendment 95 to the Gulf of Alaska Groundfish FMP in order to reduce occurrence of halibut bycatch by 15% in trawl fisheries for GOA trawl vessels.

ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Highly Effective

The GOA Pacific cod pot fishery has low bycatch rates (~8%) and, unlike the BSAI pot fishery, bycatch of crabs in GOA pot fisheries is not a major issue. Non-target species are returned to the water, and mortality rates for released invertebrates are presumed to be relatively low (Alverson et al. 1999) (NPMFC 2017b). Pot fishing gear is required to have: 1) biodegradable panels to prevent lost pots from ghost fishing, and 2) a tunnel opening or escape panels to reduce bycatch of unwanted species. All pot and pot-and-line marker buoys carried on board or used must be identifiable by a federal or state registration number. Measures are in place to minimize bycatch to the extent practicable, and the GOA Pacific cod pot fishery receives a "highly effective" score for bycatch strategy.

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Moderately Effective

Pot fisheries in Alaska are managed based on an independently conducted, current stock assessment process using fishery-dependent and fishery-independent data (NPFMC 2018). Bycatch is tracked by on-board observers (for some fisheries), required logbooks, electronic Monitoring Systems (EMS) in some fleets, and landings requirements. The majority of fisheries have partial to 100% observer requirements (except pot fisheries) and/or EMS requirements (NOAA 2018). Ghost fishing is mitigated by federally mandated gear labeling requirements and other measures, such as biodegradable twine in pot gear. However, reporting of lost gear can be inconsistent, and pot fishing gear in particular is demonstrated to have ghost gear impacts. Therefore, pot fisheries in Alaska receive a "moderately effective" score for scientific research and monitoring.

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Highly Effective

Alaska groundfish fisheries are managed via an independently conducted and current stock assessment process based on comprehensive fishery-dependent and fishery-independent data (NPFMC 2018). Bycatch is tracked by on-board observers (for some fisheries), required logbooks, electronic Monitoring Systems (EMS) in some fleets, and landings requirements. The majority of fisheries have partial to 100% observer requirements (except pot fisheries) and/or EMS requirements (NOAA 2018). Ghost fishing is mitigated by federally mandated gear labeling requirements. Therefore, all groundfish fisheries receive a "highly effective"

score for scientific research and monitoring.

Justification:

The NPFMC reviews groundfish FMP species stock status annually or biennially to ensure catch limits are up to date and scientifically valid. Additionally, GOA and BSAI Groundfish Plan Teams support the Council process by providing the Council with annual reviews of stock assessment and statistical analyses on a species and ecosystem level. The Science and Statistical Committee, a group of independent experts in biology, statistics, etc, then reviews information from the Plan Teams and makes recommendations regarding catch limits, MSY, and ecosystem function to the Council.

A number of annual fishery-independent surveys (GOA and BSAI midwater and bottom trawl, longline, etc.) are used in tandem with fishery catch data to assess fish stock abundance, distribution, and ecology. Landings data is recorded online via eLandings and is also tracked by required logbooks. Additionally, the North Pacific Observer Program was restructured to improve observer coverage and monitoring across all fleets in the BSAI and GOA. These changes increased the statistical reliability of data collected by the program, addressed cost inequality among fishery participants, and expanded observer coverage to previously unobserved fisheries (NOAA 2018). Vessels are placed into either: 1) full coverage (catcher processors, GOA catcher vessels in the Central GOA Rockfish program, Community Development Quota catcher vessels); or 2) partial coverage (hook and line catcher vessels > 40 ft, pot vessels >40 ft). Any vessel in the partial observer coverage will be part of an EM or observer random selection pool to ensure some coverage unless exemptions apply (NOAA 2018).

It's important to note that conservation concerns remain regarding observer coverage in some fleets, especially in larger scale fisheries with partial coverage (e.g., some trawl fisheries experienced less than 20% coverage in 2017). Studies have suggested that up to 50% observer coverage may be necessary to sufficiently monitor some fleets (especially with high probability of interactions with endangered species) (Babcock and Pikitch 2003) (AFSC 2018).

At the June 2018 meeting, the Council completed an initial review of the draft Regulatory Impact Review (RIR) and selected a preliminary preferred alternative to require full retention of all rockfish species for fixed gear catcher vessels (CVs) in the BSAI and GOA. Requiring full retention of rockfish by fixed gear CVs would improve identification of species catch composition when CVs are subject to electronic monitoring; improve data collection by providing more accurate estimates of total catch; reduce incentives to discard rockfish; may reduce waste; reduce overall enforcement burden; and provide more consistency in regulations (NPFMC 2018). Final action on this item will likely occur in 2019.

Factor 3.4 - 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.

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Highly Effective

Methods to ensure compliance with regulations include: mandatory use of vessel monitoring systems (VMS), on-board observers, and record-keeping requirements including mandatory logbooks and the submission of product, discard, and disposition information via eLandings. NMFS (with support from NOAA Law Enforcement) enforces regulations for these safety, permit, area, and landings requirements. Additional enforcement duties fall within the purview of the Alaska State Troopers and US Coast Guard. Comprehensive regulations and enforcement in Alaska result in a "highly effective" rating for groundfish fisheries in Alaska.

Factor 3.5 - 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, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Highly Effective

The NPFMC meets five times per year, involves and encourages participation from all major user groups at each meeting, and addresses user conflicts as needed. Therefore, Alaska groundfish fisheries receive a “highly effective” score for stakeholder inclusion.

Justification:

All NPFMC meetings are open to the public, and all action items addressed by the Council are allotted time for public testimony prior to Council recommendations. A number of independent Committees (e.g., Electronic Monitoring Committee, Ecosystem Committee, Enforcement Committee, IFQ Committee) are formed by relevant stakeholders and are used to inform Council management decisions. In June 2018, The Community Engagement Committee was formed to identify and recommend strategies for the Council to provide effective community engagement with rural and Alaska Native communities, groups that tend to have fewer opportunities to engage with regional management agencies (NPFMC 2018).

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 (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 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*

GUIDING PRINCIPLES

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Alaska / Pots / United States of America / Sablefish pot	3	+1	Very Low Concern	Green (4.472)
Alaska / Set longlines / United States of America / Sablefish longline	3	+1	Very Low Concern	Green (4.472)
Alaska / Bering Sea / Pots / United States of America / Pacific cod pot	3	+1	Very Low Concern	Green (4.472)
Alaska / Bering Sea / Bottom trawls / United States of America / Atka mackerel trawl	1	+1	Very Low Concern	Yellow (3.162)
Alaska / Bering Sea / Bottom trawls / United States of America / Greenland turbot trawl	2	+1	Very Low Concern	Green (3.873)
Alaska / Bering Sea / Bottom trawls / United States of America / Pacific cod trawl	2	+1	Very Low Concern	Green (3.873)
Alaska / Bering Sea / Bottom trawls / United States of America / Rockfish trawl	1	+1	Very Low Concern	Yellow (3.162)

Alaska / Bering Sea / Set longlines / United States of America / Pacific cod longline	3	+1	Very Low Concern	Green (4.472)
Alaska / Bering Sea / Set longlines / United States of America / Greenland turbot longline	3	+1	Very Low Concern	Green (4.472)
Alaska / Gulf of Alaska / Bottom trawls / United States of America / Pacific cod trawl	2	+1	Very Low Concern	Green (3.873)
Alaska / Gulf of Alaska / Bottom trawls / United States of America / Rockfish trawl	1	+1	Very Low Concern	Yellow (3.162)
Alaska / Gulf of Alaska / Set longlines / United States of America / Pacific cod longline	3	+1	Very Low Concern	Green (4.472)
Alaska / Gulf of Alaska / Pots / United States of America / Pacific cod pot	3	+1	Very Low Concern	Green (4.472)

Criterion 4 Assessment

SCORING GUIDELINES

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

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - 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. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - 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 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl*

fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

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

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT

3

The EFH for sablefish is varied, but generally consists of soft substrates (NMFS 2005) (Hanselman et al. 2017). According to Seafood Watch Criteria, the physical impact of pot fisheries on mixed, primarily sandy substrates scores a 3.

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

3

Sablefish distribution is typically thought to be on the upper continental slope in deeper waters than most groundfish (Hanselman et al. 2017), while Greenland turbot inhabit both the deeper slope and shelf waters (Barbeaux et al. 2016). The EFH for adult sablefish and Greenland turbot is varied, but generally consists of soft substrates mixed with rocks or boulders (NMFS 2005). Although it is possible that longlines could move small boulders, it is unlikely fishing would persist where this would often occur. Relative to trawl gear, a significant effect of longlines on bedrock, cobbles, or sand is unlikely (Hanselman et al. 2018), and based

on Seafood Watch Criteria, the physical impact of longline fishing gear on mixed substrates receives a score of 3.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL

1

The BSAI trawl fishery for Atka mackerel accesses habitats that are characterized by high rugosity and hard substrates, including rock (Lowe et al. 2017). According to Seafood Watch criteria, the physical impact of trawl fisheries on hard or rocky substrates receives a score of 1.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL

2

The BSAI trawl fishery for Greenland turbot accesses varied habitat, including silt, mud, and gravel substrates (Barbeaux et al. 2016) (NMFS 2005). Based on the Seafood Watch Criteria, the physical impact of trawl gear on mixed gravel/sand substrates receives a score of 2.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

2

Identified EFH and the BSAI and GOA Pacific cod trawl fisheries largely take place over sand, mud, sandy mud, and gravel (NMFS 2005) (Thompson 2017) (Barbeaux et al. 2017). Trawl fisheries occurring over soft or sandy substrates receive a score of 2 based on Seafood Watch Criteria.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

1

Available data suggest that the BSAI and GOA rockfish trawl fisheries typically access habitats characterized by hard, rocky, high-relief substrates (NMFS 2005) (Hulson et al. 2017) (Spencer and Ianelli 2014) (Spencer and Ianelli 2016). According to Seafood Watch Criteria, the physical impact of trawl fisheries over hard or rocky substrates receives a score of 1.

ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

3

Identified EFH and the pot fisheries for BSAI and GOA Pacific cod largely take place over sand, mud, sandy mud, and gravel (NMFS 2005) (Thompson 2017) (Barbeaux et al. 2017). The physical impact of pot fishing gear on sand, mud, and gravel habitat receives a score of 3 based on the Seafood Watch Criteria.

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

3

Identified EFH and the BSAI and GOA Pacific cod longline fisheries largely occur over sand, mud, sandy mud, and gravel (NMFS 2005)(Thompson 2017) (Barbeaux et al. 2017). According to Seafood Watch criteria, the physical impact of longline fishing gear on sand, mud, and gravel habitat receives a score of 3.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

+1

Although there are fewer area closures for longline and pot gear in Alaska, a substantial proportion of representative habitats are protected from bottom contact, and vulnerable habitats are strongly protected. Fishing effort is constrained by a number of factors including season durations, quota limits, and permitting requirements.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

+1

Significant steps have been taken towards mitigating the impact of trawl gear in the BSAI and GOA regions to protect benthic habitat, to minimize bycatch rates of prohibited species, and to minimize interactions with endangered marine mammals. Approximately 65% of the area in the US EEZ is closed to bottom trawling (Zador and Siddon 2016).

Justification:

In 2007, the Council adopted precautionary measures to conserve benthic fish habitat in the BS by "freezing the footprint" of bottom trawling by limiting trawl effort only to those areas more recently trawled. The measures prohibited bottom trawling in a deep slope and basin area (47,000 nm2), and three habitat conservation areas around St. Matthew Island, St. Lawrence Island, and an area encompassing Nunivak Island-Etolin Strait-Kuskokwim Bay. The Council also established the Northern Bering Sea Research Area that includes the shelf waters to the north of St. Matthew Island (85,000 nm2) (NPFMC 2018). These trawl closures are in addition to a number of HAPC and EFH protection zones.

In 2005, bottom trawling for all groundfish species was prohibited in 10 designated areas along the continental shelf of the GOA. The GOA Slope Habitat Conservation Areas, which contain high relief bottom and

coral communities, total 2,086 nm2 (NPFMC 2018). The entire zones of Southeast Alaska and the Arctic were also closed to trawling in 1998 and 2009, respectively (Zador and Siddon 2016)(Figure A).

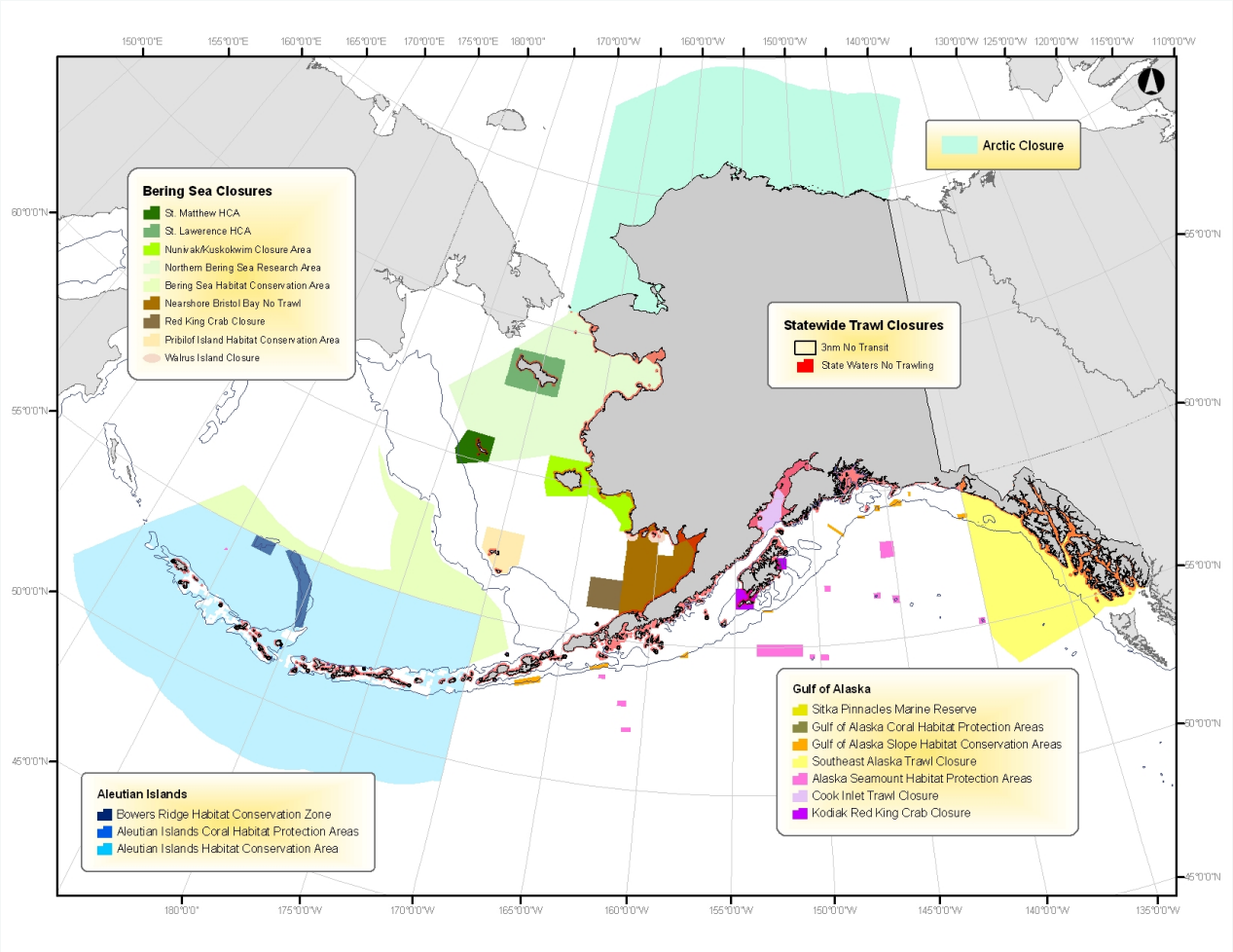

Figure 74 Year-round groundfish closures in the U.S. Exclusive Economic Zone (EEZ) o? Alaska, excluding most SSL closures (Zador & Siddon 2016).

Factor 4.3 - Ecosystem-Based Fisheries Management

ALASKA, POTS, UNITED STATES OF AMERICA, SABLEFISH POT
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ATKA MACKEREL TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, GREENLAND TURBOT TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL
ALASKA / GULF OF ALASKA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Very Low Concern

Through the requirements of the Magnuson-Stevens Act and the Council's stated ecosystem policy objectives, in their vision statement and in individual FMPs, the Council approaches Alaska fishery management with EBFM principles forefront in consideration (NPFMC 2018a). Harvest control rules are in place that account for ecosystem function, scientific uncertainty, and target and non-target species' ecological roles. Precautionary and effective spatial management is used, such as EFH and HAPC areas and regional fishery closures. Numerous ecosystem evaluations are ongoing, and Alaska's groundfish fisheries receive a "very low" score for conservation concern.

Justification:

The NPFMC has a longstanding history of leading EBFM regionally and internationally. NMFS must comply with all applicable laws when authorizing fisheries per the Council's FMP in Alaska. Many of these laws require consideration of the effects of the fisheries on components of the ecosystem. Such applicable laws and policy related to EBFM include the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act (RFA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and Executive Order 12866 (EO 12866). An example of ecosystem-driven legislation includes the Groundfish FMP Amendment 36 (1998), which established a forage fish category and prohibited directed fishing on forage fish species to conserve prey for marine mammals, seabirds, and commercially important groundfish species. Additionally, in 2001 NOAA Fisheries implemented a modified harvest control rule designed to ensure minimum levels of availability for three Steller sea lion prey species (Atka mackerel, pollock, and Pacific cod) targeted in the groundfish fisheries (NPFMC 2018a).

The annual groundfish fishery TAC setting process considers the marine food web and function. For example, the OY of the BSAI groundfish complex is 85% of the historical MSY, or 1.4 to 2.0 million t. Stock assessments focus on biological limits and stock production variability; account for uncertainty at each step; account for natural mortality, including predation mortality; and aim to continually reduce uncertainty through continually improved understanding of functional ecosystem relationships (NPFMC 2018a).

The TAC setting process and relevant management measures are also informed by the annual Ecosystem Status Report (ESR) and the Alaska Integrated Ecosystem Assessment (IEA). Data on ecosystem indicators from the ESRs provide contextual ecosystem information for Plan Teams and the Council immediately preceding the review of species-specific harvest recommendations. This allows for consideration of ecosystem status and observations that are outside the scope of individual stock assessments, yet may have impacts to the considerations of harvests (NPFMC 2018a). NOAA's IEA supports EBFM by providing a tool to help transfer scientific information to management. IEAs are intended to provide a structure to assess ecosystem status relative to management objectives, account for the social-ecological impact of management decisions, and guide management evaluations (NPFMC 2018a).

In 2014, the Council formally adopted an ecosystem approach for fisheries in the EEZ off Alaska. The Council's ecosystem approach includes a vision statement that applies to all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

Most recently, the Council initiated development of a Bering Sea Fishery Ecosystem Plan (BS FEP). FEPs are a tool that can serve as a framework for continued incorporation of ecosystem goals and actions in regional fisheries management. The initial draft of BS FEP was reviewed by the Council in the fall of 2018 and finalized in December 2018 (NPFMC 2018). Although fishery managers strive to take ecosystem function into account across all trophic levels, conservation concerns still remain about managing multi-species systems such that prey availability for non-target species, such as marine mammals and ecosystem component species, instead of just managing for target species reference points. Maintaining ecosystem integrity in light of impending climate changes is another critical conservation concern (NPFMC 2018).

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 thank the consulting researcher and author of this report, Megan Peterson, as well as several anonymous reviewers for graciously reviewing this report for scientific accuracy.

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Appendix A: Extra By Catch Species

PACIFIC HALIBUT

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Very Low Concern

Pacific halibut is managed by the International Pacific Halibut Commission (IPHC) and is assessed annually as a single stock extending from northern California to the AI and BS. The 2018 female SB is estimated to be 90,700 t. The probability that the stock is below the "trigger" reference point ($SB_{30\%}$) is estimated to be 6%, with less than a 1% chance that the stock is below the limit reference point $SB_{20\%}$ (if a stock drops below $SB_{20\%}$ it is considered overfished by the IPHC) (Stewart et al. 2016). The female SB stock is currently estimated to be 40% (95% CI) of specified unfished levels (Stewart et al. 2017). Pacific halibut is not classified as overfished (NMFS 2017 FSSI) (Stewart et al. 2017) and is within data-driven target management reference points, and Pacific halibut therefore receives a score of "very low" concern for abundance.

Justification:

The results of the 2017 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2010, largely a result of decreasing size-at-age, as well as somewhat weaker recruitment strengths than those observed during the 1980s. Since the estimated female SSB stabilized in 2010, the stock is estimated to have increased gradually through 2017 (Figure A) (Stewart et al. 2017).

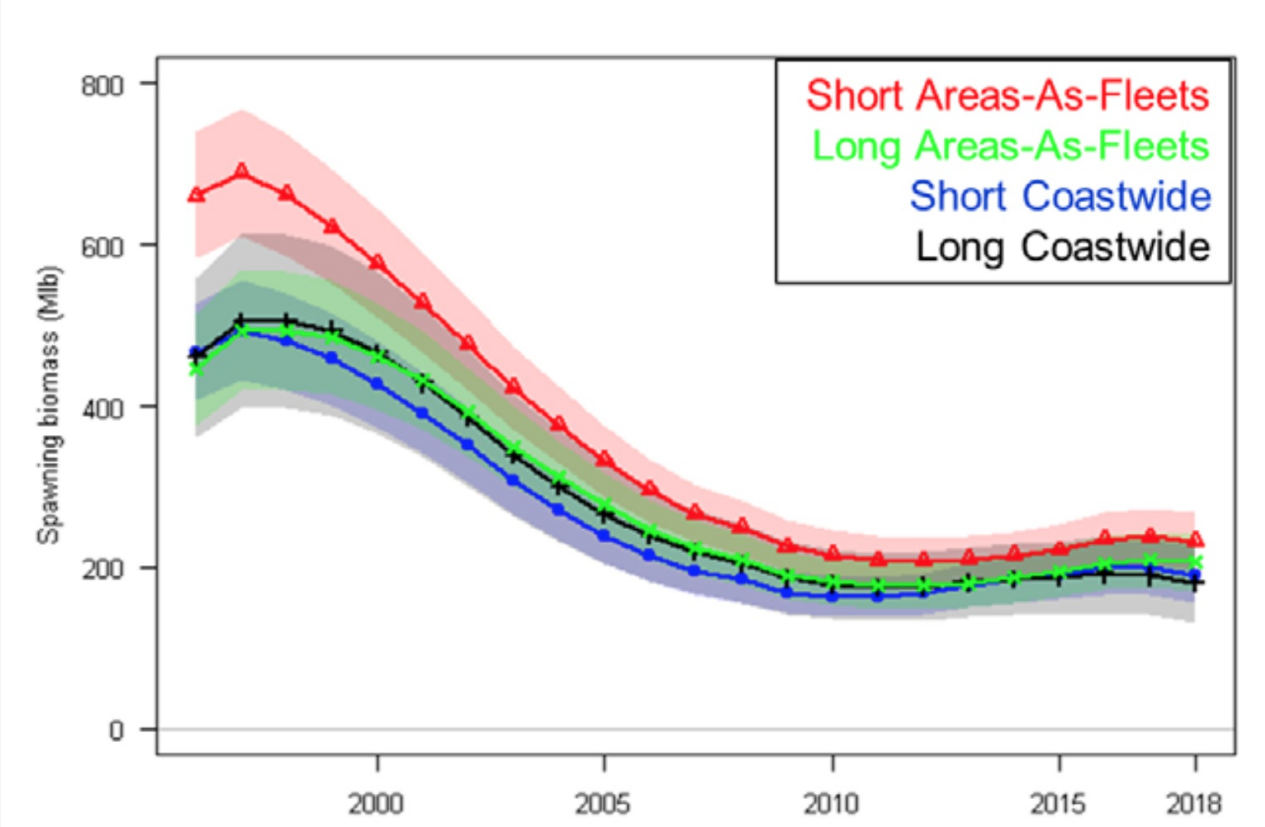

Figure 66 Estimated spawning biomass trends (1996-2018) based on the four individual models included in the

2017 stock assessment ensemble. Series indicate the maximum likelihood estimates; shaded intervals indicate approximate 95% confidence interval (Stewart et al. 2017).

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

Pacific halibut are targeted in directed halibut longline fisheries and are taken as bycatch, primarily in Pacific cod and flatfish fisheries. Total mortality in 2017 was roughly 19,250 t, which is below the 100-year average. Fishing intensity for Pacific halibut is measured via the Spawning Potential Ratio for Pacific halibut and was estimated to be SPR=40% in 2017, which likely exceeded the target reference point SPR=46%. Although the the IPHC does not have a coastwide formal limit reference point for fishing mortality, a target interim reference level SPR=46% is used to inform management actions, which most closely correspond to $F_{35\%}$ or $F_{40\%}$ reference points used in federal groundfish fishery management scenarios (Stewart et al. 2017) (Stewart & Hicks 2017). Although catches in all Alaska management areas were within limits in 2017, retrospective model analyses suggest that coastwide fishing intensity in recent years has likely moderately exceeded the interim reference level SPR=46% since 1998 (Stewart and Hicks 2017). There is of course some uncertainty with retrospective analyses, and F has been fluctuating around the proxy SPR=46% reference point. Therefore, Pacific halibut receives a score of "moderate" concern for fishing mortality.

Justification:

Over the period 1918 to 2017 removals have totaled 3.2 million t, ranging annually from 16,000 to 45,000 t with an annual average ~29,000 t (Figure A). Annual removals were above this long-term average from 1985 through 2010 and have been relatively stable near 19,000 t since 2014. Coastwide directed commercial Pacific halibut fishery landings in 2017 were approximately 11,900 t, up from a low of 10,700 t in 2014. Bycatch mortality was estimated to be 2,720 t in 2017, the lowest level since 1962. The BSAI groundfish fisheries (primarily Pacific cod and flatfish) accounted for roughly 85% of Pacific halibut bycatch mortality in 2017 (Goen and Erikson 2017). Coastwide fishing intensity has exceeded the reference level SPR=46% since1998 (Figure B) (Stewart and Hicks 2017).

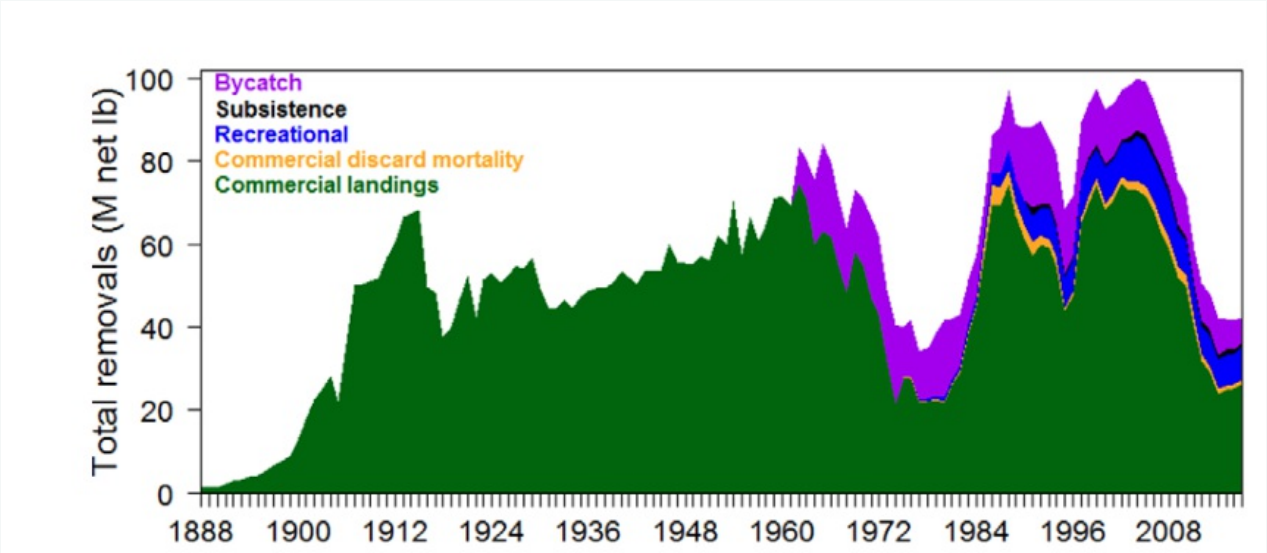

Figure 67 Summary of estimated historical mortality by source (colors), 1888-2017 (Stewart et al. 2017).

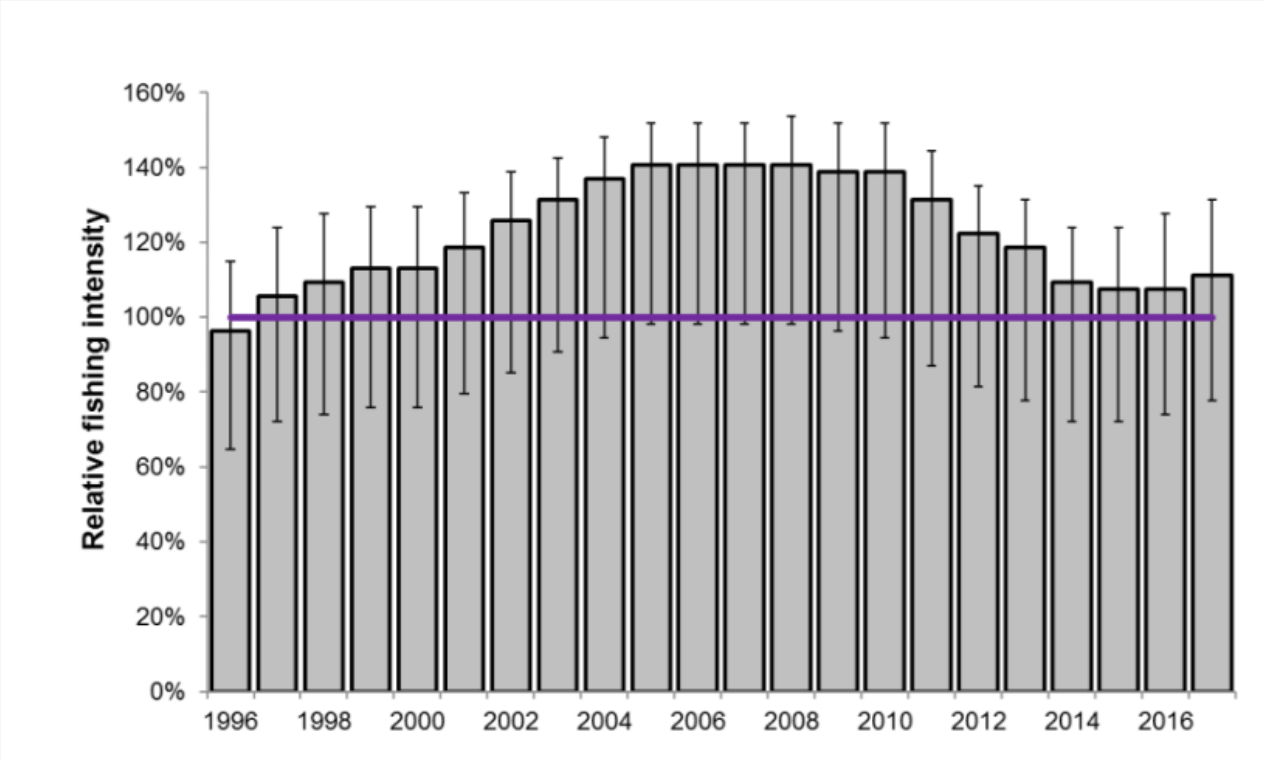

Figure 68 Recent estimated fishing intensity (based on the Spawning Potential Ratio) relative to the SPR=46% reference level (horizontal line). Vertical lines indicate approximate credible intervals from the stock assessment ensemble (Steward & Hicks 2017).

In June 2015, the Council took final action to reduce halibut PSC mortality limits in the BSAI groundfish fisheries overall from 4,426 mt to 3,515 mt, a 21% reduction, apportioned among sectors and gear types (NPFMC 2017). In June 2012, Amendment 95 to the Gulf of Alaska Groundfish FMP reduced occurrence of halibut bycatch in GOA groundfish fisheries. Reduced PSC limits were phased in, beginning in 2014, and have been fully realized as of 2017, ranging from 7% for HAL CPs to a maximum 15% reduction for GOA trawl fisheries. The NPFMC is currently reviewing alternatives to develop abundance-based PSC limits for halibut.

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the GOA typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.2.

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the GOA typically have partial observer coverage through the North Pacific Observer

Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.25. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA / BERING SEA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, PACIFIC COD TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod trawl vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod trawl fishery discard/landings ratio during that time was less than 0.6.

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

RED KING CRAB

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Low Concern

Although king crab is managed separately in a number of Alaska regions, Bristol Bay red king crab make up the vast majority of US king crab landings and will be the stock reviewed in this report. Red king crab is assessed annually using a sex- and size-structured population dynamics model incorporating data from the NMFS EBS trawl survey, the Bering Sea Fisheries Research Foundation trawl survey, landings of commercial catch, at-sea observer sampling, and dockside retained catch sampling. Red king crab Mature Male Biomass (MMB) for 2016/17 was estimated to be 25.81 thousand t and above (Minimum Size Stock Threshold (MSST;12.53 thousand t). The stock at 2017/18 time of mating is projected to be above the MSST and 85% of $B_{35\%}$, and the stock is not approaching an overfished condition in 2017/18 (Bush et al. 2017). Red king crab biomass is above the limit reference point (> MSST) but is slightly below a target reference point (2017 B/B_{MSY} ratio = 0.93)(NMFS FSSI 2017), and the stock status of red king crab is therefore deemed of "low" concern.

Justification:

Estimated mature Bristol Bay red king crab biomass increased dramatically in the mid-1970s and decreased precipitously in the early 1980s. Estimated mature crab abundance increased from 1985 to 2009 (mature females three times more abundant and mature males two times more abundant in 2009 than in 1985); however, estimated mature king crab abundance and recruitment has steadily declined since 2009 (Zheng and Siddeek 2017).

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE
ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

Low Concern

Red king crab are taken in directed and non-target fisheries, primarily in BSAI Pacific cod pot and longline and flatfish and pollock trawl fisheries. The Bristol Bay red king crab stock is not experiencing overfishing because the 2016/17 total catch (4.28 thousand t) was less than the OFL and was roughly 0.72 of the ABC (5.97 thousand t) (Zheng and Siddeek 2017}. Total catches have been well below ABCs over time, and it is probable that fishing mortality is at or below a sustainable level that will allow the king crab stock to maintain current abundance. Therefore, red king crab receive a score of "low" concern for fishing mortality in non-pollock groundfish fisheries.

Factor 2.3 - Discard Rate

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA / BERING SEA, POTS, UNITED STATES OF AMERICA, PACIFIC COD POT

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Vessels fishing Pacific pots in the BSAI typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the BSAI Pacific cod pot fishery discard/landings ratio during that time was less than 0.05. Bait use in this fishery is unknown, and the discard mortality rate for much of the bycatch (invertebrates, snails, etc.) is likely less than 100% (Alverson et al. 1994); however, neither of these factors would alter the score for this criteria.

GIANT RATTAIL

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Moderate Concern

Grenadier (including giant rattail/Pacific and popeye grenadier) was most recently assessed as a complex in 2016 as a Tier 5 species. Giant (rattail) grenadier represents the majority of the grenadier biomass and catches in Alaskan waters, and therefore it will be the only grenadier species reviewed in this assessment. Projected grenadier biomass for 2018 was 1,704,998 t, representing a moderate increase in the GOA and stable trends in the BSAI since the early 2000s (Rodgveller and Hulson 2016). Although stock assessments for grenadier are no longer required, grenadier assessments will be updated every few years based on regional

trawl survey and catch data. Recent trawl survey biomass estimates suggest the stock is stable (Rodgveller and Hulson 2016), giant grenadier is not rated highly vulnerable (Table 4), and the stock status of giant grenadier is scored "moderate" concern for abundance.

Justification:

In 2014, a federal amendment was approved that moved the grenadier complex into both FMPs as Ecosystem Components. Under this rule, they are not allowed to be targeted, but there is an 8% Maximum Retainable Allowance (MRA). Based on this change in classification, the grenadier complex is no longer assessed annually.

Table 4. Giant rattail grenadier, Alaska/Bering Sea longline

Giant rattail grenadier, Alaska/Bering Sea longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 7 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 7 = high risk)	Reference
Average age at maturity (years)	9	2	(Tupogonov et al. 2008)	Areal overlap		3	(Rodgveller & Hulson 2016)
Average maximum age (years)	56	3	fishbase.org	Vertical overlap		3	(Rodgveller & Hulson 2016)
Fecundity (eggs/yr)	329,000	1	(Tupogonov et al. 2008)	Selectivity of fishery		2	(Rodgveller & Hulson 2016)
Average maximum size (cm) (not to be used when scoring invertebrate species)	210	2	fishbase.org	Post-capture mortality		3	(Rodgveller & Hulson 2016)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	88	2	(Tupogonov et al. 2008)	Susceptibility Subscore		2.325	

Reproductive strategy	Broadcast spawner	1	(Tupogonov et al. 2008)		
Trophic level	4.3	3	fishbase.org	Productivity-Susceptibility Score	3.07
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium
Quality of Habitat	Moderately altered	2	(Rodgveller & Hulson 2016)		
Productivity Subscore		2			

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

Low Concern

Grenadier is a bycatch-only species, caught primarily in Greenland turbot and sablefish fisheries. The estimated mean catch of grenadier 2003 to 2012 in Alaska was 13,394 t (Rodgveller and Hulson 2014). Catches recorded 2011 to 2016 were well below target ABC/OFLs, and exploitation rates likely continue to be quite low (Rodgveller and Hulson 2016). There is a probable chance that fishing mortality from all sources is appropriate given grenadiers' ecological role; therefore, the grenadier fishery receives a score of "low" concern for fishing mortality in sablefish and Greenland turbot fisheries.

Factor 2.3 - Discard Rate

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Greenland turbot vessels may have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Greenland turbot longline fishery discard/landings ratio during that time was estimated to be 1.37. Giant Grenadier are caught in high numbers in this fishery, they are not retained, and discard mortality is presumed to be 100%. Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, SABLEFISH LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Sablefish longline vessels have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the sablefish longline fishery discard/landings ratio during that time was estimated to be 1.05. Giant grenadier are caught in high numbers in this fishery; they are not retained, and discard

mortality is presumed to be 100% (Rodgveller and Hulson 2016). Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

SKATES (UNSPECIFIED)

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

The BSAI "Other Skates" complex includes all skates except Alaska, Aleutian, Bering and big skate (these species comprise the majority of skate biomass in the BSAI). Primary species in the BSAI Other Skates complex include longnose, mud, and whiteblotched skates. As a Tier 5 complex there are no target reference points against which to assess the current status of BSAI Other Skates. Additionally data are limited on stock status and biomass trends for individual skate species due to their management as a complex. Data limitations for the Other Skates complex are somewhat mitigated by stable to increasing trends of skate species not included in the complex (Alaska, big, etc.). All three species evaluated here received a high vulnerability rating (Tables 13–15); however, they are all listed as IUCN "Least Concern" (stable biomass trends for longnose and mud; unknown for whiteblotched) (IUCN 2018), and BSAI Other Skates receive a score of "moderate" concern for abundance.

Justification:

Table 13. Longnose skate, Alaska/ Bering Sea longline

Longnose skate, Alaska, Bering Sea longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 6 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 6 = high risk)	Reference
Average age at maturity (years)	8.5	2	(Ormseth 2016)	Areal overlap		3	(Ormseth 2016)
Average maximum age (years)	25	2	(Ormseth 2016)	Vertical overlap		3	(Ormseth 2016)
Fecundity (eggs/yr)	25	3	(Ormseth 2016)	Selectivity of fishery		2	(Ormseth 2016)

Average maximum size (cm) (not to be used when scoring invertebrate species)	180	2	(Ormseth 2016)	Post-capture mortality	3	(Ormseth 2016)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	74	2	(Ormseth 2016)	Susceptibility Subscore	2.325	
Reproductive strategy	Demersal egg layer or brooder	2	(Ormseth 2016)			
Trophic level	4	3	fishbase.org	Productivity-Susceptibility Score	3.24	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Ormseth 2016)			
Productivity Subscore		2.25				

Table 14. Mud skate, Alaska, Bering Sea longline

Mud skate , Alaska, Bering Sea longline						
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 7 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 7 = high risk)	Reference
Average age at maturity (years)	NA	3		Areal overlap		3	(Ormseth 2016)

Average maximum age (years)	NA	3		Vertical overlap	3	(Ormseth 2016)
Fecundity (eggs/yr)	25	3	(Ormseth 2016)	Selectivity of fishery	2	(Ormseth 2016)
Average maximum size (cm) (not to be used when scoring invertebrate species)	77	1	(Ormseth 2016)	Post-capture mortality	3	(Ormseth 2016)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	64.5	2	(Ormseth 2016)	Susceptibility Subscore	2.325	
Reproductive strategy	Demersal egg layer or brooder	2	(Ormseth 2016)			
Trophic level	3.9	3	fishbase.org	Productivity-Susceptibility Score	3.32	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High	
Quality of Habitat	Moderately altered	2	(Ormseth 2016)			
Productivity Subscore		2.375				

Table 9. Mud skate, Alaska/ Bering sea longline

Table 15. Whiteblotched skate, Alaska, Bering Sea longline

Whiteblotched skate, Alaska, Bering Sea longline

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 8 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 8 = high risk)	Reference
Average age at maturity (years)	NA	3		Areal overlap		3	(Ormseth 2016)
Average maximum age (years)	NA	3		Vertical overlap		3	(Ormseth 2016)
Fecundity (eggs/yr)	25	3	(Ormseth 2016)	Selectivity of fishery		2	(Ormseth 2016)
Average maximum size (cm) (not to be used when scoring invertebrate species)	120	2	(Ormseth 2016)	Post-capture mortality		3	(Ormseth 2016)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	97	2	(Ormseth 2016)	Susceptibility Subscore		2.325	
Reproductive strategy	Demersal egg layer or brooder	2	(Ormseth 2016)				
Trophic level	4.1	3	fishbase.org	Productivity-Susceptibility Score	3.41		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High		
Quality of Habitat	Moderately altered	2	(Ormseth 2016)				
Productivity Subscore		2.5					

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

The GOA "Other Skates" complex includes all skates except big and longnose skates. GOA Other skates are managed under Tier 5, where OFL and ABC are based on survey biomass estimates and natural mortality rate. The Aleutian skate comprises the majority of the biomass of GOA Other Skates. Although Aleutian skate GOA biomass appears variable, overall biomass estimates of Other Skates have declined since 2013, and biomass estimates of all skates combined also declined moderately during the same time. Declining estimates of some species has been linked to anomalous warm years in the GOA and potential distribution shifts north to the BS (Ormseth 2017). There are no target reference points against which to assess the current status of GOA Other Skates. Variable biomass trends, vulnerable status (Table 13), and an IUCN listing of "Least Concern" with stable trends (IUCN 2018) yield a score of "moderate" concern for GOA Other Skate abundance.

Justification:

Table 13. Aleutian skate, Alaska, Gulf of Alaska longline

Aleutian skate, Alaska, Gulf of Alaska longline							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 9 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 9 = high risk)	Reference
Average age at maturity (years)	NA	3		Areal overlap		3	(Ormseth 2017)
Average maximum age (years)	14	2	(Ormseth 2017)	Vertical overlap		3	(Ormseth 2017)
Fecundity (eggs/yr)	50	3{	(Ormseth 2017)	Selectivity of fishery		2	(Ormseth 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	154	2	(Ormseth 2017)	Post-capture mortality		3	(Ormseth 2017)

Average size at maturity (cm) (not to be used when scoring invertebrate species)	127	2	(Ormseth 2017)	Susceptibility Subscore	2.325
Reproductive strategy	Demersal egg layer or brooder	2	(Ormseth 2017)		
Trophic level	4.1	3	fishbase.org	Productivity-Susceptibility Score	3.32
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High
Quality of Habitat	Moderately altered	2	(Ormseth 2017)		

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE
ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

BSAI Other Skates is a non-target fishery and comprised on average >5% of the catch in the BSAI Greenland turbot and Pacific cod hook and line fisheries since 2013. Aggregate (all species) ABCs have not been exceeded in recent years, and in 2017 the overall skate catch was 0.78 of the ABC. Much uncertainty remains regarding species-specific fishing mortality levels for the Other Skates, and the Other Skates complex receives a score of "moderate" concern for fishing mortality in the BSAI Greenland turbot and Pacific cod hook and line fisheries.

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

Directed fishing for skates is prohibited in the GOA. Other Skates have comprised on average >5% of the catch in the GOA Pacific cod hook and line fishery since 2013. Other Skate ABCs have not been exceeded in recent years, and in 2017 Other Skate catch was 0.59 of the ABC (Ormseth 2017a). Other Skates are subject to Maximum Retainable Amount (MRA) limits across all GOA fisheries. Much uncertainty remains regarding species-specific fishing mortality levels for GOA Other Skates, and the Other Skates complex receives a score of "moderate" concern for fishing mortality in the GOA Pacific cod fishery.

Justification:

It's important to note that interest in retention of skates and directed fishing for skates remains high in the GOA. The ABCs for big skates in the CGOA was exceeded every year from 2010 to 2013 and again in 2016, and the ABC for longnose skates in the WGOA was exceeded in 4 of the years from 2007 to 2013. Although the Other Skates complex has been less controversial, MRA limit reductions have been applied in recent years to curb skate retention and sale (Ormseth 2017a). And in 2016 the Alaska Regional Office indefinitely reduced the MRA for all skates in the GOA from 20% to 5%.

Factor 2.3 - Discard Rate

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, GREENLAND TURBOT LONGLINE

≥ 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Greenland turbot vessels may have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Greenland turbot longline fishery discard/landings ratio during that time was estimated to be 1.37. Giant Grenadier are caught in high numbers in this fishery, they are not retained, and discard mortality is presumed to be 100%. Bait use for this fleet is unknown; however, modifying the score based on bait use would not alter the score for this criteria.

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the GOA typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.25. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

ALASKA SKATE

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Very Low Concern

Alaska skate is assessed biennially as a Tier 3 species in the BSAI skates complex. Projected Alaska skate SSB for 2018 is 107,136 t, and for 2018 the projected SSB:$SB_{35\%}$ is approximately 1.70 (Ormseth 2017). The estimated EBS shelf biomass for Alaska skate (the most abundant species on the shelf) decreased slightly from 2016; however, biomass estimates have increased significantly since a low in 1982. Alaska skate abundance is well above target management reference points, and receives a score of "very low" concern for abundance.

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Low Concern

Alaska skate is caught as bycatch, primarily in the BSAI Pacific cod longline fishery. Catches of Alaska skate have generally increased since the late 1990s, especially in recent years from 2013 to 2017. The author-estimated catch of Alaska skate in 2017 was 24,697 t or 0.78 of the ABC (31572 t) (Ormseth 2017). Estimated exploitation rates have for Alaska skate has increased since 2010 (Ormseth 2017); however, fishing mortality has remained below the target reference point $F_{35\%}$ (in all but 3 years since the early 1980s) (Ormseth 2016) and has remained low since 2000. Alaska skate catches and fishing mortality fall within target management reference points, and Alaska skate receives a score of "low" concern for fishing mortality in the Pacific cod longline fishery.

Factor 2.3 - Discard Rate

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

BIGMOUTH SCULPIN

Factor 2.1 - Abundance

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Low Concern

Bigmouth sculpin are managed as part of the sculpin complex in the BSAI and are assessed biennially under Tier 5 protocol. The estimated 2018 total sculpin complex biomass in the BSAI is 199,937 t. The species-specific bigmouth biomass estimate increased to 39,438 t in 2017. The overall complex and bigmouth biomass estimates both increased from the last full assessment in 2014 (Spies et al. 2017b). There are no species-specific target reference points available for bigmouth sculpin in the BSAI, and bigmouth sculpin score moderately vulnerable (Table 2). Biomass estimates in the AI and BS suggest the population is stable to increasing in all regions, catches have been stable over time (Spies et al. 2017b), and bigmouth sculpin receive a score of "low" concern for abundance in the BSAI.

Justification:

Table 2. Bigmouth sculpin, Alaska/Bering sea longline

Bigmouth sculpin, Alaska/ Bering Sea longline

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 6 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 6 = high risk)	Reference
Average age at maturity (years)	6	2	(Spies et al. 2016)	Areal overlap		3	(Spies et al. 2016)
Average maximum age (years)	23	2	(Spies et al. 2016)	Vertical overlap		3	(Spies et al. 2016)
Fecundity (eggs/yr)	230,000	1	(Spies et al. 2016)	Selectivity of fishery		2	(Spies et al. 2016)
Average maximum size (cm) (not to be used when scoring invertebrate species)	83	1	(Spies et al. 2016)	Post-capture mortality		2	(Alverson et al. 1994)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	NA	3		Susceptibility Subscore		1.875	
Reproductive strategy	Demersal egg layer or brooder	2	(Spies et al. 2016)				
Trophic level	4.5	3	fishbase.org	Productivity-Susceptibility Score	2.74		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium		
Quality of Habitat	Moderately altered	2	(Spies et al. 2016)				
Productivity Subscore		2					

Factor 2.2 - Fishing Mortality

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Low Concern

Sculpin complex catches have historically been well under the ABCs, and in 2017 the catch of 5,170 t was approximately 0.12 of the ABC (42387 t). However, TACs have been moderately exceeded every year from 2011 to 2017 (Spies et al. 2017b). TACs are intentionally set well below ABCs in order to stay within the overall 2 million t cap for the whole groundfish complex while allowing higher TACs for other species that are more likely to fulfill them (I. Spies, NMFS, personal communication 2018). Target reference points specific to fishing mortality and exploitation rates are unavailable for BSAI bigmouth sculpin; however, sculpin catches remain well below ABCs, which are set to reflect a sustainable fishing mortality level, and bigmouth sculpin receive a score of "low" concern for fishing mortality in the BSAI Pacific cod hook and line fishery.

Factor 2.3 - Discard Rate

ALASKA / BERING SEA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the BSAI typically have 100% observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.19. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

REDSTRIPE ROCKFISH

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

Redstripe rockfish are assessed biennially under Tier 5 guidelines as part of the Other Rockfish complex in the GOA. Six species generally comprise > 95% of the Other Rockfish catch and/or biomass: harlequin, redbanded, redstripe, sharpchin, silvergray, and yelloweye rockfish. Overall Other Rockfish biomass in 2017 was 25% above the historical survey average, and redbanded survey estimated biomass increased 81% from the 2015 value (Tribuzio et al. 2017). Since 1984, redstripe biomass estimates have been variable (much of this variability is attributed to patchy distributions) with no significant trend. There are no species-specific target reference points available for redstripe rockfish; however, biomass is estimated bienially, and 2017 estimates were the highest in the time series 1984 to 2017. Redstripe rockfish are vulnerable (Table 7); however biomass estimates and catch composition data suggest this population is at relatively robust level (Tribuzion et al. 2017), and redstripe rockfish receive a score of "moderate" concern for abundance in the GOA.

Justification:

Table 7. Redstripe rockfish, Alaska/ Gulf of Alaska trawl

Redstripe rockfish, Alaska/ Gulf of Alaska trawl

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 9 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 9 = high risk)	Reference
Average age at maturity (years)	NA	3		Areal overlap		3	(Tribuzio et al. 2017)
Average maximum age (years)	41	3	(Tribuzio et al. 2017)	Vertical overlap		3	(Tribuzio et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Tribuzio et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	61	1	fishbase.org	Post-capture mortality		3	(Tribuzio et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	NA	3		Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3					
Trophic level	3.8	3	fishbase.org	Productivity-Susceptibility Score	3.32		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High		
Quality of Habitat	Moderately altered	2	(Tribuzio et al. 2017)				
Productivity Subscore		2.375					

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Redstripe rockfish are predominately caught in rockfish trawl fisheries, with much of the catch occurring in the central GOA. As a Tier 5 complex, there is no species specific ABC (In 2013 to 2017 the redstripe catch average was 77.5 t). Redstripe biomass estimates can be relatively high and catch is low (e.g. catch/biomass ratio for 2017 was <0.003). Redstripe rockfish therefore receives a score of "low" concern for fishing mortality in the GOA rockfish trawl fishery.

Justification:

Beginning with the 2014 year the ABC and TAC for the western and central GOA Other Rockfish were combined. The ABC for Other Rockfish was exceeded in the western GOA consistently from 2009 to 2013 and would have been exceeded each year since if the ABCs were not combined. During this period redstripe was a relatively small portion of the Other Rockfish catch (~ 8% of the GOA Other Rockfish catch), suggesting redstripe rockfish were not subject to regionally high exploitation rates (Tribuzio et al. 2017).

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. GOA Rockfish trawl vessels have partial observer coverage through the North Pacific Observer Program. Vessels fishing in the central GOA as part of the Alaska Rockfish program have 100% observer coverage. Data were analyzed 2013 to 2017, and the GOA rockfish trawl fishery discard/landings ratio during that time was less than 0.1.

SHARPCHIN ROCKFISH

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Sharpchin rockfish is assessed biennially as part of the Other Rockfish complex in the GOA. Sharpchin is the only rockfish species in the complex that has sufficient maturity and growth data to meet Tier 4 guidelines. Overall Other Rockfish biomass in 2017 was 25% above the historical survey average; however, sharpchin estimated biomass decreased 74% from the 2015 value (down to 1,283 t) (Tribuzio et al. 2017). Much of this variability is attributed to patchy distribution patterns, and estimates have high associated CVs. The time trend data of sharpchin biomass estimates supports this high variability. Since 1984, sharpchin biomass estimates have been variable with no significant trend overall. Sharpchin rockfish are not highly vulnerable (Table 9), biomass is estimated bienially using quantitative life history data, exhibiting a stable time trend, and catches have been stable to increasing in the GOA since 2013. Therefore, sharpchin receives a score of "low" concern for abundance in the GOA.

Justification:

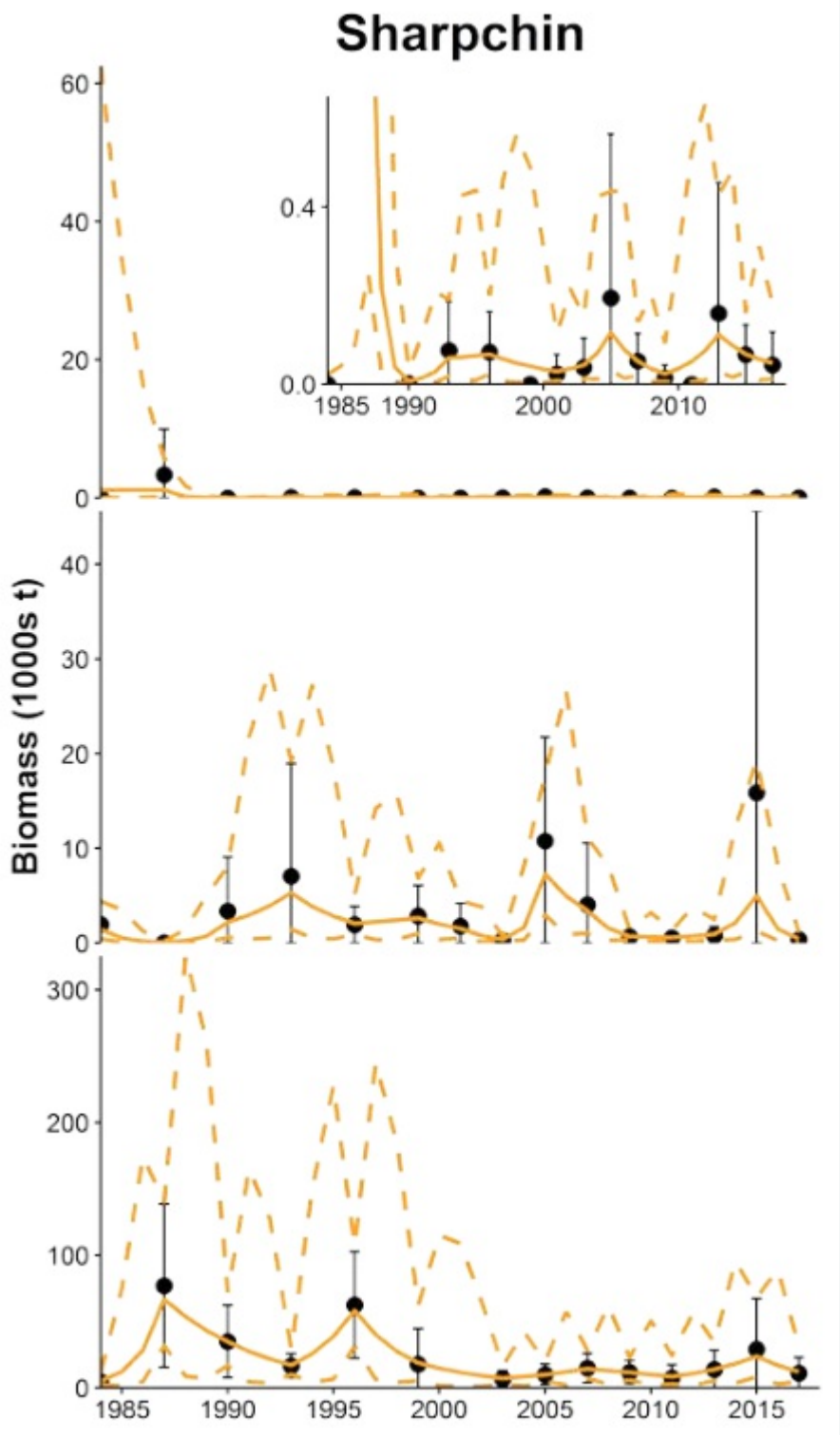

Figure 69 Estimated random effects biomass for sharpchin rockfish by NMFS regulatory areas: Western Gulf of Alaska (WGOA), Central GOA (CGOA) and Eastern GOA (EGOA). The regional model takes into account the missing survey in the EGOA in 2001. The inset in the WGOA sharpchin panel shows the same data as the panel, but zoomed in to show detail (Tribuzio et al. 2017).

Table 9. Sharpchin rockfish, Alaska/Gulf of Alaska trawl

Sharpchin rockfish, Alaska/ Gulf of Alaska trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 10 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 10 = high risk)	Reference
Average age at maturity (years)	10	2	(Tribuzio et al. 2017)	Areal overlap		3	(Tribuzio et al. 2017)
Average maximum age (years)	58	3	(Tribuzio et al. 2017)	Vertical overlap		3	(Tribuzio et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Tribuzio et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	39	1	fishbase.org	Post-capture mortality		3	(Tribuzio et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	26.5	1	(Tribuzio et al. 2017)	Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3	(Tribuzio et al. 2017)				
Trophic level	3.7	3	fishbase.org	Productivity-Susceptibility Score	3.07		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium		

Quality of Habitat	Moderately altered	2	(Tribuzio et al. 2017)
Productivity Subscore		2	

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Sharpchin rockfish are predominately caught in rockfish trawl fisheries, with much of the catch occurring in the central GOA. Catch of sharpchin rockfish catch in 2017 was 145.9 t or 0.06 of the gulfwide sharpchin ABC (2280 t). The OFL limit for sharpchin rockfish is determined based on the $F_{35\%}$ rate (0.079 for 2017 and 2018). Sharpchin catches have been well below sharpchin ABCs, and GOA sharpchin rockfish receives a "low" concern for fishing mortality in the GOA rockfish trawl fishery.

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. GOA Rockfish trawl vessels have partial observer coverage through the North Pacific Observer Program. Vessels fishing in the central GOA as part of the Alaska Rockfish program have 100% observer coverage. Data were analyzed 2013 to 2017, and the GOA rockfish trawl fishery discard/landings ratio during that time was less than 0.1.

SILVERGRAY ROCKFISH

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

Silvergray rockfish is one of the most abundant rockfish species in the GOA, and the center of its distribution is likely Southeast Alaska and British Columbia, based on survey data. Silvergray rockfish is assessed biennially under Tier 5 guidelines as part of the Other Rockfish complex. Overall Other Rockfish biomass in 2017 was 25% above the historical survey average, while silvergray estimated biomass decreased 18% from the 2015 value (Tribuzio et al. 2017). Since 1984, silvergray rockfish biomass estimates have been highly variable with no significant trend (similar to other rockfish species). Biomass estimates suggest the population is stable, however silvergray rockfish are vulnerable (Table 12), and there are no estimates of biomass relative to target reference points; therefore, silvergray rockfish receives "moderate" concern for abundance in the GOA.

Justification:

Table 12. Silvergray rockfish, Alaska, GOA trawl

Silvergray rockfish, Alaska, Gulf of Alaska trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 10 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 10 = high risk)	Reference
Average age at maturity (years)	NA	3		Areal overlap		3	(Tribuzio et al. 2017)
Average maximum age (years)	75	3	(Tribuzio et al. 2017)	Vertical overlap		3	(Tribuzio et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Tribuzio et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	NA	3		Post-capture mortality		3	(Tribuzio et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	40	2	(Tribuzio et al. 2017)	Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3	(Tribuzio et al. 2017)				
Trophic level	3.8	3	fishbase.org	Productivity-Susceptibility Score	3.41		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	High		

Quality of Habitat	Moderately altered	2	(Tribuzio et al. 2017)
Productivity Subscore		2.5	

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Silvergray rockfish are predominately caught in rockfish trawl fisheries, with much of the catch occurring in the central GOA. As a Tier 5 complex, there is no species-specific ABC (2013 to 2017 catch average 47.9 t). This constitutes less than 5% of the total Other Rockfish catch during that time. Target reference points specific to fishing mortality and exploitation rates are limited for GOA silvergray rockfish. However, silvergray biomass estimates are relatively high and catch is low (e.g. catch/biomass ratio for 2017 was <0.001). Silvergray rockfish receive a "low" concern for fishing mortality in the GOA rockfish trawl fishery.

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. GOA Rockfish trawl vessels have partial observer coverage through the North Pacific Observer Program. Vessels fishing in the central GOA as part of the Alaska Rockfish program have 100% observer coverage. Data were analyzed 2013 to 2017, and the GOA rockfish trawl fishery discard/landings ratio during that time was less than 0.1.

QUILLBACK ROCKFISH

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

Quillback rockfish is assessed biennially under Tier 6 guidelines as part of the Other Rockfish complex in the GOA and as part of the demersal subgroup. Overall Other Rockfish biomass in 2017 was 25% above the historical survey average; however, biomass estimates specific to quillback in these management areas are unavailable (Tribuzio et al. 2017). There are no species-specific target reference points available for quillback rockfish. Quillback rockfish is not highly vulnerable (Table 6), and receives a score of "moderate" concern for abundance in the GOA due to limited data.

Justification:

Table 6. Quillback rockfish, Alaska/ Gulf of Alaska trawl

Quillback rockfish, Alaska/ Gulf of Alaska trawl

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 11 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 11 = high risk)	Reference
Average age at maturity (years)	11	2	(Tribuzio et al. 2017)	Areal overlap		3	(Tribuzio et al. 2017)
Average maximum age (years)	95	3	(Tribuzio et al. 2017)	Vertical overlap		3	(Tribuzio et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery		2	(Tribuzio et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	61	1	fishbase.org	Post-capture mortality		3	(Tribuzio et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	29	1	(Tribuzio et al. 2017)	Susceptibility Subscore		2.325	
Reproductive strategy	Live bearer	3	(Tribuzio et al. 2017)				
Trophic level	3.8	3	fishbase.org	Productivity-Susceptibility Score	3.07		
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium		
Quality of Habitat	Moderately altered	2	(Tribuzio et al. 2017)				
Productivity Subscore		2					

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

Moderate Concern

Quillback rockfish are predominately caught as bycatch in the Pacific cod hook and line fishery and, to a lesser extent, in the rockfish trawl fishery. The 2017 total catch of quillback rockfish was roughly 15.8 t, and catch levels continue to remain low for this non-target species. Target reference points specific to fishing mortality and exploitation rates do not exist for quillback rockfish, and they receive a score of "moderate" concern for fishing mortality in the GOA pacific cod fishery.

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, SET LONGLINES, UNITED STATES OF AMERICA, PACIFIC COD LONGLINE

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. Pacific cod longline vessels in the GOA typically have partial observer coverage through the North Pacific Observer Program. Data were analyzed 2013 to 2017, and the Pacific cod longline fishery discard/landings ratio during that time was roughly 0.25. Bait use for this fleet is unknown; however, modifying the score marginally based on bait use would not impact the ratio sufficiently to alter the score for this criteria.

WIDOW ROCKFISH

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

Widow rockfish has been managed as a Tier 6 species as part of the Other rockfish complex in the GOA since 2012. Overall Other Rockfish biomass in 2017 was 25% above the historical survey average; however, biomass estimates specific to widow in these management areas are unavailable (Tribuzio et al. 2017). There are no species-specific target reference points available for widow rockfish, widow rockfish is not highly vulnerable (Table 16), and receives a score of "moderate" concern for abundance in the GOA due to limited data.

Justification:

Table 16. Widow rockfish, Alaska/ Gulf of Alaska trawl

Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 4 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 4 = high risk)	Reference

Average age at maturity (years)	NA	3		Areal overlap	3	(Tribuzio et al. 2017)
Average maximum age (years)	59	3	(Tribuzio et al. 2017)	Vertical overlap	3	(Tribuzio et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery	2	(Tribuzio et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	60	1	fishbase.org	Post-capture mortality	3	(Tribuzio et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	36	1	fishbase.org	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3				
Trophic level	3.7	3	fishbase.org	Productivity-Susceptibility Score	3.15	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium	
Quality of Habitat	Moderately altered	2	(Tribuzio et al. 2017)			
Productivity Subscore		2.125				

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

Widow rockfish are predominately caught in rockfish trawl fisheries. The 2017 total catch of widow rockfish was roughly 32.8 t, and catch levels continue to remain low for this non-target species. Target reference points specific to fishing mortality and exploitation rates do not exist for quillback rockfish, and they receive a score of "moderate" concern for fishing mortality in the GOA rockfish trawl fishery.

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. GOA Rockfish trawl vessels have partial observer coverage through the North Pacific Observer Program. Vessels fishing in the central GOA as part of the Alaska Rockfish program have 100% observer coverage. Data were analyzed 2013 to 2017, and the GOA rockfish trawl fishery discard/landings ratio during that time was less than 0.1.

HARLEQUIN ROCKFISH

Factor 2.1 - Abundance

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Low Concern

Harlequin rockfish is managed as part of the Other Rockfish assemblage in the GOA as a Tier 5 species. As such, there are no target reference points against which to assess the current status of GOA harlequin rockfish stock status. Estimated harlequin biomass for 2017 is 12,920 t; however, biomass estimates are historically highly variable with high CVs (Tribuzio et al. 2017). Overall, Other Rockfish biomass in 2017 was 25% above the historical survey average, and harlequin estimated biomass increased 458% from the 2015 value (Tribuzio et al. 2017). It's important to note that one survey tow in the western GOA influenced the extreme variation in estimated harlequin abundance between 2015 and 2017. Similar to other rockfish species, harlequin biomass is highly variable, and they are difficult to sample. Harlequin rockfish biomass is estimated biennially and shows no major trend; they are not highly vulnerable (Table 5), and catches have been stable to increasing in the GOA since 2013. Therefore harlequin rockfish receives a score of "low" concern for abundance in the GOA.

Justification:

Table 5. Harlequin rockfish, Alaska/ Gulf of Alaska trawl

Harlequin rockfish, Alaska/ Gulf of Alaska trawl							
Productivity Attributes	Value	Score (1 = low risk; 2 = medium risk; 8 = high risk)	Reference	Susceptibility Attribute	Information	Score (1 = low risk; 2 = medium risk; 8 = high risk)	Reference
Average age at maturity (years)	NA	3		Areal overlap		3	(Tribuzio et al. 2017)

Average maximum age (years)	47	3	(Tribuzio et al. 2017)	Vertical overlap	3	(Tribuzio et al. 2017)
Fecundity (eggs/yr)	NA	1		Selectivity of fishery	2	(Tribuzio et al. 2017)
Average maximum size (cm) (not to be used when scoring invertebrate species)	38	1	fishbase.org	Post-capture mortality	3	(Tribuzio et al. 2017)
Average size at maturity (cm) (not to be used when scoring invertebrate species)	23	1	fishbase.org	Susceptibility Subscore	2.325	
Reproductive strategy	Live bearer	3				
Trophic level	3.7	3	fishbase.org	Productivity-Susceptibility Score	3.15	
Density dependence (invertebrates only)	NA			Vulnerability Rating (high, medium or low)	Medium	
Quality of Habitat	Moderately altered	2				
Productivity Subscore		2.125				

Factor 2.2 - Fishing Mortality

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

Moderate Concern

Other rockfish (including harlequin) are managed as a bycatch-only fishery. As part of the Other rockfish assemblage, TACs and ABCs/OFLs are not specific to harlequin rockfish at the species level. Harlequin catches averaged 529.3 t from 2013 to 2017, primarily in the western GOA management area. Target reference points specific to fishing mortality and exploitation rates are limited for GOA harlequin rockfish, and the fishery receives a "moderate" concern for fishing mortality.

Justification:

GOA harlequin rockfish are caught primarily with trawl gear, likely because they are thought to feed on

plankton and are not attracted to longlines. GOA harlequin are typically smaller and of lower commercial value than other OR species or species targeted in the direct GOA rockfish trawl fishery. Beginning in the 2014 fishery, the ABC and TAC for the western and central GOA were combined. The ABC for the OR (formerly Other Slope Rockfish) was exceeded in the western GOA consistently from 2009 to 2013 and would have been exceeded each year since if the ABCs were not combined. During this period harlequin rockfish was, on average, 77% of the OR catch in the western GOA, suggesting exploitation rates for harlequin rockfish may have been relatively high regionally (Tribuzio et al. 2017).

Factor 2.3 - Discard Rate

ALASKA / GULF OF ALASKA, BOTTOM TRAWLS, UNITED STATES OF AMERICA, ROCKFISH TRAWL

< 100%

Data on catch retention and discards are available through the NMFS Catch Accounting system. GOA Rockfish trawl vessels have partial observer coverage through the North Pacific Observer Program. Vessels fishing in the central GOA as part of the Alaska Rockfish program have 100% observer coverage. Data were analyzed 2013 to 2017, and the GOA rockfish trawl fishery discard/landings ratio during that time was less than 0.1.