APPENDIX B

STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

FOR THE GROUNDFISH RESOURCES OF THE GULF OF ALASKA

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Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska

Table of Contents

Summary 3
- Introduction 3
- Overview of Stock Assessments 9
- Economic Summary of the GOA commercial groundfish fisheries in 2013-14 11
- Ecosystem Considerations summary 14
- Stock assessment summaries 17
- Summary tables 41

Stock Assessment Chapters

1 Walleye pollock 47
2 Pacific cod 183
3 Sablefish 327
4 Shallow water flatfish 503
4.1. Northern and southern rock sole 555
5 Deep water flatfish 649
6 Rex sole 657
7 Arrowtooth flounder 743
8 Flathead sole 841
9 Pacific ocean perch 913
10 Northern rockfish 993
11 Shortraker rockfish 1001
12 Dusky rockfish 1049
13 Rougheye and blackspotted rockfish 1055
14 Demersal shelf rockfish 1153
15 Thornyhead rockfish 1169
16 Other rockfish 1177
17 Atka mackerel 1223
18 Skates 1257
19 Sculpins 1315
20 Sharks 1343
21 Squid 1345
22 Octopus 1369

Ecosystem Considerations ..... Bound separately

Economic Status of Groundfish Fisheries off Alaska ..... Bound separately

Summary

by

The Plan Team for the Groundfish Fisheries of the Gulf of Alaska

Introduction

The *National Standard Guidelines for Fishery Management Plans* published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). The SAFE reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries under federal management. The FMPs for the groundfish fisheries managed by the Council require that drafts of the SAFE reports be produced each year in time for the December North Pacific Fishery Management Council (Council) meetings.

The SAFE report for the Gulf of Alaska (GOA) groundfish fisheries is compiled by the Plan Team for the Gulf of Alaska Groundfish FMP from chapters contributed by scientists at NMFS Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G). The stock assessment section includes recommended acceptable biological catch (ABC) levels for each stock and stock complex managed under the FMP. The ABC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other management strategies for the fisheries.

The GOA Groundfish Plan Team met in Seattle on November 13-17, 2017 to review the status of stocks of twenty three species or species groups that are managed under the FMP. The Plan Team review was based on presentations by ADF&G and NMFS AFSC scientists with opportunity for public comment and input. Members of the Plan Team who compiled the SAFE report were James Ianelli (co-chair), Jon Heifetz (co-chair), Craig Faunce, Sandra Lowe, Chris Lunsford, Ben Williams, Kresimir Williams (new member), Janet Rumble, Nat Nichols, Dan Lew, Paul Spencer, Jim Armstrong, and Obren Davis.

Management Areas and Species

The Gulf of Alaska (GOA) management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Fig. 1). Formerly, five categories of finfishes and invertebrates were designated for management purposes: target species, other species, prohibited species, forage fish species and non-specified species. Effective for the 2011 fisheries, these categories have been revised in Amendments 96 and 87 to the FMPs for Groundfish of the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA), respectively. This action was necessary to comply with requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to prevent overfishing, achieve optimum yield, and to comply with statutory requirements for annual catch limits (ACLs) and accountability measures (AMs). Species and species groups must be identified "in the fishery" for which ACLs and AMs are required. An ecosystem component (EC) is also included in the FMPs for species and species groups that are not:

1) targeted for harvest
2) likely to become overfished or subject to overfishing, and
3) generally retained for sale or personal use.

The effects of the action amended the GOA and BSAI groundfish FMPs to:

1) identify and manage target groundfish stocks "in the fishery"
2) eliminate the "other species" category and manage (GOA) squids, (BSAI and GOA) sculpins, (BSAI and GOA) sharks, and (BSAI and GOA) octopuses separately "in the fishery";
3) manage prohibited species and forage fish species in the ecosystem component category; and
4) remove the non-specified species outside of the FMPs.

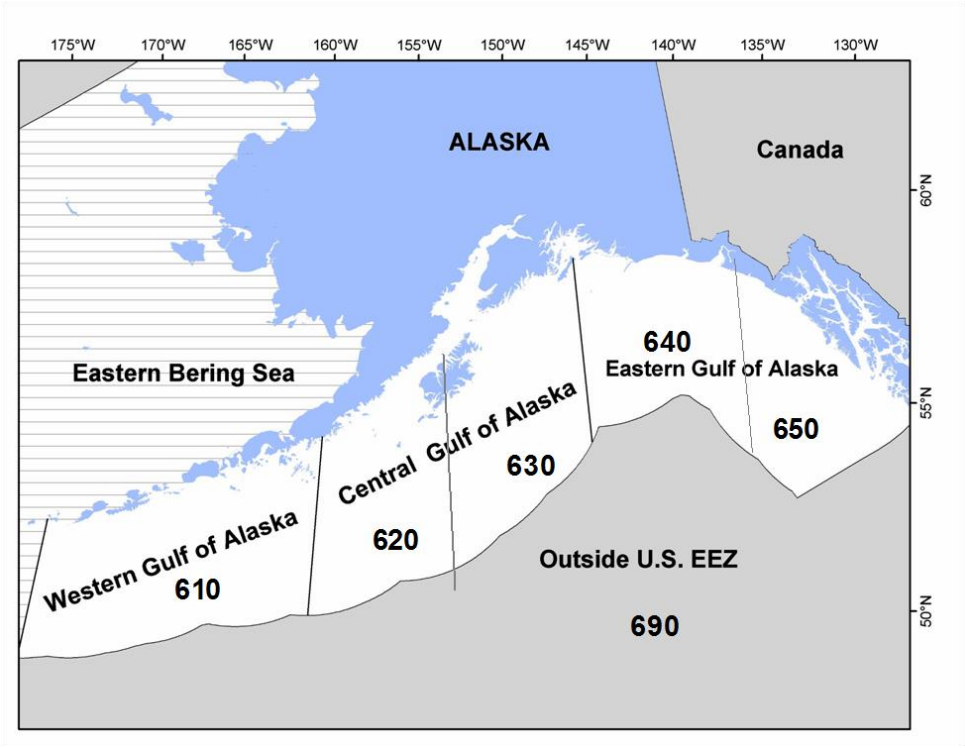

Figure 1. Gulf of Alaska statistical and reporting areas.

Species may be split or combined within the "target species" category according to procedures set forth in the FMP. The three categories of finfishes and invertebrates that have been designated for management purposes are listed below.

In the Fishery:

1) Target species – are those species that support a single species or mixed species target fishery, are commercially important, and for which a sufficient data base exists that allows each to be managed on its own biological merits. Accordingly, a specific total allowable catch (TAC) is established annually for each target species or species assemblage. Catch of each species must be recorded and reported. This category includes walleye pollock, Pacific cod, sablefish, shallow and deep water flatfish, shallow water flatfish, rex sole, flathead sole, arrowtooth flounder, Pacific ocean perch, shortraker rockfish, rougheye/blackspotted rockfish, northern rockfish, "other" rockfish, dusky rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, squids, sculpins, sharks, octopus, big skates, longnose skates, and other skates.

Ecosystem Component:

2) Prohibited Species–are those species and species groups the catch of which must be avoided while fishing for groundfish, and which must be immediately returned to sea with a minimum of injury except when their retention is authorized by other applicable law. Groundfish species and species groups under the FMP for which the quotas have been achieved shall be treated in the same manner as prohibited species.
3) Forage fish species–are those species listed in the table below, which are a critical food source for many marine mammal, seabird and fish species. The forage fish species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for forage fish. Management measures for this species category will be specified in regulations. These may include measures prohibiting

directed fishing, limiting allowable bycatch retention, or limiting commercial exchange and the processing of forage fish in a commercial facility.

4) Grenadiers – The grenadier complex (family Macrouridae), also known as "rattails", are comprised of at least seven species of grenadier known to occur in Alaskan waters, but only three are commonly found at depths shallow enough to be encountered in commercial fishing operations or in fish surveys: giant grenadier (*Albatrossia pectoralis*), Pacific grenadier (*Coryphaenoides acrolepis*), and popeye grenadier (*Coryphaenoides cinereus*).

The following lists the GOA stocks within these FMP species categories:

In the Fishery	
Target Species[1]	Walleye pollock, Pacific cod, Sablefish, Flatfish (shallow-water flatfish, deep-water flatfish, rex sole, flathead sole, arrowtooth flounder), Rockfish (Pacific ocean perch, northern rockfish, shortraker rockfish, rougheye/blackspotted rockfish, other rockfish, dusky rockfish, demersal shelf rockfish[3], thornyhead rockfish), Atka mackerel, Skates (big skates, longnose skates, and other skates), Squids, Sculpins, Sharks, Octopus
Ecosystem Component	
Prohibited Species[2]	Pacific halibut, Pacific herring, Pacific salmon, Steelhead trout, King crab, Tanner crab
Forage Fish Species[4]	Osmeridae family (eulachon, capelin, and other smelts), Myctophidae family (lanternfishes), Bathylagidae family (deep-sea smelts), Ammodytidae family (Pacific sand lance), Trichodontidae family (Pacific sand fish), Pholidae family (gunnels), Stichaeidae family (pricklebacks, warbonnets, eelblennys, cockscombs, and shannys), Gonostomatidae family (bristlemouths, lightfishes, and anglemouths), Order Euphausiacea (krill)
Grenadiers[5]	Macrouridae family (grenadiers)

[1] TAC for each listing. Species and species groups may or may not be targets of directed fisheries
[2] Must be immediately returned to the sea
[3]Management delegated to the State of Alaska
[4]Management measures for forage fish which are an Ecosystem Component are established in regulations implementing the FMP
[5] The grenadier complex was added to both FMPs as an Ecosystem Component in 2014

This SAFE report describes stock status of target and non-target species in the fishery. Amendments 100/91 added grenadiers to the GOA and BSAI FMPs as an Ecosystem Component in 2014.

A species or species group from within the fishery category may be split out and assigned an appropriate harvest level. Similarly, species in the fishery category may be combined and a single harvest level assigned to the new aggregate species group. The harvest level for demersal shelf rockfish in the Eastern Regulatory Area is specified by the Council each year. However, management of this fishery is deferred to the State of Alaska with Council oversight.

The GOA FMP recognizes single species and species complex management strategies. Single species specifications are set for stocks individually, recognizing that different harvesting sectors catch an array of species. In the Gulf of Alaska these species include pollock, Pacific cod, sablefish, Pacific ocean perch, flathead sole, rex sole, arrowtooth flounder, northern rockfish, shortraker rockfish, dusky rockfish, Atka mackerel, big skates, and longnose skates. Other groundfish species that are usually caught in groups have been managed as complexes (also called assemblages). For example, other rockfish, rougheye and

blackspotted rockfish, demersal shelf rockfish, thornyhead rockfish, deep water flatfish, shallow water flatfish, and other skates have been managed as complexes.

Beginning in 2011, squids, sculpins, octopus, and sharks are managed as individual complexes (previously they were managed as "other species"). Also in 2011, the rockfish categories were reorganized: widow and yellowtail rockfish were removed from the pelagic shelf rockfish complex leaving dusky rockfish as a single species category. Widow and yellowtail rockfish were added to the 15 species that were part of the former "other slope" rockfish group to form a new category in the Gulf of Alaska, "other rockfish". Previously, yellowtail and widow rockfish were part of the "pelagic shelf" rockfish group in the Gulf of Alaska, which no longer exists (for assessment purposes) since 2012. Both shortraker rockfish and "other rockfish" were presented as separate SAFE chapters in 2013. Separating these two chapters responds to recommendations from the Gulf of Alaska Plan Team and the NPFMC Scientific and Statistical Committee.

The FMP authorizes splitting species, or groups of species, from the complexes for purposes of promoting the goals and objectives of the FMP. Atka mackerel was split out from "other species" beginning in 1994. In 1998, black and blue rockfish were removed from the GOA FMP and management was conferred to the ADF&G. In 2008, dark rockfish were similarly removed from the GOA FMP with sole management taken over by the ADF&G. Beginning in 1999, osmerids (eulachon, capelin and other smelts) were removed from the "other species" category and placed in a separate forage fish category. In 2004, Amendment 63 to the FMP was approved which moved skates from the other species category into a target species category whereby individual OFLs and ABCs for skate species and complexes could be established.

Groundfish catches are managed against TAC specifications for the EEZ and near coastal waters of the GOA. State of Alaska internal water groundfish populations are typically not covered by NMFS surveys and catches from internal water fisheries generally not counted against the TAC. The Team has recommended that these catches represent fish outside of the assessed region, and should not be counted against an ABC or TAC. Beginning in 2000, the pollock assessment incorporated the ADF&G survey pollock biomass, therefore, the Plan Team acknowledged that it is appropriate to reduce the Western (W), Central (C) and West Yakutat (WY) combined GOA pollock ABC by the anticipated Prince William Sound (PWS) harvest level for the State fishery. The 2001 through 2019 W/C/WY pollock ABCs have been reduced by the PWS GHL as provided by ADF&G, before area apportionments were made. At the 2012 September Plan Team meeting, ADFG presented a proposal to set the PWS GHL in future years as a fixed percentage of the W/C/WY pollock ABC of 2.5%. That value is the midpoint between the 2001-2010 average GHL percentage of the GOA ABC (2.44%) and the 1996 and 2012 levels (2.55%). The Plan Team accepted this proposal, but noted concern regarding the lack of a biomass-based allocation in PWS. The Team continues to encourage the State to work with the AFSC in order to provide a biomass-based evaluation for PWS prior to fixing a percentage in regulation. In the interim, the Plan Team will deduct a value for the 2018 and 2019 PWS GHL (equal to 2.5% of the recommended 2019 and 2019 W/C/WY pollock ABCs) from the recommended 2018 and 2019 W/C/WY pollock ABCs (listed in the summary table), before area apportionments are made. It is important to note that the value of the PWS GHL is dependent on the final specified W/C/WY pollock ABC. The values used by the Plan Team to derive the 2018 and 2019 W/C/WY pollock apportioned ABCs are listed in the pollock summary under *Area apportionment*.

The Plan Team has provided subarea ABC recommendations on a case-by-case basis since 1998 based on the following rationale. The Plan Team recommended splitting the EGOA ABC for species/complexes that would be disproportionately harvested from the West Yakutat area by trawl gear. The Team did not split EGOA ABCs for species that were prosecuted by multi-gear fisheries or harvested as bycatch. For those species where a subarea ABC split was deemed appropriate, two approaches were examined. The point estimate for WY biomass distribution based on survey results was recommended for seven species/complexes to determine the WY and East Yakutat/Southeast Outside subarea ABC splits. For some species/complexes, a range was recommended bounded by the point estimate and the upper end of the 95% confidence limit from all three surveys. The rationale for providing a range was based on a desire to

incorporate the variance surrounding the distribution of biomass for those species/complexes that could potentially be constrained by the recommended ABC splits.

No Split	Split, Point Estimate	Split, Upper 95% CI
Pacific cod	Pollock	Pacific ocean perch
Atka mackerel	Sablefish	Dusky rockfish
Shortraker rockfish	Deep-water flatfish	
Rougheye/blackspotted rockfish	Shallow-water flatfish	
Thornyhead	Rex sole	
Northern rockfish	Arrowtooth flounder	
Demersal shelf rockfish	Flathead sole	
All skates	Other rockfish	

Biological Reference Points

A number of biological reference points are used in this SAFE. Among these are the fishing mortality rate (F) and stock biomass level (B) associated with MSY (F_{MSY} and B_{MSY}, respectively). Fishing mortality rates reduce the level of spawning biomass per recruit to some percentage P of the pristine level ($F_{P\%}$). The fishing mortality rate used to compute ABC is designated F_{ABC}, and the fishing mortality rate used to compute the overfishing level (OFL) is designated F_{OFL}.

Definition of Acceptable Biological Catch and the Overfishing Level

Amendment 56 to the GOA Groundfish FMP, approved by the Council in June 1998, defines ABC and OFL for the GOA groundfish fisheries. The new definitions are shown below, where the fishing mortality rate is denoted F, stock biomass (or spawning stock biomass, as appropriate) is denoted B, and the F and B levels corresponding to MSY are denoted F_{MSY} and B_{MSY} respectively.

<u>Acceptable Biological Catch</u> is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under "overfishing" below.

<u>Overfishing</u> is defined as any amount of fishing more than a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is reliable for this definition, and may use either objective or subjective criteria in making such determinations. For Tier (1), a pdf refers to a probability density function. For Tiers (1-2), if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For Tiers (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For Tiers (1-3), the coefficient α is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For Tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to X% of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For Tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

Tier

1) Information available: *Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.*
   - 1a) Stock status: $B/B_{MSY} > 1$
     $F_{OFL} = \mu_A$, *the arithmetic mean of the pdf*
     $F_{ABC} \leq \mu_H$, *the harmonic mean of the pdf*
   - 1b) Stock status: $\alpha < B/B_{MSY} \leq 1$
     $F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     $F_{ABC} \leq \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - 1c) Stock status: $B/B_{MSY} \leq \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
2) Information available: *Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.*
   - 2a) Stock status: $B/B_{MSY} > 1$
     $F_{OFL} = F_{MSY}$
     $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$
   - 2b) Stock status: $\alpha < B/B_{MSY} \leq 1$
     $F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
     $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
   - 2c) Stock status: $B/B_{MSY} \leq \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
3) Information available: *Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.*
   - *3a) Stock status:* $B/B_{40\%} > 1$
     $F_{OFL} = F_{35\%}$
     $F_{ABC} \leq F_{40\%}$
   - *3b) Stock status:* $\alpha < B/B_{40\%} \leq 1$
     $F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
     $F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
   - *3c) Stock status:* $B/B_{40\%} \leq \alpha$
     $F_{OFL} = 0$
     $F_{ABC} = 0$
4) Information available: *Reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.*
   $F_{OFL} = F_{35\%}$
   $F_{ABC} \leq F_{40\%}$
5) Information available: *Reliable point estimates of B and natural mortality rate M.*
   $F_{OFL} = M$
   $F_{ABC} \leq 0.75 \times M$
6) Information available: *Reliable catch history from 1978 through 1995.*
   OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information
   $ABC \leq 0.75 \times OFL$

<u>Overfished or approaching an overfished condition</u> is determined for all age-structured stock assessments by comparison of the stock level in relation to its MSY level according to the following two harvest scenarios (Note for Tier 3 stocks, the MSY level is defined as $B_{35\%}$):

Overfished (listed in each assessment as scenario 6):

In all future years, F is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is overfished. If the stock is expected to be 1) above its MSY level in 2019 or 2) above ½ of its MSY level in 2019 and above its MSY level in 2028 under this scenario, then the stock is not overfished.)

Approaching an overfished condition (listed in each assessment as scenario 7):

In 2018 and 2019, F is set equal to *max* F_{ABC}, and in all subsequent years, F is set equal to F_{OFL}. (Rationale: This scenario determines whether a stock is approaching an overfished condition. If the stock is 1) above its MSY level in 2019 or 2) above 1/2 of its MSY level in 2019 and expected to be above its MSY level in 2029 under this scenario, then the stock is not approaching an overfished condition.)

For stocks in Tiers 4-6, no determination can be made of overfished status or approaching an overfished condition as information is insufficient to estimate the MSY stock level.

Overview of Stock Assessments

The status of individual groundfish stocks managed under the FMP is summarized in this section. The spawning biomass of pollock, Dover sole, flathead sole, northern and southern rock sole, arrowtooth flounder, Pacific ocean perch, rougheye and blackspotted rockfish, northern rockfish, and dusky rockfish are above target stock size (Fig. 2). The spawning biomass of Pacific cod and sablefish is below target stock size. The target biomass levels for deep-water flatfish (excluding Dover sole), shallow-water flatfish (excluding northern and southern rocksole), rex sole, shortraker rockfish, other rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, skates, sculpins, squid, octopus, and sharks are unknown.

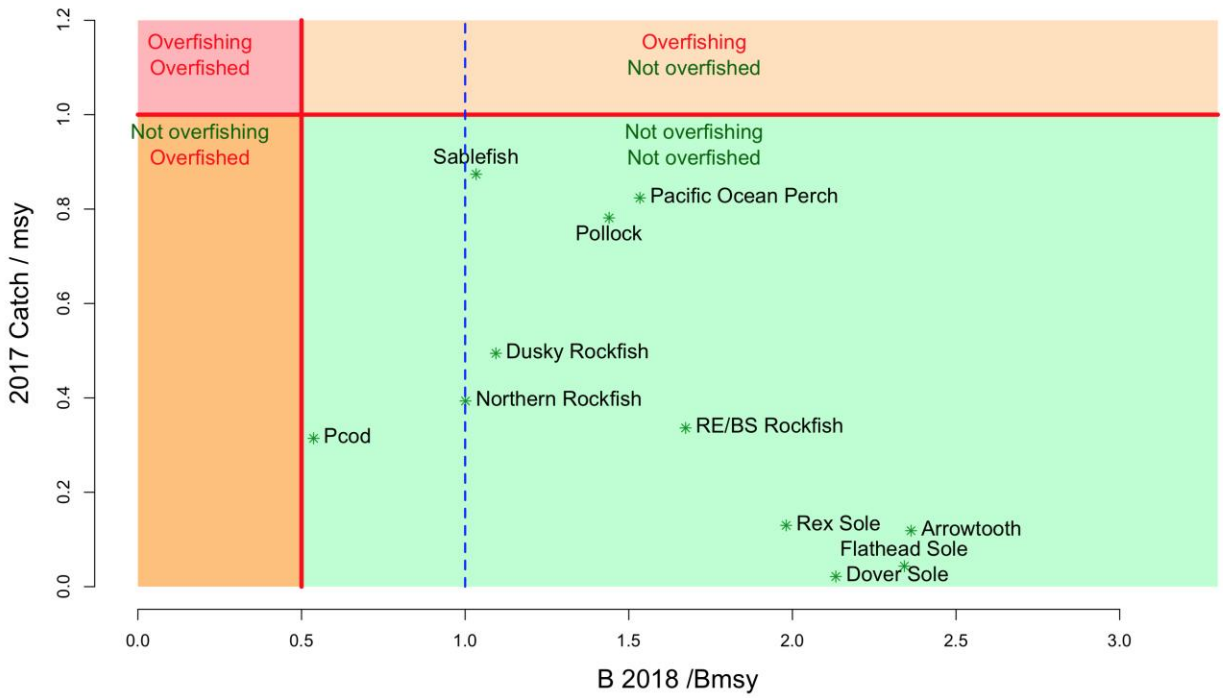

Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{MSYy}; horizontal axis) and current year catch relative to fishing at F_{msy} (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

Summary and Use of Terms

Tables 1 and 2 provide a summary of the status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2017, and recommendations for ABCs and overfishing levels (OFLs) for 2018 and 2019. Fishing mortality rates (*F*) and OFLs used to set these specifications are also listed in Table 2 and Plan Team recommended rates (and corresponding ABCs) that were lower than the maximum permissible are given in Table 3. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. Table 4 provides historical groundfish catches in the GOA, 1956-2017.

The sums of the preliminary 2018 and 2019 ABCs for target species are 536,558 and 480,190 t respectively which are within the FMP-approved optimum yield (OY) of 116,000 - 800,000 t for the Gulf of Alaska. The sums of the 2018 and 2019 OFLs are 655,853 and 604,337 t, respectively. The Team notes that because

of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2018 will be considerably under this upper limit. For perspective, the sum of the 2017 TACs was 535,863 t, and the sum of the ABCs was 667,877 t (and catch through November 4th, 2017 was just above 298,500 t).

The following conventions in this SAFE are used:

1) "Fishing mortality rate" refers to the full-selection *F* (i.e., the rate that applies to fish of fully selected sizes or ages). A full-selection *F* should be interpreted in the context of the selectivity schedule to which it applies.
2) For consistency and comparability, "exploitable biomass" refers to projected age+ biomass, which is the total biomass of all cohorts greater than or equal to some minimum age. The minimum age varies from species to species and generally corresponds to the age of recruitment listed in the stock assessment. Trawl survey data may be used as a proxy for age+ biomass. The minimum age (or size), and the source of the exploitable biomass values are defined in the summaries. These values of exploitable biomass may differ from values listed in the corresponding stock assessments if the technical definition is used (which requires multiplying biomass at age by selectivity at age and summing over all ages). In those models assuming knife-edge recruitment, age+ biomass and the technical definitions of exploitable biomass are equivalent.
(3) The values listed as 2016 and 2017 ABCs correspond to the values (in metric tons, abbreviated "t") approved by NMFS. The Council TAC recommendations for pollock were modified to accommodate revised area apportionments in the measures implemented by NMFS to mitigate pollock fishery interactions with Steller sea lions and for Pacific cod removals by the State water fishery of not more than 25% of the Federal TAC. The values listed for 2018 and 2019 correspond to the Plan Team recommendations.
(4) The exploitable biomass for 2016 and 2017 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2018 biomass with previous years' levels should be made with biomass levels from the revised hindcast reported in each assessment.
(5) The catches listed in the following summary tables are those reported by the Alaska Regional Office Catch Accounting System (alaskafisheries.noaa.gov/sustainablefisheries/catchstats.htm) unless otherwise noted.
(6) The values used for 2018 and 2019 were from modified assessments for selected species, rolled over (typically for Tiers 4-6) or based on updated projections. Note that projection values often assume catches and hence their values are likely to change (as are the Tiers 4-6 numbers when new data become available and/or is incorporated in the assessment).

General recommendations

The Team recommends that authors ensure survey and fishery data are updated over the entire time series (biomass estimates, composition data, etc.)

Two year OFL and ABC Determinations

Amendment 48/48 to the GOA and BSAI Groundfish FMPs, implemented in 2005, made two significant changes with respect to the stock assessment process. First, annual assessments for rockfish, flatfish, and Atka mackerel since changed to correspond with new survey data were available. E.g., full assessments were provided in 2015 to coincide with new survey data available from the 2015 GOA trawl and longline surveys. This amendment also required specifications for a period of at least two years (as in Tables 1 and 2). In the case of stocks managed under Tier 3 and for which modified assessments was produced, 2018 and 2019 ABC and OFL projections are typically based on the output for Scenarios 1 or 2 from the standard projection model using assumed (best estimates) of total year catch levels. For stocks managed under Tiers 3, 4 and 5 for which only a summary was produced, the latest survey data (2017) was reported and for Tier

5 species used for ABC and OFL calculations. Tier 6 stocks may have alternatives based on updated catch information.

The 2019 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2019 because data from any 2018 surveys may affect the status of stocks. Note that the next AFSC bottom trawl survey is scheduled for summer 2019.

Revised Stock Assessment Schedule

Based on consideration of stock prioritization including assessment methods and data availability, some stocks are assessed on an annual basis while others are assessed less frequently. The following table provides an overview of the level of assessment presented in this year's SAFE report, the Tier level and schedule, as well as the year of the next full assessment by stock.

Stock Assessment schedule for the Gulf of Alaska

Stock	2017 Assessment status	Tier	Schedule (years)	Year of next Full Assessment
Pollock	Full	3	1	2018
Pacific cod	Full	3	1	2018
Sablefish	Full	3	1	2018
Northern and southern rock sole	Full	3	4	2021
Shallow water flatfish	Full	5	4	2021
Deepwater flatfish (Dover)	Partial	3/6	4	2019
Rex sole	Full	5	4	2021
Arrowtooth flounder	Full	3	2	2019
Flathead sole	Full	3	4	2021
Pacific ocean perch	Full	3	2	2019
Northern rockfish	Partial	3	2	2018
Shortraker rockfish	Full	5	2	2019
Other rockfish	Full	4/5/6	2	2019
Rougheye & blackspotted rockfish	Full	3	2	2019
Dusky rockfish	Partial	3	2	2018
Demersal shelf rockfish	Partial*	4/6	2	2018
Thornyheads	Partial*	5	2	2018
Atka mackerel	Full	6	2	2019
Octopus	Full	6	2	2019
Skates	Full	5	2	2019
Sculpins	Full	5	4	2021
Sharks	None	6	2	2018
Squid	Full	6	2	2019
Forage species	None	eco	2	2018
Grenadiers (BSAI/GOA)	None	eco	4	2020

* Authors elected to undertake analysis

Economic Summary of the GOA commercial groundfish fisheries in 2015-16

The ex-vessel value of all Alaska domestic fish and shellfish catch, which includes the amount paid to harvesters for fish caught, and the estimated value of pre-processed fish species that are caught by catcher/processors, decreased from $1,781 million in 2015 to $1,717 million in 2016. The first wholesale value of 2016 groundfish catch after primary processing was $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.

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 $444 million or 26% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to $270 million or

16% of the total for Alaska and exceeded the value of Pacific halibut (*Hippoglossus stenolepis*) with $119 million or 7% of the total for Alaska.

The Economic SAFE report (appendix bound separately) contains detailed information about economic aspects of the groundfish fisheries, including figures and tables, economic performance indices, catch share fishery indicators, product price forecasts, a summary of the Alaskan community participation in fisheries, an Amendment 80 fishery economic data report (EDR) summary, an Amendment 91 fishery economic data report (EDR) and vessel master survey summary, market profiles for the most commercially valuable species, a summary of the relevant research being undertaken by the Economic and Social Sciences Research Program (ESSRP) at the Alaska Fisheries Science Center (AFSC), and a list of recent publications by ESSRP analysts. Beginning in this report, data tables have been re-organized and are now divided into four relatively distinct sections: (1) All Alaska, (2) BSAI, (3) GOA, and (4) Pacific halibut. Additionally, flatfish and rockfish data are now incorporated into the main data tables (rather than in the appendices in previous years). The figures and tables in the report provide estimates of total groundfish catch, groundfish discards and discard rates, prohibited species catch (PSC) and PSC rates, the ex-vessel value of the groundfish catch, the ex-vessel value of the catch in other Alaska fisheries, the gross product value of the resulting groundfish seafood products, the number and sizes of vessels that participated in the groundfish fisheries off Alaska, vessel activity, and employment on at-sea processors. Appendices contain global whitefish production from the FAO, fisheries export data from the Census Bureau, employment data from the Alaska Dept. of Labor, and alternative ex-vessel pricing and value based on CFEC fish tickets. Generally, the data presented in this report cover 2012 - 2016, but limited catch and ex-vessel value data are reported for earlier years to illustrate the rapid development of the domestic groundfish fishery in the 1980s and to provide a more complete historical perspective on catch. The data behind the tables from this and past Economic SAFE reports are available online at:
www.afsc.noaa.gov/refm/Socioeconomics/SAFE

Decomposition of the change in first-wholesale revenues from 2015-16 in the GOA

The following brief analysis summarizes the overall changes that occurred between 2015-16 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2017 Economic SAFE report, the ex-vessel value of GOA groundfish decreased from $208 million in 2015 to $189 million in 2016 (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the Gulf of Alaska (GOA) were relatively flat between 2015 ($354 million) and 2016 ($353 million) (Figure 4). At the same time, the total quantity of groundfish products from the GOA increased from 126 thousand metric tons to 135 thousand metric tons, a 7% increase. These changes in the GOA are comparable to those in the BSAI, which together account for the 4% year-to-year increase in first-wholesale revenues from Alaska groundfish fisheries overall.

By species group, negative quantity effects were offset somewhat by smaller positive price effects for Pacific cod, but still resulting in a $12 million net decrease in first-wholesale revenues from the GOA for 2015-16 (Figure 5). This was countered to an extent by positive price and negative quantity effects for sablefish resulting in a positive net effect of $9 million. For pollock, large negative price and positive quantity effects mostly canceled each other out, resulting in a small positive net effect of about $1 million. There was also a small negative price effect and larger positive quantity effect for rockfish, resulting in a net positive effect of almost $3 million. By product group, small positive price effects coupled with larger positive quantity effects in the fillets category resulted in a positive net effect of $32 million in the GOA first-wholesale revenue decomposition for 2015-16, while negative price and quantity effects in the whole and head and gut category and negative quantity effects for roe resulted in a negative net effect of $36 million combined.

In summary, first-wholesale revenues from the GOA groundfish fisheries decreased by less than $1 million from 2015-16. The main drivers of this was a negative net revenue effect for Pacific cod being offset by positive net effects for sablefish. In comparison, first-wholesale revenues increased by $93 million from

2015-16 in the BSAI due in large part to positive price effects for flatfish and pollock, and positive quantity effects for Pacific cod.

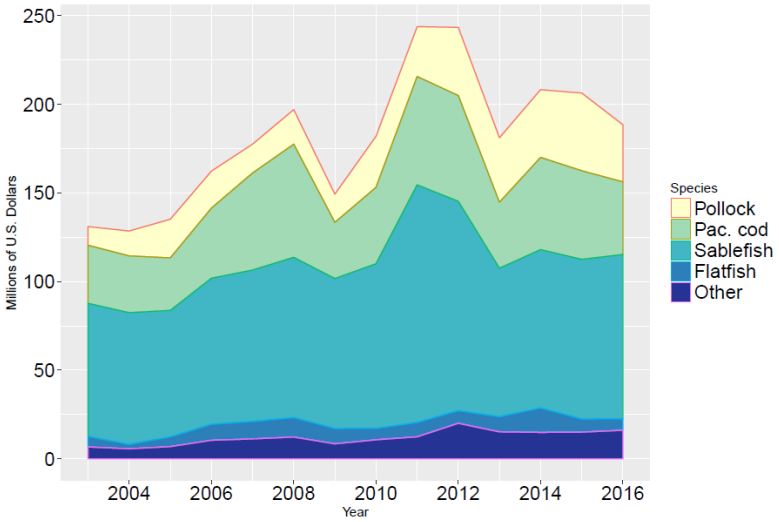

Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2003-2016 (base year = 2016).

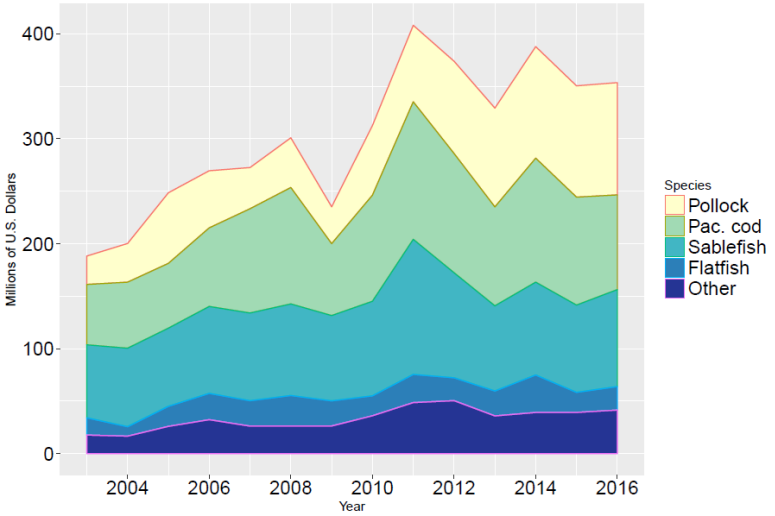

Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2003-2016 (base year = 2016).

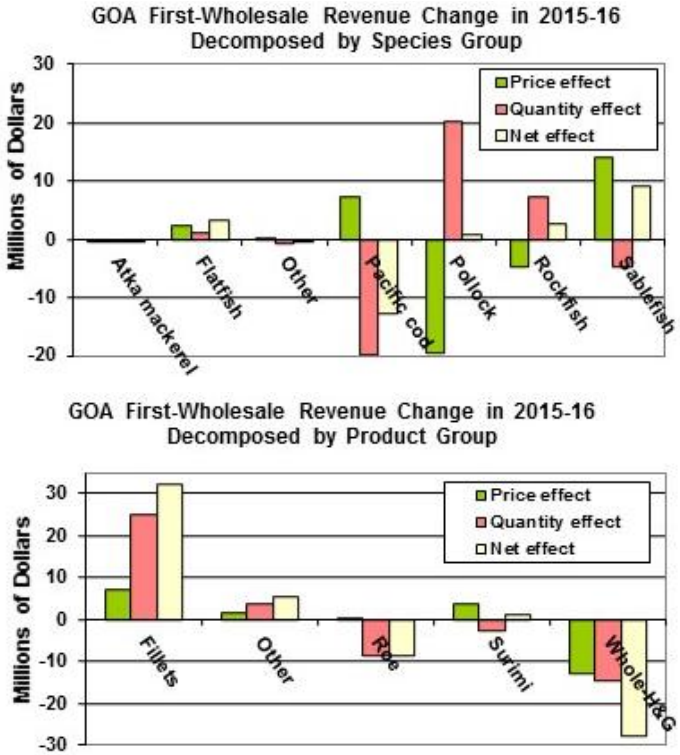

Figure 5. Decomposition of the change in first-wholesale revenues from 2015-16 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the 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. Year-to-year changes in the total quantity of first-wholesale groundfish products include changes in total catch and the mix of product types (e.g., fillet vs. surimi).

Ecosystem Considerations summary

The *Ecosystem Considerations 2017: Status of Alaska's Marine Ecosystems* chapter consists of four main components:

1) an executive summary with ecosystem report cards, and physical, environmental, ecosystem, fishing, and fisheries trends,
2) responses to SSC comments,
3) an ecosystem assessment, and
4) ecosystem indicators.

The ecosystem assessment section combines information from the stock assessment chapters with the indicators followed in this chapter to summarize the climate and fishery effects on the ecosystem. An updated Gulf of Alaska ecosystem assessment was presented including 2017 Gulf of Alaska Report Cards. For 2017, two separate report cards were produced, one for the Western GOA and one for the Eastern GOA.

The **Western GOA** (which includes the CGOA and WGOA NMFS management areas) report card includes ten indicators summarized as follows:

- The Gulf of Alaska in 2017 continued with warm conditions but have moderated since the extreme heat wave of 2014–2016. The PDO remains in a positive pattern but with lower amplitude.
- The freshwater runoff into the GOA appears to have been greater than normal during the fall of 2016 and somewhat less than normal in summer 2017, with implications for the baroclinic component of the Alaska Coastal Current.
- Mesozooplankton biomass measured by the continuous plankton recorder has often shown a largely biennial trend, however biomass remained greater than average in 2014 – 2016. Biomass trends can be influenced by ecosystem conditions and mean size of the community. This suggests that prey availability for planktivorous fish, seabirds, and mammals has been variable recently. The biennial patterns suggest a possible link with biennially varying planktivorous pink salmon abundance which have shown lower than expected marine survival for the 2015 and 2016 outmigration year classes.
- Copepod community size remained small for the fourth consecutive year. The prevalence of small copepods fits predictions of warm conditions favoring small copepods. This suggests that planktivorous predators may have had to work harder to fill nutritional needs from the numerous, but small, prey items.
- Bottom trawl survey biomass of motile epifauna was below its long-term mean for the first time since 2001. The increase from 1987 to 2001 was driven by hermit crabs and brittle stars, which continue to dominate the biomass. Octopus catches, which were record high in 2015, declined to a low not seen since 1990.
- Trends in capelin as sampled by seabirds and groundfish have indicated that capelin were abundant from 2008 to 2013, but declined in during the warm years of 2015–2016. Their apparent abundance coincided with the period of cold water temperatures in the Gulf of Alaska. Preliminary reports suggest that predators were again foraging on capelin in 2017.
- Fish apex predator biomass during 2017 bottom trawl surveys was at its lowest level in the 30-year time series, and the recent 5-year mean is below the long-term average. The trend is driven primarily by Pacific cod and arrowtooth flounder which were both at the lowest abundance in the survey time series. Pacific halibut and arrowtooth flounder have shown a general decline since their peak survey biomasses in 2003. Pacific cod has continued to decline from a peak survey biomass in 2009.
- Black-legged kittiwakes had moderate reproductive success in 2017 at the Semedi Islands, in contrast to the complete failure in 2015 for kittiwakes as well as other seabird species. Their reproductive success is typically variable, presumably reflecting foraging conditions prior to the breeding season, during, or both. In general, fish-eating seabirds had less successful reproduction in 2017 than mixed fish and plankton-eating seabird species.
- Modelled estimates of western Gulf of Alaska Steller sea lion non-pup counts were approaching the long-term in 2016, suggesting conditions had been favorable for sea lions in this area. However, preliminary estimates show a decline in the number of pups from 2015 to 2017 and declines in the number of non-pups in the Cook Inlet, Kodiak, and Semidi area.
- Human populations in the small (<1500 people) fishing communities in the western Gulf of Alaska remained stable as a whole since 2000.

The **Eastern GOA** report card includes ten active indicators summarized as follows:

- The Gulf of Alaska in 2017 continued with warm conditions but have moderated since the extreme heat wave of 2014–2016. The neutral El Niño of last winter has lessened, and La Niña conditions are slightly more favored that neutral for next winter.

- The sub-arctic front was farther south than usual, which was consistent with surface currents. Strong winter winds from the north impelled the PAPA trajectory index to its most southerly latitude since the late 1930s. This represented a substantial change from the northerly surface current pattern during the previous three winters.
- Total zooplankton density in Icy Strait increased in 2016 relative to the previous three years but remained lower than the peak values in 2006–2009. Zooplankton were numerically dominated by gastropods and small copepods, while large copepod and euphausiid densities remained below average.
- Also in Icy Strait, the increase in large and decrease in small copepod abundances in 2016 relative to the previous year resulted in an increase in copepod community size. However, the low abundances of all copepods do not indicate substantially improved foraging conditions for planktivorous predators.
- Bottom trawl survey biomass of motile epifauna is typically dominated by brittle stars and a group composed of sea urchins, sand dollars and sea cucumbers. Record catches of hermit crabs influenced the peak biomass estimate in 2013. Catches of many of the more dominant members of this foraging guild were low in 2015. Brittle stars and miscellaneous crabs were the most abundant in 2017.
- A decrease in estimated total mature herring biomass in southeastern Alaska has been observed since the peak in 2011. Modeling indicates that the declines in biomass may be related to lower survival.
- Bottom-trawl survey fish apex predator biomass is currently below its 30-year mean, following a peak in 2015. The trend is driven primarily by arrowtooth flounder which caught in great numbers in 2015. Pacific halibut and sablefish, the next most abundant species in this foraging guild have shown variable but generally stable trends in recent surveys. Pacific cod were at their lowest abundance in the time series in 2017, but had been at their highest relative abundance in 2015.
- Growth rates of piscivorous rhinoceros auklet chicks were anomalously low in 2015 and 2016, suggesting that the adult birds were not able to find sufficient prey to support successful chick growth. This is in contrast to 2012 and 2013, when chick growth rates were above the long-term average.
- Modelled estimates of eastern Gulf of Alaska Steller sea lion non-pup counts are above the long term mean through 2015. However, preliminary estimates suggest that non-pup counts declined 12% in 2017 relative to 2015. This unusual recent decline in a long-increasing stock may indicate adverse responses to the marine heat wave of recent years.
- Human populations in the small (<1500 people) fishing communities in the eastern Gulf of Alaska have remained stable in recent years following a gradual decline since peak population counts in thee mid-1990s.

There were two "hot topics" noted for the GOA this year:

Pyrosomes seen for first time in Gulf of Alaska research surveys - Researchers observed *Pyrosoma atlanticum* in three types of Alaska fish surveys this year — NOAA's acoustic, surface and bottom trawl surveys. Fishermen first reported seeing the organisms when trolling for salmon off Sitka, AK in February.

LEO Network - The NMFS AFSC is interested in documenting and learning from citizen science observations that may be incorporated into future Ecosystem Status Reports (ESRs). They have identified the LEO Network as a potential platform for tracking these observations. They are seeking Council input on the utilization of this network to gather citizen science observations on marine environment changes for future ESRs. Other citizen science efforts exist in Alaska, but these efforts are mostly project specific (e.g., bird spotting and identification) or community specific.

Stock summaries

1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017. The GOA-wide and W/C/WYAK ABCs listed in this table are before reductions for the Prince William Sound GHL. However, the federal TACs from earlier years reflect reductions from the ABC due to State waters GHL. State waters GHL is presently computed as 2.5% of the total W/C/WYAK ABC. The ABC for 2019 is lower than Max ABC as it was based on an adjusted F40% harvest rate.

Area	Year	Age 3+ Bio.	OFL	ABC	TAC	Catch
GOA	2016	1,981,987	349,310	274,150	257,872	173,226
	2017	1,391,290	249,033	213,689	208,595	184,243
	2018	1,124,930	198,756	170,265		
	2019		142,867	115,341		
W/C/WYAK	2016	1,981,987	336,084	264,230	247,952	173,226
	2017	1,391,290	235,807	203,769	198,675	184,243
	2018	1,124,930	187,059	161,492		
	2019		131,170	106,568		
SEO	2016	44,087	13,226	9,920	9,920	0
	2017	44,087	13,226	9,920	9,920	0
	2018	38,989	11,697	8,773		
	2019		11,697	8,773		

Changes from the previous assessment

This year's pollock assessment features the following new data: 1) 2016 total catch and catch-at-age from the fishery, 2) 2017 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2017 biomass and length composition from NMFS bottom trawl survey, 4) 2017 biomass and 2016 age composition from the ADFG crab/groundfish trawl survey, and 5) 2017 biomass and length composition from the summer GOA-wide acoustic survey.

The age-structured assessment model used for GOA W/C/WYAK pollock assessment was slightly modified from the 2016 assessment (Model 16.2). The 2017 assessment compared 4 models to the Model 16.2 with the new data:

Model 17.1—Age composition data reweighted using the Francis (2011) method.

Model 17.2—Same as model 17.1, but with random walks in survey catchability for the Shelikof Strait acoustic survey and the ADFG survey. This was the author's preferred model.

Model 17.3—Same as 17.2, but a smaller penalty on variation in catchability.

Model 17.4—Same as 17.2, but with an offset for natural mortality for the 2012 year class.

Model 17.1 explored using the Francis (2011) method in place of the McAllister and Ianelli method (1997) used since 2014. While this change reduced the effective sample size of age composition data by 46-86%, the model results did not appear to be particularly sensitive to the weighting method used.

Models 17.2 and 17.3 implemented a random walk process to estimate year specific catchability for the Shelikof Strait and ADF&G trawl surveys, as the proportion of total stock observed by these surveys could be expected to not to be constant. Model 17.3 differs from 17.2 in that the penalty term for annual variation was increased, allowing greater change in year-to-year catchability estimates. Model 17.2 was chosen as being less likely to overfit the data given a stronger constraint on change in catchability.

Model 17.4 implemented a cohort specific natural mortality for the 2012 year class, under the assumption that this may be lower given the dominance of this year class in the current surveys. A 26% reduction in M was estimated by the model, but the improvement in overall fit was negligible and therefore not recommended going forward.

Model 17.2 fits to biomass estimates follow general trends in survey time series. Fits to fishery age composition data were reasonable. The largest residuals tended to be at ages 1-2 in the NMFS bottom trawl survey due to inconsistencies between the initial estimates of abundance and subsequent information about year class size. Model fits to biomass estimates were like previous assessments, and general trends in survey time series were fit reasonably well. The model did not fit the most recent high Shelikof Strait acoustic survey biomass estimate, as this input was in contrast with the NMFS bottom trawl survey in 2017, which was substantially lower than previous years, and an age-structured pollock population cannot increase as rapidly as is indicated by this estimate. The model was unable to fit the extreme low value for the ADFG survey for 2015-2017, though otherwise the fit to this survey was quite good. The fit to the age-1 and age-2 Shelikof acoustic indices appeared adequate though variable.

The Team concurred with the assessment author to use Model 17.2.

Spawning biomass and stock trends

In 1998, the stock dropped below $B_{40\%}$ for the first time since the early 1980s and reached a minimum in 2003 at 25% of unfished stock size. Over the years 2009-2013, the stock increased from 32% to 60% of unfished stock size, but declined to 39% by 2016. The spawning stock is projected to increase again in 2018 as the strong 2012 year class continues to increase in body size. Survey data in 2017 are contradictory, with acoustic surveys indicating large or increasing biomass, and bottom trawl surveys indicating a steep decline in recent years. These divergent trends are likely due to changes in the availability of pollock to different surveying methods, though additional research is needed to confirm this hypothesis. The model estimate of female spawning biomass in 2018 is 342,683 t, which is 57.5% of unfished spawning biomass (based on average post-1977 recruitment) and above the $B_{40\%}$ estimate of 238,000 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Because the model projection of female spawning biomass in 2018 is above $B_{40\%}$, the W/C/WYAK Gulf of Alaska pollock stock is in Tier 3a. The projected 2018 age-3+ biomass estimate is 1,124,930 t (for the W/C/WYAK areas). Markov Chain Monte Carlo analysis indicated the probability of the stock dropping below $B_{20\%}$ is negligible (< 1 %) through 2022. For 2019, F_{ABC} was adjusted downward to $F_{47\%}$ based on the author's recommendation.

The 2018 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 161,492 t which is a decrease of 21% from the 2017 ABC. The OFL is 187,059 t for 2018. The 2018 Prince William Sound (PWS) GHL is 4,037 t (2.5% of the ABC).

For pollock in southeast Alaska (East Yakutat and Southeastern areas), the ABC for both 2018 and 2019 is 8,773 t and the OFL for both 2018 and 2019 is 11,697 t. These recommendations are based on placing southeast Alaska pollock in Tier 5 of the NPFMC tier system, and basing the ABC and OFL on natural mortality (0.3) and the biomass estimate from a random effects model fit to the 1990-2017 bottom trawl survey biomass estimates in Southeast Alaska.

Status determination

The Gulf of Alaska pollock stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

The assessment was updated to include the most recent data available for area apportionments within each season (Appendix C of the GOA pollock chapter). The NMFS bottom trawl survey, typically extending

from mid-May to mid-August, was considered the most appropriate survey time series for apportioning the TAC during the summer C and D seasons. Last year, the Plan Team recommended that summer acoustic survey data be averaged with the random effects model of bottom-trawl survey biomass to determine the summer allocation. Area apportionments, reduced by 2.5% of the ABC (4,037 t in 2018 and 2,664 t in 2019) for the State of Alaska managed pollock fishery in Prince William Sound, are as follows:

Area apportionments (with ABCs reduced by Prince William Sound GHL) for 2018 and 2019 pollock ABCs for the Gulf of Alaska (t).

Year	610 Western	620 Central	630 Central	640 WYAK	650 SEO	Total
2018	30,188	79,495	40,939	6,833	8,773	167,375
2019	19,921	52,459	27,016	4,509	8,773	113,824

2. Pacific cod

Status and catch specifications (t) of Pacific cod in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017.

Year	Age 0+ biomass	OFL	ABC	TAC	Catch
2016	518,800	116,700	98,600	71,925	39,544
2017	426,384	105,378	88,342	64,442	33,115
2018	170,565	23,565	18,000		
2019		21,412	17,000		

Changes from the previous assessment

The fishery catch data was updated for 2016 and 2017 (2017 expected total year catch was projected). Fishery size composition data were updated for 2016, preliminary fishery size composition were included for 2017, and weight and age at length and age compositions for the 2015 bottom trawl survey were included. The AFSC 2017 longline and bottom trawl survey indices of abundance and their corresponding length composition data were included. Length composition data from ADF&G port sampling program were used to augment pot fishery catch composition data where observer data were not present. Both the longline survey and trawl survey indices had steep declines. The 2017 trawl survey biomass estimate was the lowest in the time series and was 58% lower than the 2015 estimate. The longline survey RPN dropped 53% from 2016 to 2017.

The author evaluated several models and presented a subset of models that included the model configuration from 2016 with updated data (Model 17.08.25). Model 17.08.35 was recommended by the author and Team concurred. This model was the best fit to the data and had reasonable retrospective patterns. A major feature of this model that differed from last year's model was having natural mortality (M) estimated in two time blocks; 1) 1977-2014 and 2017 and 2) 2015 and 2016. This feature allowed the model to fit the recent steep declines in the longline and trawl survey indices of abundance that was likely due to temperature related mortality. The protracted warm conditions from 2014-2016 may have resulted in increased metabolic demands for Pacific cod that potentially lead to starvation and mortality. The estimate of M=0.49 during the 1977–2014 and 2017 block was similar to Model 17.08.25 (M=0.47). The estimate of M was 0.71 for the 2015-2016 block.

Another feature of this model was specifying the AFSC longline RPN index to be conditioned on water temperature. This feature allowed the model to be consistent with changing availability of small fish to the longline survey due to bottom temperatures. Smaller fish are encountered more frequently in this survey in warm years than in cold years.

Spawning biomass and stock trends

The $B_{40\%}$ estimate was 67,433 t, with projected 2018 spawning biomass of 36,209 t. Recruitment was generally above average for the 2005-2012 period and below average for 2013-2016. Spawning biomass is expected to decline sharply in the near future.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

This stock is in Tier 3b because the 2018 spawning biomass is estimated to be at $B_{21\%}$. The $F_{35\%}$ and $F_{40\%}$ values are 0.82 and 0.66, respectively. The Tier 3b F_{OFL} and F_{ABC} values are 0.42 and 0.34, respectively. The OFL is 23,565 t and the maximum permissible ABC is 19,401 t. The authors recommended that the F_{ABC} value be reduced to 0.31 to help ensure that the stock does reach the $B_{20\%}$ value. If the Pacific cod stock is projected to be equal to or below $B_{20\%}$, directed fishing is prohibited due to Steller sea lion regulations. The Plan Team concurred with the author's recommended ABC and OFL values. The recommended ABC is 18,000 t for 2018 which is an 80% decrease from the 2017 ABC of 88,342 t.

Status determination

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

Since the 2014 assessment, the random effects model has been used for Pacific cod apportionment. Using this method with the trawl survey biomass estimates through 2017, the area-apportioned ABCs are:

Year	Western	Central	Eastern	Total
2018	8,082	8,118	1,800	18,000
2019	7,633	7,667	1,700	17,000

3. Sablefish

Status and catch specifications (t) of sablefish in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2017 and 2018 are those recommended by the Plan Team. Catch data are current through November 4th, 2017.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2016	122,000	10,326	9,087	9,087	9,354
2017	139,000	11,885	10,074	10,074	10,386
2018	356,000	22,703	11,505		
2019		35,989	16,194		

Relative to last year's assessment, the following substantive changes in the current assessment were made.

Changes in the input data

New data included in the assessment model were relative abundance and length data from the 2017 longline survey, biomass and length data from the 2017 bottom trawl survey, relative abundance, and length data from the 2016 fixed gear fishery, length data from the 2016 trawl fisheries, age data from the 2016 longline survey and 2016 fixed gear fishery, updated catch for 2016, and projected 2017 - 2019 catches. In addition, estimates of killer and sperm whale depredation in the fishery were updated and projected for 2017-2019.

Changes in the assessment methodology

Relative to the 2016 assessment, which adopted several Center for Independent Experts (CIE) review panel recommendations for improving the reference model, there were no changes to the assessment methodology.

New for this year, a new Ecosystem and Socioeconomic Profile (ESP) was presented as an appendix that highlights specific ecosystem indicators that may help explain variability in the stock assessment and included an economic performance report for the sablefish fishery.

Spawning biomass and stock trends

Projected 2018 spawning biomass is 36% of unfished spawning biomass. The longline survey abundance index increased 14% from 2016 to 2017 following a 34% increase between 2015 and 2016. However, the lowest point of the time series occurred in 2015. The fishery abundance index decreased 23% from 2015 to 2016 and is the time series low (the 2017 data are not available yet). Spawning biomass is projected to increase rapidly from 2018 to 2022, and then stabilize.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Sablefish are managed under Tier 3 of NPFMC harvest rules. Reference points were calculated using recruitments from 1977-2013. The updated point estimates of $B_{40\%}$, $F_{40\%}$, and $F_{35\%}$ from this assessment are 98,332 t (combined across the EBS, AI, and GOA), 0.096, and 0.114, respectively. Projected female spawning biomass (combined areas) for 2018 is 88,928 t (90% of $B_{40\%}$ or $B_{36\%}$), placing sablefish in Tier 3b.

The authors recommended ABCs for 2018 and 2019 that are lower than maximum permissible ABC and the Team concurred for two important reasons. First, a lower ABC than maximum permissible was recommended based on estimates of whale depredation occurring in the fishery in the same way that was recommended and accepted in 2017. Second, the 2014 year class is estimated to be 2.5 times higher than any other year class observed in the current recruitment regime. Thus, the recruitment estimate for the 2014 year class was set equal to the 1977 recruitment estimate because there are concerns regarding the lack of older fish and spawning biomass, the uncertainty surrounding the estimate of the strength of the 2014 year class, and the uncertainty about the environmental conditions that may affect the success of the 2014 year class.

The maximum permissible value of F_{ABC} under Tier 3b is 0.086. After accounting for the uncertainty surrounding the extremely high 2014 recruitment estimate and whale depredation, the authors' recommended F_{ABC} equals 0.077, which results in a recommended 2018 ABC of 11,505 t for the GOA. The OFL fishing mortality rate is 0.102 which results in a 2017 OFL of 22,073 t for the GOA.

Status determination

Model projections indicate that this stock is not subject to overfishing, overfished, nor approaching an overfished condition.

Area apportionment

Apportionments have been held constant since the 2013 fishery and the Teams concurred:

	2017			2018		2019	
Region	**OFL**	**ABC**	**TAC**	**OFL**	**ABC**	**OFL**	**ABC**
W	--	1,349	1,349	--	1,544	--	2,174
C	--	4,514	4,514	--	5,158	--	7,260
**WYAK	--	1,605	1,605	--	1,829	--	2,573
SEO	--	2,606	2,606	--	2,974	--	4,187
GOA	**11,885**	**10,074**	**10,074**	**22,703**	**11,505**	**35,989**	**16,194**
BS	1,499	1,274	1,274	2,887	1,464	4,576	2,061
AI	2,044	1,735	1,735	3,917	1,988	6,209	2,798
Total	15,428	13,083	13,083	29,507	14,957	46,775	21,053

* 95:5 split in the EGOA following the trawl ban in SEO

4. Shallow water flatfish

Status and catch specifications (t) of shallow water flatfish and projections for 2018 and 2019. The shallow water complex is comprised of northern rock sole, southern rock sole, yellowfin sole, butter sole, starry flounder, English sole, sand sole and Alaska plaice. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	303,299	54,520	44,364	36,763	3,808
2017	299,858	54,583	44,514	36,843	2,481
2018	339,152	67,240	54,688		
2019		68,114	55,422		

Changes from the previous assessment

A full assessment for shallow water flatfish was presented. Age structured assessment models are used for northern and southern rock sole, and the random effects model is used for the remaining tier 5 species in the shallow water flatfish complex (as well as for apportionment). The northern and southern rock sole assessment model was updated with data through 2017, including updated 2016 catch and estimated 2017 catch, 2017 trawl survey biomass, 2017 fishery length composition, 2017 trawl survey length composition, and 2015 trawl survey conditional-age-at-length (CAAL). The random effects model was updated with 2017 trawl survey biomass.

The author's recommended change to the rock sole assessment models for 2017 incorporated the time series of trawl survey length compositions and removed the age compositions. The age data from the trawl survey is employed within the CAAL framework. The Plan Team concurred with the use of this model.

Spawning biomass and stock trends

The complex total current biomass estimate for 2018 is 339,152 t, which is a 13% increase from the 2017 value of 299,858 t. This increase is due primarily to an increase in the model estimate of both northern and southern rock sole and 2017 survey estimates that were higher than 2015 for yellowfin sole, starry flounder, sand sole, and Alaska plaice (estimated from the random effects model). The random effects model estimates for 2017 biomass of butter sole and English sole were smaller than estimated in 2017. On the whole, the random effects model estimated an increase in biomass in 2017 compared to 2015 for the complex combined.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Northern and southern rock sole are in Tier 3a while the other species in the complex are in Tier 5. The GOA Plan Team agrees with authors' recommended ABC for the shallow water flatfish complex which was equivalent to maximum permissible ABC. For the shallow water flatfish complex, ABC and OFL for southern and northern rock sole are combined with the ABC and OFL values for the rest of the shallow water flatfish complex. This yields a combined ABC of 54,688 t and OFL of 67,240 t for 2018.

Status determination

Information is insufficient to determine stock status relative to overfished criteria for the complex as a whole. For the rock sole species, the assessment model indicates they are not overfished nor are they approaching an overfished condition. Catch levels for this complex remain below the TAC and below levels where overfishing would be a concern.

Area apportionment

The recommended apportionment percentages based on the random effects model applied to survey biomass estimates for ABC are:

Year	Western	Central	WYAK	SEO	Total
2018	25,206	25,315	2,242	1,925	54,688
2019	25,544	25,655	2,272	1,951	55,422

5. Deepwater flatfish complex (Dover sole and others)

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2018 and 2019. Biomass for each year is for Dover sole only and corresponds to the model estimate associated with the ABC for that year. Catch data in this table are current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	141,824	11,102	9,226	9,226	238
2017	143,333	11,182	9,292	9,292	241
2018	144,654	11,294	9,385		
2019		11,431	9,499		

The deepwater flatfish complex is comprised of Dover sole, Greenland turbot, and deepsea sole. This complex is assessed every fourth year and was last assessed in 2015 and will be assessed again in 2019. In non-assessment years, such as 2017, an executive summary is completed to recommend harvest levels for the next two years.

Changes from the previous assessment

For Dover sole, a single species projection model was run using parameter values from the accepted 2015 assessment model and using updated catch information for 2015-2017.

Greenland turbot and deepsea sole are Tier 6 stocks, and accordingly, ABCs and OFLs are based on historical catch levels and these quantities were not updated. ABCs and OFLs for the individual species in the deepwater flatfish complex are determined and then summed for calculating complex-level OFLs and ABCs.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Dover sole is a Tier 3 stock and is assessed using an age-structured model. The single species projection model was run using parameter values from the accepted 2015 Dover sole assessment model. The 2018 and 2019 Dover sole ABCs are 9,202 t and 9,316 t, respectively, and 2018 and 2019 OFLs of 11,050 t and 11,187 t, respectively.

For the Tier 6 species in the complex, 2018 and 2019 OFL (average catch from 1978–1995) is 244 t, and ABC (75%OFL) is 183 t.

The GOA Plan Team agrees with the authors' recommendation to use the combined ABC and OFL for the deepwater flatfish complex for 2018 and 2019. This equates to a 2018 maximum permissible ABC of 9,385 t and OFL of 11,294 t for the deepwater flatfish complex, and a 2019 maximum permissible ABC of 9,499 t and OFL of 11,431 t.

Status determination

Gulf of Alaska Dover sole is not being subjected to overfishing, and is neither overfished nor approaching an overfished condition. Information is insufficient to determine stock status relative to overfished criteria for Greenland turbot and deepsea sole. Since Dover sole comprises approximately 98% of the deepwater flatfish complex they are considered the main component for determining the status of this stock complex. Catch levels for this complex remain well below the TAC and below levels where overfishing would be a concern.

Area apportionment

The random effects model is used to determine area apportionment for Dover sole and was recommended by the GOA Plan Team in 2016. The Greenland turbot and deepsea sole portion of the apportionment is based on the relative proportion of survey biomass of these species found in each area, averaged over the years 2005-2015. The ABC by area for the deepwater flatfish complex is then the sum of the species-specific portions of the ABC.

Year	Western	Central	WYAK	SEO	Total
2018	413	3,400	3,239	2,332	9,385
2019	416	3,442	3,279	2,361	9,499

6. Rex Sole

Status and catch specifications (t) of rex sole and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	67,941	9,791	7,493	7,493	1,748
2017	75,359	10,860	8,311	8,311	1,410
2018	97,982	18,706	15,373		
2019		17,692	14,529		

Changes from the previous assessment

Rex sole are now assessed on a four year cycle. The recommended model added new assessment inputs including updated fishery catch and length data (2015-2017); new 2017 bottom trawl survey biomass estimates and length compositions; new 2015 bottom trawl survey age-at-length data; and newly available historical fishery age data. In addition, this model added a likelihood component to fit the model to fishery age composition data; estimated growth within the assessment model using a conditional age-at-length approach; and split the model into two areas with growth estimated within each area to account for differences in length-at-age between the Eastern GOA and Western-Central GOA. The Team supported use of the author's preferred model

The preferred model is a two area model with growth and survey selectivity parameters estimated separately for each region which substantially reduces uncertainty about fishing mortality rates and improves fits to fishery length and age composition data. Key results and reference points were computed for each region separately and then summed to get values for the entire stock.

Spawning biomass and stock trends

The model estimates of female spawning biomass and total biomass (3+) for the Eastern GOA were 9,376 t and 21,338 t and for the Central-Western region were 36,374 t and 76,644 t. Summing these values results in an overall spawning biomass estimate of 45,750 t and a total biomass (3+) of 97,982 t. Spawning biomass and total biomass have been declining since a peak in 2012 and are expected to decline slightly in 2019.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Previously, rex sole were assessed as a Tier 5 stock because reliable fishery reference values were not available. The Team agreed that the recommended model produces reliable estimates of $F_{40\%}$ and $F_{35\%}$ which places rex sole in Tier 3a.

For rex sole in the Eastern GOA the maximum permissible value of F_{ABC} under Tier 3a is 0.25 and in the Western-Central GOA F_{ABC} is 0.23. Combined, the overall ABC for GOA rex sole in 2018 is 15,373 and OFL is 18,706 t. These values are substantially higher than the 2017 ABC of 8,311 t and OFL of 10,860 t, both of which were determined using the previously recommended Tier 5 approach.

Status determination

The Gulf of Alaska rex sole is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Catches are well below TACs and below levels where overfishing would be a concern.

Area apportionment

Area apportionments of rex sole ABC's for 2018 and 2019 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2018	3,086	8,739	1,737	1,811	15,373
2019	2,909	8,236	1,657	1,727	14,529

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 4th, 2017.

Year	Biomass[1]	OFL	ABC	TAC	Catch
2016	2,103,860	219,430	186,188	103,300	19,830
2017	2,103,090	219,327	186,093	103,300	26,007
2018	1,421,306	180,697	150,945		
2019		173,872	145,234		

[1] Total biomass (ages 1+) from the projection model based on parameters from the age-structured model.

Changes from the previous assessment

There were several changes from the previous assessment. The length-age conversion matrix was estimated from length at age data from 1984-2013, and the weight at age was re-estimated. An ageing error matrix was added, and the age and length and age composition information was weighted with the Francis (2011) method.

Spawning biomass and stock trends

Arrowtooth flounder biomass estimates in the current model have decreased relative to the projection model estimates in 2016. The projected spawning biomass for 2018, assuming fishing mortality equal to the recent 5-year average, was 873,789 t. This was 24% lower than the projected 2018 biomass from the 2016 assessment of 1,154,310 t. The projected estimate of total biomass for 2018 of 1,421,306 t was 32% lower than the estimate from 2016 projection model.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The 2018 ABC of 150,945 t was 11% lower than estimate from the 2016 projection model. Arrowtooth flounder is estimated to be in Tier 3a, and the Team accepted the recommended ABC and OFL.

Status determination

This stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

The recommended area apportionment from the random effects model was used by the Team to provide apportionments for the 2018 and 2019 ABCs:

Year	Western	Central	WYAK	SEO	Total
2018	37,253	73,480	16,468	23,744	150,945
2019	35,844	70,700	15,845	22,845	145,234

8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 4 th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	265,088	42,840	35,020	27,832	2,420
2017	269,638	43,128	35,243	27,856	1,875
2018	281,635	43,011	35,266		
2019		44,822	36,746		

Changes from the previous assessment

Flathead sole are assessed on a biennial schedule. This year a full assessment was conducted but no new changes were made to the assessment methodology. The 2015 assessment model was updated with the most recent fishery catch and length data (2015-2017), 2017 bottom trawl survey biomass and length compositions, and 2015 bottom trawl survey conditional age-at-length data.

Spawning biomass and stock trends

The 2018 spawning biomass estimate (85,765 t) is above $B_{40\%}$ (36,620 t) and projected to be stable through 2019. Total biomass (3+) for 2018 is 281,635 t and is projected to slightly increase in 2019.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Flathead sole are determined to be in Tier 3a. For 2018 the Plan Team concurred with the authors' recommendation to use the maximum permissible ABC of 35,266 t which is nearly identical to the 2017 ABC of 35,243 t. The F_{OFL} is set at $F_{35\%}$ (0.40) which corresponds to an OFL of 43,011 t.

Status determination

The Gulf of Alaska flathead sole stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Catches are well below TACs and below levels where overfishing would be a concern.

Area apportionment

Area apportionments of flathead sole ABC's for 2018 and 2019 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SE	Total
2018	12,690	20,238	1,932	406	35,266
2019	13,222	21,087	2,013	424	36,746

9. Pacific Ocean Perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model; catch data are current through November 4, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	457,768	28,431	24,437	24,437	23,127
2017	445,672	27,826	23,918	23,918	22,919
2018	511,924	34,762	29,236		
2019		34,010	28,605		

Changes from the previous assessment

Changes to the input data include updated survey biomass estimates for 2017, survey age compositions for 2015, fishery age composition for 2014 and 2016, final catch for 2015 and 2016, and preliminary catch and projected catches for 2017-2019. The fishery length composition data was changed to 1 cm length bins with a plus group of 45 cm. The 1984 and 1987 bottom trawl survey biomass and age composition data were removed from the assessment.

Two changes to the 2015 assessment model were recommended for this year: 1) bottom trawl survey biomass is fit with a log-normal distribution; and 2) an additional fishery selectivity time period (2007-present) was added to accommodate the Central GOA rockfish program and the availability of older fish to the fishery.

Spawning biomass and stock trends

There was a 22% increase in ABC and 13% increase in spawning biomass from 2017 to 2018, and the spawning stock biomass is projected to decrease by 1.4% from 2018 to 2019. Total biomass has been increasing since the early 1980s.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA Pacific ocean perch stock is in Tier 3a. The Team accepted the author recommended model resulting in an estimated maximum permissible ABC of 29,236 t ($F_{ABC} = F_{40\%}$ of 0.094). The F_{OFL} is specified to be equal to the $F_{35\%}$ (0.113) and results in an OFL of 34,762 t.

Status determination

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

The following table shows the recommended apportionment for 2018 and 2019 from the random effects model.

Area apportionment	Western	Central	Eastern	Total
2018 Area ABC (t)	3,312	20,112	5,812	29,236
2019 Area ABC (t)	3,240	19,678	5,687	28,605

Amendment 41 prohibited trawling in the Eastern GOA east of 140° W longitude. Trawling is allowed in the W. Yakutat (between 147° W and 140° W) portion of the Eastern GOA, and the proportion of Eastern GOA biomass is 0.58, smaller than the estimate of 0.61 from the 2015 assessment. The random effects

model was not applied for the WYAK and EYAK/SEO split and the weighting method of using upper 95% confidence of the ratio in biomass between these two areas used in previous assessments was continued. This results in the following apportionment of the Eastern Gulf area:

Area apportionment	W.Yakutat	E.Yakutat/ Southeast	Total
2018 Area ABC (t)	3,371	2,441	5,812
2019 Area ABC (t)	3,298	2,389	5,687

In 2012, the Plan Team and SSC recommended combined OFLs for the Western, Central, and West Yakutat areas (W/C/WYK) because the original rationale of an overfished stock no longer applied. However, because of concerns over stock structure, the OFL for SEO remained separate to ensure this unharvested OFL was not utilized in another area. The Council adopted these recommendations. This results in the following apportionment for the W/C/WYK area:

Area apportionment	Western/Central/ W.Yakutat	E.Yakutat/ Southeast	Total
2018 Area OFL (t)	31,860	2,902	34,762
2019 Area OFL (t)	31,170	2,840	34,010

10. Northern Rockfish

Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017. Note that for management purposes, northern rockfish in the EGOA are managed in the other rockfish complex, which is 4 t in 2018 and 3 t in 2019, respectively, from the northern rockfish ABC.

Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2016	77,596	4,783	4,004	4,004	3,437
2017	75,028	4,522	3,790	3,786	1,779
2018	74,748	4,380	3,685		
2019		3,984	3,350		

Changes from the previous assessment

For Gulf of Alaska northern rockfish in 2017, the authors presented a partial assessment to recommend harvest levels for the next two years. There were no changes in assessment methodology. New data added to the projection model included updated catch data from 2015 (3,944 t) and 2016 (3,437 t), and new estimated catches for 2017-2019.

Spawning biomass and stock trends

The 2018 spawning biomass estimate (28,017 t) is above $B_{40\%}$ (27,983 t) and projected to decrease to 26,512 t in 2019. Total biomass (2+) for 2018 is 74,748 t and is projected to decrease to 73,814 in 2019.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Northern rockfish are estimated to be in Tier 3a in 2018 and 3b in 2019. The Plan Team agreed with the authors' recommendation to use the maximum permissible 2018 ABC and OFL values of 3,685 t and 4,380 t, respectively.

Status determination

This stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

Area apportionments of northern rockfish ABC's for 2018 and 2019 are based on the random effects model applied to GOA bottom trawl survey biomass estimates through 2015 for the Western, Central, and Easter Gulf of Alaska resulting in the following percentage area apportionments: Western 11.40%, Central 88.50% and Eastern 0.01%. Note that the small northern rockfish ABC apportionments from the Eastern Gulf are combined with other rockfish for management purposes. Northern rockfish area apportionments for ABCs in 2018 and 2019:

Year	Western	Central	Eastern	Total
2018	420	3,261	4	3,685
2019	382	2,965	3	3,350

11. Shortraker rockfish

Status and catch specifications (t) of GOA shortraker rockfish and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data for 2017 are current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	57,175	1,715	1,286	1,286	777
2017	57,175	1,715	1,286	1,286	547
2018	38,361	1,151	863		
2019		1,151	863		

Changes from the previous assessment

The last full assessment for Gulf of Alaska shortraker rockfish was in 2015. New data included in this year's full assessment are 2017 survey biomass estimates.

Spawning biomass and stock trends

Applying the random effects model to trawl survey data from 1984–2017 results in a 2018 biomass of 38,361 t for shortraker rockfish, a 33% decrease from the previous year's biomass (57,175 t).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Shortraker rockfish are Tier 5 species for specifications where $F_{\mathrm{ABC}} = 0.75M = 0.0225$, and $F_{OFL} = 0.03$; applying this definition to the biomass results in an ABC of 863 t and an OFL 1,151 t for 2018.

Status determination

Available data are insufficient to determine stock status relative to overfished criteria. This stock was not being subjected to overfishing last year.

Area apportionment

For area apportionment of ABC, the random effects model was fit to area-specific biomass and proportions of survey biomass by area were calculated. The following table shows the recommended area apportionment (t) for 2018 and 2019.

Year	Western	Central	Eastern	Total
2018 and 2019	44 (5.1%)	305 (35.3%)	514 (59.6%)	863 (100.0%)

12. Dusky rockfish

Status and catch specifications (t) of dusky rockfish and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2016	60,072	5,733	4,686	4,686	3,328
2017	57,307	5,233	4,278	4,278	2,587
2018	56,103	4,841	3,957		
2019		4,488	3,668		

Changes in assessment methods and data

Dusky rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. This off-year assessment consists of updating the catch data and running the projection model from the 2015 assessment. There were no changes in the assessment methods. New data added to the projection model included updated 2015 catch and new projected catches for 2016-2018.

Spawning biomass and stock status trends

Estimates of spawning biomass for 2017 and 2019 from the current year (2017) projection model are 23,201 t and 20,151 t, respectively. Both estimates are above the $B_{40\%}$ estimate of 19,707 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The dusky rockfish stock is in Tier 3a. The Plan Team agreed with the authors' recommendation of maximum permissible ABC of 3,957 t from the updated projection model. This ABC is 8% lower than the 2017 ABC of 4,278 t.

Status determination

The stock is not being subject to overfishing, is not currently overfished, nor is it approaching an overfished condition.

Area apportionment

The following table shows the recommended ABC apportionment for 2018 and 2019. The apportionment percentages are the same as in the last full assessment.

Area Apportionment	Western	Central	Eastern	Total
2018 Area ABC (t)	146	3,502	309	3,957
2019 Area ABC (t)	135	3,246	287	3,668

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The ratio of biomass still obtainable in the W. Yakutat area (between 147° W and 140° W) is 0.75. This results in the following apportionment to the W. Yakutat area:

	W. Yakutat	E. Yakutat/Southeast
2018 Area ABC (t)	232	77
2019 Area ABC (t)	215	72

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2018 and 2019. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Total biomass estimates are age-3+ from the age-structured model; catch data are current as of Nov 4, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	41,864	1,596	1,328	1,328	641
2017	41,650	1,594	1,327	1,327	536
2018	45,624	1,735	1,444		
2019		1,715	1,427		

Changes from the previous assessment

Data input changes included the following: Updated catch estimates for 2016, fishery ages for 2014 and 2016, fishery lengths for 2015, a trawl survey biomass estimate for 2017, trawl survey ages for 2015, longline survey relative population numbers (RPN) and lengths for 2016 and 2017. There were no changes to the assessment methodology.

Spawning biomass and stock status trends

The 2018 projected spawning biomass estimate (15,059 t) is above $B_{40\%}$ (8,998 t) and projected to slightly decrease to 14,972 t in 2019

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The rougheye/blackspotted complex qualifies as a Tier 3a stock. For the 2017 fishery, the Plan Team accepts the authors' recommended maximum permissible ABC of 1,444 t ($F_{ABC} = F_{40\%} = 0.04$) and OFL ($F_{OFL}=F_{35\%} = 0.048$) of 1,735 t.

Status determination

This stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition.

Area apportionment

The apportionment percentages have changed with the addition of the 2017 trawl survey biomass. In past assessments, apportionment was based on a 4:6:9 weighted average of the proportion of biomass in each area from the three most recent bottom trawl surveys. The Plan Team and SSC have requested that the random effects model be applied to the bottom trawl survey data. However, the author included the longline survey in the model, and chose to use the weighted average methodology. The following table shows the resulting ABC apportionment for the 2018 and 2019 fishery (from the three survey-weighted average).

	WGOA	CGOA	EGOA	Total
2018 ABC (t)	176	556	712	1,444
2019 ABC (t)	174	550	703	1,427

14. Demersal shelf rockfish

Status and catch specifications (t) of GOA demersal shelf rockfish and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data for 2017 are current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016[1]	10,559	364	218	211	117
2017[1]	10,347	357	227	124	124
2018[1]	11,508	394	250		
2019[1]		394	250		

[1] For 2016–2019, the non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology. Non-yelloweye Tier 6 ABCs and OFLs are added to the Tier 4 yelloweye ABCs and OFLs for total DSR values.

Changes from the previous assessment

Catch information and the average weight of yelloweye rockfish caught in the commercial fishery were updated for 2017. Density estimates from the ROV survey were updated for the State EYKT subdistrict.

The results of a preliminary statistical age-structured assessment model (ASA) are not presented this year due to personnel changes. The ASA will be presented in full in 2018 or 2019; updates to the status quo methodology are presented here.

Spawning biomass and stock trends

The yelloweye rockfish biomass estimate increased from 10,347 t to 11,508 t from 2017 to 2018. The increase in abundance is largely driven by an increased density estimate for CSEO subdistrict – an area closed to directed commercial fishing since 2014 – as well as an increase in mean fish weight in CSEO and SSEO subdistricts.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Under Tier 4 for yelloweye rockfish the overfishing level (OFL) was set using $F_{35\%}$=0.032; which equates to 394 t for 2018. As in the past F_{ABC} is set based on F=M=0.02 rather than the maximum permissible F. This results in an ABC for 2018 of 250 t, up slightly from that recommended for 2017.

Status determination

The DSR stock complex in the SEO district of the Gulf of Alaska is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable.

Area apportionment

The ABC and OFL for DSR are for the SEO District. DSR management is deferred to the State of Alaska and any further apportionment within the SEO District is at the discretion of the State.

15. Thornyheads

Status and catch specifications (t) of thornyheads in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data for 2017 are current through November 4, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	87,155	2,615	1,961	1,961	1,119
2017	87,155	2,615	1,961	1,961	1,012
2018	90,570	2,717	2,038		
2019		2,717	2,038		

Changes from previous assessment

In 2017, the North Pacific Fishery Management Council reviewed the frequency for groundfish stock assessments, and recommended that the thornyhead complex remain on a biennial assessment schedule with full assessments in even years and no stock assessments in odd years. Although not required, a partial assessment was produced this year to better monitor the time series of survey biomass estimates (which have displayed high variability) and evaluate catch relative to ABC, since catch in the western GOA has exceeded the subarea ABC for this area in the past. The partial assessment includes catch estimates (though 17 October 2017) and biomass estimates from the GOA trawl survey from 1984-2017.

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable for thornyheads. The 2017 trawl survey estimate was 10% lower from the 2015 estimate, whereas the 2017 longline survey relative population number was 30% higher than the 2016 estimate, and the 2017 estimates for these two surveys were above their long-term means. The thornyhead complex is a Tier 5 stock, with biomass estimated by applying the random-effects method to the trawl survey biomass time series by region and depth in order to compensate for missing data (i.e., thornyheads are found to 1000m, but deep survey strata are not sampled in in each survey).

The estimated catch to biomass ratios have been below 2% since 1995, and the annual catches during this period have generally been between 30% to 70% of the ABC. The 2017 catch (as of Oct 17) in the western GOA and central GOA are 36% and 23% lower, respectively, than the 2016.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team concurred with the author's recommendation for OFL and ABC for 2018 and 2019. Gulf-wide catch of thornyheads in 2016 was 46% of the ABC. The 2018 (and 2019) ABC recommendation (F_{ABC} =0.0225) is 2,038 t and the OFL (F_{OFL} =0.03) is 2,717 t.

Status determination

The thornyhead complex is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable.

Area apportionment

Apportionment is based on random effects estimation of biomass by region, fit to 1984-2017 trawl survey biomass estimates. Subarea ABCs for 2018 and 2019 ABC are:

2018 and 2019	Western	Central	Eastern	Total
ABC	344	921	773	2,038

16. Other rockfish

Status and catch specifications (t) of other rockfish. Biomass estimates for 2018 and 2019 are based on the random effects model for Tier 4 and 5 species. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017. Note that 4 t and 3t of northern rockfish have been added to the 2018 and 2019 ABCs, respectively, for management purposes.

Year	Survey biomass	OFL	ABC	TAC	Catch
2016	104,826	7,424	5,773	2,308	1,283
2017	104,826	7,424	5,773	2,308	1,059
2018	96,107	7,356	5,594		
2019		7,356	5,593		

Changes from the previous assessment

Other rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. New data included in the assessment are 2017 Gulf of Alaska survey biomass estimates and standard errors, and updated total catch for 2003 – 2017. To determine biomass values the random effects time series of biomasses have been updated. ABC/OFL calculations are based on Tier 4, 5, and 6 methods (depending on species). There are no changes to the Tier 4 or 5 methods used in this assessment.

The historical catch time series used for the Tier 6 species was expanded from the 2013 – 2014 time series used in the last assessment to include 2003 – 2016. As in the last assessment, the maximum value of catch during the time series is used. Maximum catches were calculated individually by species and summed for the Tier 6 ABC/OFL.

Spawning biomass and stock trends

For the Tier 4 and 5 species, the estimated biomass of 96,107 t is based on the random effects model. The model indicates stability for this complex. There is considerable variation in individual species biomass estimates that can mostly be attributed to sampling variation as many of these species are not sampled well by the trawl survey.

Tier determination/ Plan Team discussion and resulting ABC and OFL recommendations

The Plan Team agreed with the authors' recommendation of an OFL of 7,424 t and a maximum permissible ABC of 5,594 t and 5,593 t for 2018 and 2019 (including values from the northern rockfish assessment). The Plan Team discussed the appropriateness of moving the demersal sub-group of other rockfish into the DSR assessment (i.e., the Tier 6 species) and make the DSR assessment GOA-wide. The Team reviewed this issue within the context of Council's Stock Structure and Spatial Management Policy. The Team again supported the conclusions of the author and reiterate that the demersal sub-group be moved into the DSR assessment and make the DSR assessment GOA-wide pending Council evaluation of management and economic implications.

Status determination

The other rockfish complex is not being subjected to overfishing. Information is insufficient to determine stock status relative to overfished criteria as estimates of spawning biomass are unavailable. Catch levels for this stock remain below the TAC and below levels where overfishing would be a concern.

Area apportionment

Area apportionment is based on the sum of random effects model biomass (Tier 4/5 species) and catch history (Tier 6 species) by region. The Plan Team again recommends a single ABC for the combined WGOA and CGOA areas to address concerns about the ability to manage smaller ABCs in the WGOA. The apportionments recommended for 2018 and 2019 are:

Year	Other Rockfish	W/C GOA	WYAK	EYAK/SE	Total
2018	ABC (t)	1,737	368	3,489*	5,594
2019	ABC (t)	1,737	368	3,488*	5,593

*Note for management purposes this includes values of northern rockfish from the northern rockfish stock EGOA allocation.

17. Atka mackerel

Status and catch specifications (t) of Atka mackerel in recent years. Atka mackerel are managed under Tier 6 because reliable estimates of biomass are not available. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	-	6,200	4,700	2,000	1,092
2017	-	6,200	4,700	3,000	1,048
2018	-	6,200	4,700		
2019	-	6,200	4,700		

Changes from the previous assessment

Atka mackerel are assessed on a biennial schedule to coincide with the timing of survey data. The last full assessment was conducted in 2015. New information in this year's full assessment includes updated catch data, biomass estimates and length frequency data from the 2017 GOA bottom trawl survey, and age data from the 2016 GOA fisheries.

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable for Atka mackerel. The very patchy distribution of GOA Atka mackerel results in highly variable estimates of abundance. Therefore, survey biomass estimates are considered unreliable indicators of absolute abundance or indices of trend.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Since 1996, the maximum permissible ABC has been 4,700 t under Tier 6 and the OFL has been 6,200 t. The Plan Team continues to recommend that GOA Atka mackerel be managed under Tier 6. The Plan Team recommends a 2018 ABC for GOA Atka mackerel equal to the maximum permissible value of 4,700 t. The 2018 OFL is 6,200 t under Tier 6.

Due to concerns over uncertainty with the ABC estimates using Tier 6, a low TAC is recommended to provide for anticipated incidental catch needs of other fisheries, principally for Pacific cod, rockfish, and pollock fisheries.

Status determination

Information is insufficient to determine stock status relative to overfished criteria. Catches are below ABC and below levels where overfishing would be a concern.

18. Skates

Status and catch specifications (t) of skates in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017.

Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2016	50,857	5,086	3,814	3,814	2,101
	2017	50,857	5,086	3,814	3,814	1,565
	2018	37,975	3,797	2,848		
	2019		3,797	2,848		
Longnose Skate	2016	42,737	4,274	3,206	3,206	1,396
	2017	42,737	4,274	3,206	3,206	1,119
	2018	47,632	4,763	3,572		
	2019		4,763	3,572		
Other Skates	2016	25,580	2,558	1,919	1,919	1,666
	2017	25,580	2,558	1,919	1,919	1,472
	2018	18,454	1,845	1,384		
	2019		1,845	1,384		

Changes from the previous assessment

Skates are assessed on a biennial schedule with full assessments presented in odd years to coincide with the timing of survey data. A full assessment was completed for 2017. There were no changes in methodology but possible shifts in distribution were explored more thoroughly.

New inputs this year were the biomass estimates and length composition data from the 2017 GOA bottom trawl survey, updated groundfish fishery catch data, and fishery length composition data through 2017.

Spawning biomass and stock trends

The 2017 survey biomass estimates for big skates declined substantially from 2015, there were fewer large-sized big skates that were encountered in the survey and fisheries with more small big skates in CGOA and fewer in EGOA. The biomass of the Other Skates declined also, mostly in the CGOA. The longnose skate biomass estimates increased from 2015 to 2017 with estimates increasing in the WGOA and CGOA. Fewer large-sized big skates were caught in the survey and in the fisheries during 2016 and 2017; the population is dominated by smaller individuals. Also, there may be shifts in abundance of big skates to the CGOA from EGOA. For longnose skates, they seem to have moved shallower in the water column.

The application of the RE model to the survey data for each skate category continues to provide reasonable results for biomass estimates.

The catches of big skates are substantially lower than in the years preceding 2014 (particularly 2009-2013). This decrease likely is due to prohibitions on retention of big skates in the CGOA (beginning in 2013), which discouraged "topping-off" behavior that resulted in high levels of catch, particularly for big skates in the CGOA. In January 2016, the Alaska Regional Office indefinitely reduced the maximum retainable amount for all skates in the GOA

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Skates are managed in Tier 5. Applying M=0.1 and 0.75M to the estimated biomass from the random effects models for each stock component, gives stock specific OFLs and ABCs. The Team concurred with this approach as used in the 2016 assessment.

Status determination

Catch as currently estimated does not exceed any gulf-wide OFLs, and therefore, none of the skate stocks are subject to overfishing. It is not possible to determine the status of stocks in Tier 5 with respect to overfished status.

Area apportionment

The author continued the use of the random effects (RE) model that was introduced in the 2016 skate assessment for use in estimating survey biomass. In response to Plan Team and SSC requests, a separate RE model was run for each managed group, and for each regulatory area. The Team concurred with the use of the random effects model for estimating proportions by area. Big and longnose skates have area-specific ABCs and gulf-wide OFLs; other skates have a gulf-wide ABC and OFL.

		ABC			
Years	**Species**	**Western**	**Central**	**Eastern**	**Total**
2018 and 2019	Big skate	504	1,774	570	2,848
	Longnose skate	149	2,804	619	3,572
	other skates				1,384

19. Sculpins

Status and catch specifications (t) of GOA sculpins and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data for 2017 are current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	34,943	7,338	5,591	5,591	1,332
2017	34,943	7,338	5,591	5,591	1,284
2018	33,134	6,958	5,301		
2019		6,958	5,301		

Changes from the previous assessment

GOA sculpins are now being assessed on a quadrennial stock assessment schedule to coincide with the timing of the NMFS bottom trawl survey; prior to 2017, GOA sculpins were assessed biennially. There were no changes to the assessment methodology used in 2017. New information includes 2017 trawl survey biomass estimates and updated catch.

Spawning biomass and stock trends

The stock complex trends overall appear to be stable based on survey data. At the Plan Team's request, the author further explored the decline in survey biomass estimates of bigmouth sculpin; fecundity, fishing mortality, and survey catchability were considered, but no conclusions were drawn (See Plan Team minutes).

Tier determination/Plan Team discussion and resulting ABC and OFL recommendations

The Team concurred with the Tier 5 approach, including the biomass estimates based on the random effects model.

Status determination

There is insufficient data to determine if the sculpin complex is in an overfished condition. Recent catches of sculpins have been well below the ABC first established for the sculpin complex in 2011. The sculpin complex is not currently being subjected to overfishing.

Area apportionment

GOA sculpins are managed gulf-wide.

20. Sharks

In accordance with the approved schedule, **no assessment was conducted** for the shark complex this year; however, a full stock assessment will be conducted in 2018. Until then, the values generated from the previous stock assessment will be rolled over for 2018 specifications. Additional information can be found in the previous full assessment.

Status and catch specifications (t) of the GOA shark complex and projections for 2018 and 2019. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data for 2017 are current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	56,181	6,020	4,514	4,514	2,016
2017	56,181	6,020	4,514	4,514	1,505
2018	56,181	6,020	4,514		
2019		6,020	4,514		

Area apportionment

GOA sharks are managed Gulf-wide.

21. Squid

Status and catch specifications (t) of GOA squid. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 4th, 2017.

Year	OFL	ABC	TAC	Catch
2016	1,530	1,148	1,148	239
2017	1,516	1,137	1,148	44
2018	1,516	1,137		
2019	1,516	1,137		

Changes from the previous assessment

Trawl survey data from 2017 was added to the assessment, and total catch and retention rates were updated. An executive summary was presented in the 2017 SAFE report.

Spawning biomass and stock trends

The 2017 trawl survey biomass estimate was 2,296 t, the lowest it has been since 1999. Reliable estimates of spawning biomass and stock trends are unavailable. Squid catch in 2017 was low compared to recent prior years. Squid retention rates are variable but indicate that many captured squids were retained.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Since reliable estimates of biomass do not exist, the squid complex is in Tier 6. The Plan Team concurred with the author's recommendation to set the OFL equal to the maximum historical catch between 1997 and 2007 (1,516 t) and the ABC equal to 0.75 x OFL (1,137 t).

Status determination and area apportionment

As a Tier 6 stock, there is insufficient data to determine if the squid complex is in an overfished condition or being subject to overfishing and therefore the status is unknown. This complex is managed Gulf-wide.

22. Octopus

Status and catch specifications (t) of GOA octopus. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2018 and 2019 are those recommended by the Plan Team. 2017 catches current through November 4th, 2017.

Year	Biomass	OFL	ABC	TAC	Catch
2016	12,271	6,504	4,878	4,878	383
2017	12,271	6,504	4,878	4,878	180
2018	1,539	1,300	975		
2019	1,539	1,300	975		

Changes from the previous assessment
There have been no changes in the assessment methods.

Spawning biomass and stock trends
The most recent data from the 2017 GOA trawl survey and suggested a decrease in octopus biomass.

Tier determination/Plan Team discussion and resulting ABCs and OFLs
The author recommended a biomass estimate based on trawl survey data and a conservative rate of natural mortality be used to set OFL and ABC, as in previous years. The Plan Team, however, recommends that maximum catch be used to set the ABC and OFL. Historically, there was high variability in the biomass estimates including a large decrease in the estimate from 2015 to 2017. Incidental catch of octopus varies greatly from year to year. There is a precedent for maximum catch to be used to set the ABC for other Tier 6 species including squid, sharks, flatfish, and rockfish. The Team believes this method is appropriate and does not have conservation concerns.

Status determination and area apportionment
Biomass estimates for octopuses are unreliable so determination of spawning biomass or stock status is unavailable. The stock is not being subjected to overfishing. This stock is managed Gulf-wide.

Tables

Table 1. Gulf of Alaska groundfish 2018 and 2019 OFLs and ABCs, 2017 TACs, and 2017 catch (reported through November 4th, 2017).

		2017				2018		2019	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	State GHL		5,094	0	-		4,037		2,664
	W(61)		43,602	43,602	49,878		30,188		19,921
	C(62)		98,652	98,652	81,565		79,495		52,459
	C(63)		48,929	48,929	52,760		40,939		27,016
	WYAK		7,492	7,492	40		6,833		4,509
	Subtotal	235,807	203,769	198,675	184,243	187,059	161,492	131,170	106,568
	EYAK/SEO	13,226	9,920	9,920	-	11,697	8,773	11,697	8,773
	Total	249,033	213,689	208,595	184,243	198,756	170,265	142,867	115,341
Pacific Cod	W		36,291	25,404	17,239		8,082		7,633
	C		44,180	33,135	15,823		8,118		7,667
	E		7,871	5,903	53		1,800		1,700
	Total	105,378	88,342	64,442	33,115	23,565	18,000	21,412	17,000
Sablefish	W		1,349	1,349	1,166		1,544		2,174
	C		4,514	4,514	4,767		5,158		7,260
	WYAK		1,605	1,605	1,667		1,829		2,573
	SEO		2,606	2,606	2,786		2,974		4,187
	Total	11,885	10,074	10,074	10,386	22,703	11,505	35,989	16,194
Shallow Water Flatfish	W		20,921	13,250	270		25,206		25,544
	C		19,306	19,306	2,211		25,315		25,655
	WYAK		3,188	3,188	-		2,242		2,272
	EYAK/SEO		1,099	1,099	-		1,925		1,951
	Total	54,583	44,514	36,843	2,481	67,240	54,688	68,114	55,422
Deep Water Flatfish	W		256	256	20		413		416
	C		3,454	3,454	211		3,400		3,442
	WYAK		3,017	3,017	8		3,239		3,279
	EYAK/SEO		2,565	2,565	2		2,332		2,361
	Total	11,182	9,292	9,292	241	11,294	9,385	11,431	9,499
Rex Sole	W		1,459	1,459	48		3,086		2,909
	C		4,930	4,930	1,360		8,739		8,236
	WYAK		850	850	2		1,737		1,657
	EYAK/SEO		1072	1072	-		1,811		1,727
	Total	10,860	8,311	8,311	1,410	18,706	15,373	17,692	14,529
Arrowtooth Flounder	W		28,100	14,500	269		37,253		35,844
	C		107,934	75,000	25,692		73,480		70,700
	WYAK		37,405	6,900	32		16,468		15,585
	EYAK/SEO		12,654	6,900	14		23,744		22,845
	Total	219,327	186,093	103,300	26,007	180,697	150,945	173,872	145,234
Flathead Sole	W		11,098	8,650	73		12,690		13,222
	C		20,339	15,400	1,802		20,238		21,087
	WYAK		2,949	2,949	-		1,932		2,013
	EYAK/SEO		857	857	-		406		424
	Total	43,128	35,243	27,856	1,875	43,011	35,266	44,822	36,746

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Table 1. (continued) Gulf of Alaska groundfish 2018 - 2019 OFLs and ABCs, 2017 TACs, and 2017 catch (reported through November 4th, 2017).

		2017				2018		2019	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Species**	**Area**	**OFL**	**ABC**	**TAC**
Pacific Ocean Perch	W		2,679	2,679	2,686		3,312		3,240
	C		16,671	16,671	17,476		20,112		19,678
	WYAK		2,786	2,786	2,757		3,371		3,298
	W/C/WYAK	25,753	22,136	22,136	22,919	31,860	26,795	31,170	26,216
	SEO	2,073	1,782	1,782	-	2,902	2,441	2,840	2,389
	Total	27,826	23,918	23,918	22,919	34,762	29,236	34,010	28,605
Northern Rockfish	W		432	432	232		420		382
	C		3,354	3,354	1,547		3,261		2,965
	E		4	0	-		4		3
	Total	4,522	3,790	3,786	1,779	4,380	3,685	3,984	3,350
Shortraker Rockfish	W		38	38	43		44		44
	C		301	301	229		305		305
	E		947	947	275		515		515
	Total	1,715	1,286	1,286	547	1,151	863	1,151	863
Dusky Rockfish	W		158	158	123		146		135
	C		3,786	3,786	2,437		3,502		3,246
	WYAK		251	251	22		232		215
	EYAK/SEO		83	83	5		77		72
	Total	5,233	4,278	4,278	2,587	4,841	3,957	4,488	3,668
Rougheye and Blackspotted Rockfish	W		105	105	34		176		174
	C		706	706	328		556		550
	E		516	516	174		712		703
	Total	1,594	1,327	1,327	536	1,735	1,444	1,715	1,427
Demersal shelf rockfish	GOA-wide	357	227	227	124	394	250	394	250
Thornyhead Rockfish	W		291	291	151		344		344
	C		988	988	612		921		921
	E		682	682	249		773		773
	Total	2,615	1,961	1,961	1,012	2,717	2,038	2,717	2,038
Other Rockfish	WC		1,534	1,534	986		1,737		1,737
	WYAK		574	574	42		368		368
	EYAK/SEO		3,665	200	31		3,489		3,488
	Total	7,424	5,773	2,308	1,059	7,356	5,594	7,356	5,593
Atka mackerel	GOA-wide	6,200	4,700	3,000	1,048	6,200	4,700	6,200	4,700
Big Skate	W		908	908	163		504		504
	C		1,850	1,850	1,298		1,774		1,774
	E		1,056	1,056	104		570		570
	Total	5,086	3,814	3,814	1,565	3,797	2,848	3,797	2,848
Longnose Skate	W		61	61	167		149		149
	C		2,513	2,513	685		2,804		2,804
	E		632	632	267		619		619
	Total	4,274	3,206	3,206	1,119	4,763	3,572	4,763	3,572
Other Skates	GOA-wide	2,558	1,919	1,919	1,472	1,845	1,384	1,845	1,384
Sculpins	GOA-wide	7,338	5,591	5,591	1,284	6,958	5,301	6,958	5,301
Sharks	GOA-wide	6,020	4,514	4,514	1,505	6,020	4,514	6,020	4,514
Squids	GOA-wide	1,516	1,137	1,137	44	1,516	1,137	1,516	1,137
Octopuses	GOA-wide	6,504	4,878	4,878	180	1,300	975	1,300	975
Total		796,158	667,877	535,863	298,538	655,707	536,921	604,413	480,187

*Note that the 4 t (2018) and 3 t (2019) of EGOA northern rockfish is excluded from that stock's total as it is managed as part of the EGOA "other rockfish" category (grand totals deduct these since they appear twice in areas).

Table 2. Gulf of Alaska 2018 ABCs, biomass, and overfishing levels (t) for Western, Central, Eastern, Gulf-wide, West Yakutat, and Southeast Outside regulatory areas.

Stock or Assemblage	Tier	Area	Biomass	2018				2019			
				OFL	F_{OFL}	ABC	F_{ABC}	OFL	F_{OFL}	ABC	F_{ABC}
Pollock*	3a	W(61)			0.30	30,188	0.26		0.30	19,921	0.24
		C(62)				79,495				52,459	
		C(63)				40,939				27,016	
		WYAK				6,833				4,509	
		Subtotal	1,124,930	187,059		161,492		131,170		106,568	
	5	EYAK/SEO	38,989	11,697		8,773		11,697		8,773	
		Total				170,265				115,341	
Pacific Cod	3b	W			0.42	8,082	0.31		0.40	7,633	0.31
		C				8,118				7,667	
		E				1,800				1,700	
		Total	170,565	23,565		18,000		21,412		17,000	
Sablefish	3a	W			0.102	1,544	0.077		0.114	2,174	0.085
		C				5,158				7,260	
		WYAK				1,829				2,573	
		EY/SEO				2,974				4,187	
		Total	330,655	22,703		11,505		35,989		16,194	
Shallow water Flatfish	3a, 5	W		25,206	0.462, 0.326[a]	25,206	0.382, 0.271[a]		0.462, 0.326[a]	25,544	0.382, 0.271[a,]
		C		25,315		25,315				25,655	
		WYAK		2,242		2,242				2,272	
		EYAK/SEO		1,925		1,925				1,951	
		Total	339,152	67,240		54,688		68,114		55,422	
Deepwater Flatfish	3a, 6	W			0.12	413	0.1		0.12	416	0.1
		C				3,400				3,442	
		WYAK				3,239				3,279	
		EYAK/SEO				2,332				2,361	
		Total	144,654	11,294		9,385		11,431		9,499	
Rex sole	3a	W			0.31[b] 0.29	3,086	0.25[b] 0.23		0.31[b] 0.29	2,909	0.25[b] 0.23
		C				8,739				8,236	
		WYAK				1,737				1,657	
		EYAK/SEO				1,811				1,727	
		Total	97,982	18,706		15,373		17,692		14,529	
Arrowtooth Flounder	3a	W			0.238	58,295	0.196		0.238	56,089	0.196
		C				62,597				60,229	
		WYAK				12,377				11,909	
		EYAK/SEO				17,676				17,007	
		Total	1,421,306	180,697		150,945		173,872		145,234	
Flathead sole	3a	W			0.36	12,690	0.28		0.36	13,222	0.28
		C				20,238				21,087	
		WYAK				1,932				2,013	
		EYAK/SEO				406				424	
		Total	281,635	43,011		35,266		44,822		36,746	

*The Prince William Sound GHL (2.5% of ABC; 4,037 t in 2018, 2,664 t in 2019) is deducted from the area apportioned pollock ABCs.

[a] F_{OFL} and F_{ABC} values for shallow water flatfish are for Tier 3 northern and southern rock sole.

[b] Rex sole is assessed for two different areas

Table 2. Continued… Gulf of Alaska 2018 ABCs, biomass, and overfishing levels (t) for Western, Central, Eastern, Gulf-wide, West Yakutat, and Southeast Outside regulatory areas.

Stock or Assemblage	Tier	Area	Biomass	2018				2019			
				OFL	F_{OFL}	ABC	F_{ABC}	OFL	F_{OFL}	ABC	F_{ABC}
Pacific Ocean Perch	3a	W			0.113	3,312	0.094		0.113	3,240	0.094
		C				20,112				19,678	
		WYAK				3,371				3,298	
		EYAK/SEO				2,441				2,389	
		Total	511,934	34,762		29,236		34,010		28,605	
Northern Rockfish	3a,3b[a]	W			0.074	420	0.062		0.070	382	0.058
		C				3,261				2,965	
		E				4				3	
		Total	74,748	4,380		3,685		3,984		3,350	
Shortraker	5	W			0.03	44	0.0225		0.03	44	0.0225
		C				305				305	
		E				514				514	
		Total	38,361	1,151		863		1,151		863	
Dusky Rockfish	3a	W				146	0.098			135	
		C				3,502				3,246	0.098
		WYAK				232				215	
		EYAK/SEO				77				72	
		Total	56,103	4,841	0.121	3,957		4,488	0.121	3,668	
Rougheye / Blackspotted Rockfish	3a	W			0.048	176	0.040		0.048	174	0.040
		C				556				550	
		E				712				703	
		Total	45,624	1,735		1,444		1,715		1,427	
DSR	4, 6	Total	10,347[d]	394	0.032[d]	250	0.02[d]	394	0.032[d]	250	0.02[d]
Thornyhead rockfish	5	W			0.03	291	0.0225		0.03	291	0.0225
		C				988				988	
		E				682				682	
		Total	87,155	2,717		2,038		2,717		2,038	
Other Rockfish	4, 5, 6	W				1,737				1,737	
		C			0.079[b]	368	0.065[c]		0.079[b]	368	0.065[c]
		E			0.073[b]	3,489	0.055[c]		0.073[b]	3,488	0.055[c]
		Total	96,107	7,356		5,594		7,356		5,593	
Atka mackerel	6		--	6,200	--	4,700	--	6,200	--	4,700	--
Big Skates	5	W			0.1	504	0.075		0.1	504	0.075
		C				1,774				1,774	
		E				570				570	
		Total	37,975	3,797		2,848		3,797		2,848	
Longnose Skates	5	W			0.1	149	0.075		0.1	149	0.075
		C				2,804				2,804	
		E				619				619	
		Total	47,632	4,763		3,572		4,763		3,572	
Other Skates	5		18,454	1,845	0.1	1,384	0.075	1,845	0.1	1,384	0.075
Sculpins	5		33,134	6,958	0.21	5,301	0.16	6,958	0.21	5,301	0.16
Sharks	6		56,181[e]	6,020	0.097[e]	4,514	0.073[e]	6,020	0.097[e]	4,514	0.073[e]
Squid	6		--	1,516	--	1,137	--	1,516	--	1,137	--
Octopus	6			1,300	--	975	--	1,300	--	975	--
Total		Total		655,853		536,558		604,337		480,190	

[a] Northern rockfish are in Tier 3a for 2018 and Tier 3b for 2019.
[b] F_{OFL} equal to 0.079 for Tier 4 sharpchin and 0.73 for 17 Tier 5 other rockfish species.
[c] F_{ABC} equal to 0.065 for Tier 4 sharpchin rockfish and 0.055 for 17 Tier 5 other rockfish species.
[d] Values listed are for Tier 4 yelloweye rockfish.
[e] Values listed are for spiny dogfish.While spiny dogfish are a Tier 6 species, a Tier 5 approach is used. They are not a Tier 5 because the trawl survey biomass is not considered reliable for the species.

Table 3. Maximum permissible fishing mortality rates and ABCs as defined in Amendment 56 to the GOA and BSAI Groundfish FMPs, and the Plan Team's 2018 and 2019 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum.

			2018		
Species	Tier	*Max* F_{ABC}	*Max* ABC	F_{ABC}	ABC
Pacific cod	3b	0.34	19,401	0.31	18,000
Sablefish	3b	0.086	25,583	0.077	14,957
Demersal shelf rockfish	4, 6	0.026	289	0.02	227
			2019		
Species	Tier	*Max* F_{ABC}	*Max* ABC	F_{ABC}	ABC
Pacific cod	3b	0.32	17,634	0.31	17,000
Walleye pollock	3a	0.26	113,153	0.24	106,568
Sablefish	3b	0.096	41,044	0.085	21,053
Demersal shelf rockfish	4, 6	0.026	289	0.02	227

Table 4. Groundfish landings (metric tons) in the Gulf of Alaska,1956-2017.

Year	Pollock	Pacific cod	sablefish	Flatfish	Arrowtooth Flounder	Slope rockfish[a]
1956			1,391			
1957			2,759			
1958			797			
1959			1,101			
1960			2,142			
1961			897			16,000
1962			731			65,000
1963			2,809			136,300
1964	1,126	196	2,457	1,028		243,385
1965	2,749	599	3,458	4,727		348,598
1966	8,932	1,376	5,178	4,937		200,749
1967	6,276	2,225	6,143	4,552		120,010
1968	6,164	1,046	15,049	3,393		100,170
1969	17,553	1,335	19,376	2,630		72,439
1970	9,343	1,805	25,145	3,772		44,918
1971	9,458	523	25,630	2,370		77,777
1972	34,081	3,513	37,502	8,954		74,718
1973	36,836	5,963	28,693	20,013		52,973
1974	61,880	5,182	28,335	9,766		47,980
1975	59,512	6,745	26,095	5,532		44,131
1976	86,527	6,764	27,733	6,089		46,968
1977	112,089	2,267	17,140	16,722		23,453
1978	90,822	12,190	8,866	15,198		8,176
1979	98,508	14,904	10,350	13,928		9,921
1980	110,100	35,345	8,543	15,846		12,471
1981	139,168	36,131	9,917	14,864		12,184
1982	168,693	29,465	8,556	9,278		7,991
1983	215,567	36,540	9,002	12,662		7,405
1984	307,400	23,896	10,230	6,914		4,452
1985	284,823	14,428	12,479	3,078		1,087
1986	93,567	25,012	21,614	2,551		2,981
1987	69,536	32,939	26,325	9,925		4,981
1988	65,625	33,802	29,903	10,275		13,779
1989	78,220	43,293	29,842	11,111		19,002
1990	90,490	72,517	25,701	15,411		21,114
1991	107,500	76,997	19,580	20,068		13,994
1992	93,904	80,100	20,451	28,009		16,910
1993	108,591	55,994	22,671	37,853		14,240
1994	110,891	47,985	21,338	29,958		11,266
1995	73,248	69,053	18,631	32,273		15,023
1996	50,206	67,966	15,826	19,838	22,183	14,288
1997	89,892	68,474	14,129	17,179	16,319	15,304
1998	123,751	62,101	12,758	11,263 [i]	12,974	14,402
1999	95,637	68,613	13,918	8,821	16,209	18,057
2000	71,876	54,492	13,779	13,052	24,252	15,683
2001	70,485	41,614	12,127	11,817	19,964	16,479
2002	49,300 [j]	52,270	12,246	12,520	21,230	17,128
2003	49,300	52,500	14,345	10,750	23,320	18,678
2004	62,826	43,104	15,630	7,634	15,304	18,194
2005	80,086	35,205	13,997	9,890	19,770	17,306
2006	70,522	37,792	13,367	14,474	27,653	20,492
2007	51,842	39,473	12,265	15,077	25,364	18,718
2008	51,721	43,481	12,326	16,393	29,293	18,459
2009	42,389	39,397	10,910	17,360	24,937	18,621
2010	75,167	58,003	10,086	13,556	24,334	21,368
2011	79,789	62,475	11,148	10,043	30,890	19,612
2012	101,356	56,520	11,914	8,909	20,714	22,334
2013	93,733	51,792	11,945	12,283	21,620	19,367
2014	140,260	62,223	10,422	11,236	36,290	23,360
2015	163,065	55,260	10,313	7,572	19,054	24,915
2016	173,226	42,517	9,354	8,214	19,830	29,265
2017	184,243	33,115	10,386	6,007	26,007	26,840

a Catch defined as follows: (1) 1961-78, Pacific ocean perch (*S.alutus*) only;(2)1979-1987, the 5 species of the Pacific ocean perch complex; 1988-90, the 18 species of the slope rock assemblage;1991-1995, the 20 species of the slope rockfish assemblage.

b Catch from Southeast Outside District.

c Thornyheads were included in the other species category, and are foreign catches only.

d Other species category stabilized in 1981 to include sharks, skates, sculpins, eulachon, capelin (and other smelts in the family Osmeridae and octopus. Atka mackerel and squid were added in 1989. Catch of Atka Mackerel is reported separately for 1990-1992; thereafter Atka mackerel was assigned a separate target species.

e Atka mackerel was added to the Other Species category in1988 and separated out in 1994

f PSR includes light dusky, yellowtail, widow, dark, dusky, black, and blue rockfish; black and blue excluded in 1998, dark in 2008, widow and yellowtail in 2012 (note only dusky remains in PSR since 2012)

g Does not include at-sea discards.

h Catch data reported through November 4th,2017.

i Includes all species except arrowtooth.

j Does not include state fisheries

k Includes all managed skate species

Table 4. (cont'd) Groundfish landings (t) in the Gulf of Alaska, 1956-2017. See legend on previous page for conditions that apply.

Year	Pelagic Shelf rockfish	Demersal shelf rockfish[b]	Thornyheads[c]	Atka mackerel[e]	Skates[k]	Other species[d]	Total
1956							1,391
1957							2,759
1958							797
1959							1,101
1960							2,142
1961							16,897
1962							65,731
1963							139,109
1964							248,192
1965							360,131
1966							221,172
1967							139,206
1968							125,822
1969							113,333
1970							84,983
1971							115,758
1972							158,768
1973							144,478
1974							153,143
1975							142,015
1976							174,081
1977			0	19,455		4,642	195,768
1978			0	19,588		5,990	160,830
1979			0	10,949		4,115	162,675
1980			1,351	13,166		5,604	202,426
1981			1,340	18,727		7,145	239,476
1982		120	788	6,760		2,350	234,001
1983		176	730	12,260		2,646	296,988
1984		563	207	1,153		1,844	356,659
1985		489	81	1,848		2,343	320,656
1986		491	862	4		401	147,483
1987		778	1,965	1		253	146,703
1988	1,086	508	2,786	-		647	158,411
1989	1,739	431	3,055	-		1,560	188,253
1990	1,647	360	1,646	1,416		6,289	236,591
1991	2,342	323	2,018	3,258		1,577	247,657
1992	3,440	511	2,020	13,834		2,515	261,694
1993	3,193	558	1,369	5,146		6,867	256,482
1994	2,990 [f]	540	1,320	3,538		2,752	232,578
1995	2,891	219 [g]	1,113	701		3,433	216,585
1996	2,302	401	1,100	1,580		4,302	199,992
1997	2,629	406	1,240	331		5,409	231,312
1998	3,111	552	1,136	317		3,748	246,113
1999	4,826	297	1,282	262		3,858	231,780
2000	3,730	406	1,307	170		5,649	204,396
2001	3,008	301	1,339	76		4,801	182,011
2002	3,318	292	1,125	85		4,040	173,554
2003	2,975	229	1,159	578		6,339	180,173
2004	2,674	260	818	819	2,912	1,559	171,734
2005	2,235	187	719	799	2,710	2,294	185,211
2006	2,446	166	779	876	3,501	3,526	195,594
2007	3,318	250	701	1,453	3,498	2,928	174,887
2008	3,634	149	741	2,109	3,606	2,776	184,149
2009	3,057	138	666	2,222	7,020	2,870	169,604
2010	3,111	128	565	2,417	5,056	2,042	215,833
2011	2,531	82	612	1,615	4,437	2,362	225,596
2012	4,012	178	746	1,187	4,107	1,940	233,927
2013	3,978	218	1,153	1,277	6,160	6,766	230,292
2014	3,061	105	1,130	1,042	5,199	2,646	296,974
2015	2,781	108	1,034	1,228	4,968	3,808	294,106
2016	3,327	117	1,118	1,092	5,163	3,970	297,193
2017	2,587	124	1,012	1,048	4,156	3,013	298,538