APPENDIX B

STOCK ASSESSMENT AND FISHERY EVALUATION REPORT

FOR THE GROUNDFISH RESOURCES

OF THE GULF OF ALASKA

Compiled by

The Plan Team for the Groundfish Fisheries of the Gulf of Alaska
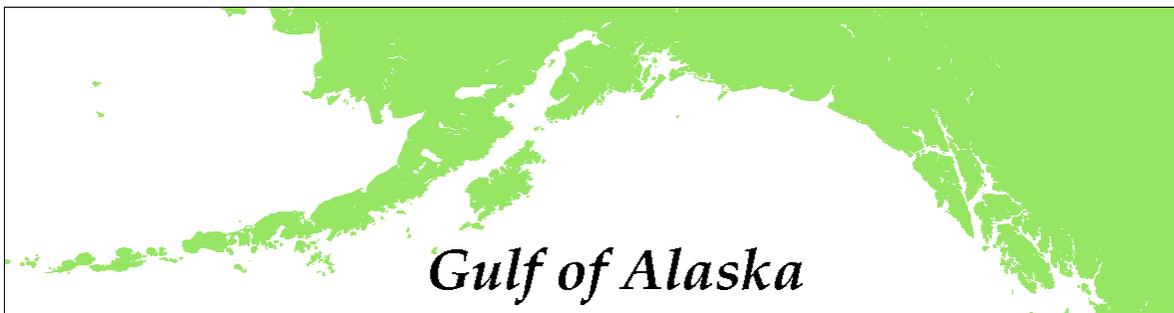
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North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
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Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska

GOA Introduction Contents

NOTE: full chapters are available through links within each summary and via website [HERE](#).

Summary

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 13-16, 2018 to review the status of stocks of twenty-one 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), Chris Lunsford (co-chair), Craig Faunce, Sandra Lowe, Ben Williams, Kresimir Williams, Lisa Hillier, Pete Hulson, 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 subjected 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.

In June 2017, the North Pacific Fishery Management Council (NPFMC) took final action to amend the FMPs for the Bering Sea and Aleutian Islands (Amendment 117) and GOA (Amendment 106) regions and moved the squid stock complex into the ecosystem component category. These amendments were effective August 8, 2018, and the new management regime will be implemented in January 2019.
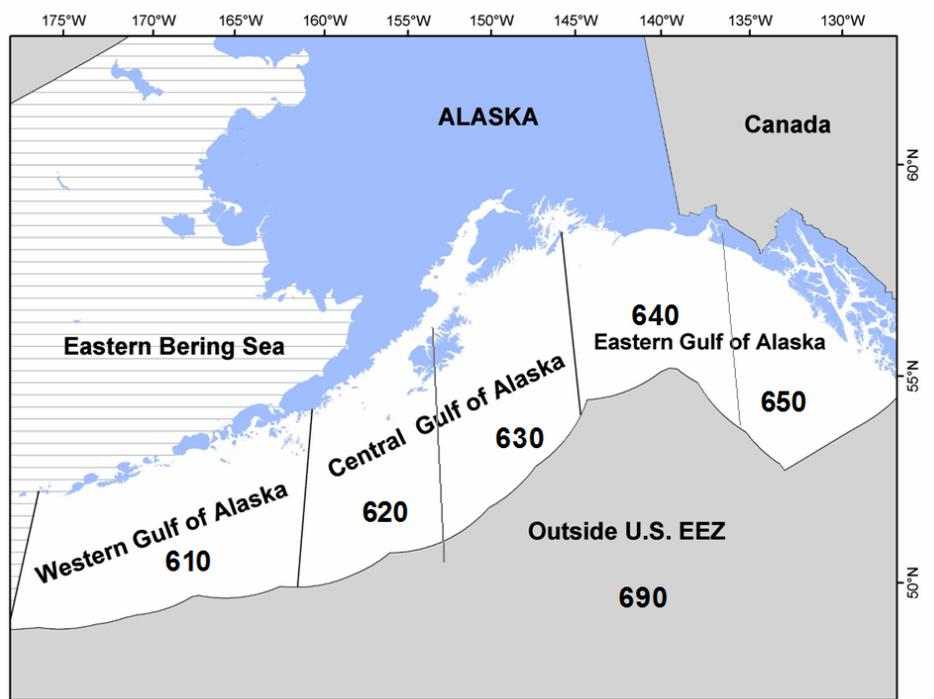
Figure 1.   Gulf of Alaska statistical and reporting areas.

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:

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, 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, sculpins, sharks, octopus, big skates, longnose skates, and other skates.

Ecosystem Component:

1) 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.

2) 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. Beginning in 2019, squid is included in the Ecosystem Component, rather than in the Fishery.
3) <u>Grenadiers</u> – 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*).
4) <u>Squids</u> – There are approximately 15 species of squids in the GOA, which are mainly distributed along the shelf break. The most abundant species is *Berryteuthis magister* (magistrate armhook squid). Squid in Alaska are generally taken incidentally in the target fishery for pollock. Catches of squids are generally low relative to population size and most of the squid bycatch occurs in the central GOA.

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), 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)
Squids[6]	Chiroteuthidae family, Cranchiidae family, Gonatidae family, Onychoteuthidae family, Sepiolidae family,

[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
[6] The squid complex was added to both FMPs as an Ecosystem Component in 2018

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. Amendments 106/117 added squids to the GOA and BSAI FMPs as an Ecosystem Component in 2018.

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"). In 2018, squids were moved to the ecosystem component. 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.

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. In 2018 squids were removed from a target fishery category and placed in a separate ecosystem component category. **This year the Team received a [report on GOA forage fish](#) from Olav Ormseth that included information on squids.**

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. Since 2001, the 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. The Plan Team deducted a value for the 2019 and 2020 PWS GHL (equal to 2.5% of the recommended 2019 and 2020 W/C/WY pollock ABCs) from the recommended 2019 and 2020 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 2019 and 2020 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% Cl
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 2018 or 2) above ½ of its MSY level in 2018 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 2019 and 2020, 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 2020 or 2) above 1/2 of its MSY level in 2020 and expected to be above its MSY level in 2030 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 abundances of pollock, Dover sole, flathead sole, rex 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 abundance of Pacific cod and sablefish are below target stock size. The target biomass levels for deep-water flatfish (excluding Dover sole), shallow-water flatfish (excluding northern and southern rocksole), shortraker rockfish, other rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, skates, sculpins, octopus, and sharks are unknown.

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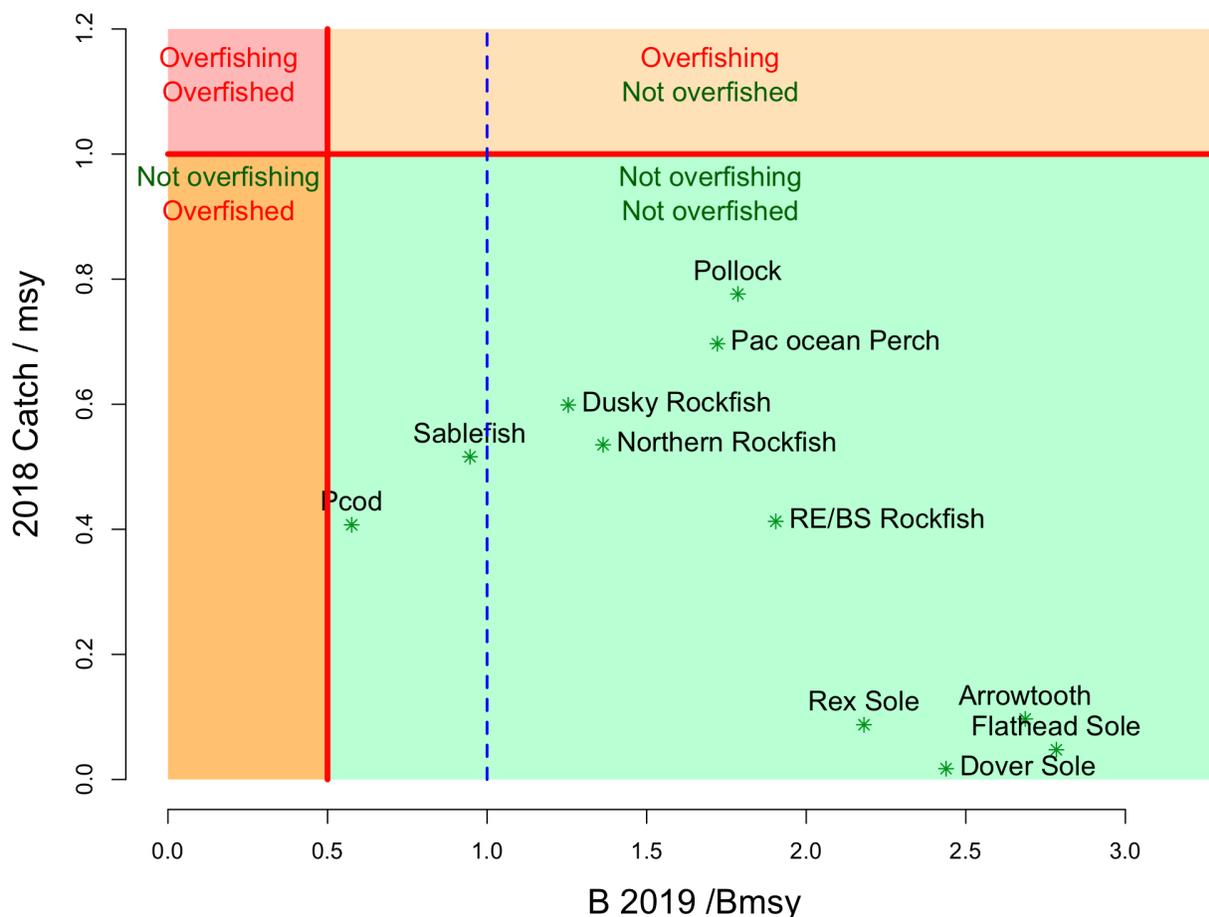
Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{MSY}; horizontal axis) and current year catch relative to fishing at F_{MSY} (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

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 2018, and recommendations for ABCs and overfishing levels (OFLs) for 2019 and 2020. Fishing mortality rates (*F*) and OFLs used to set these specifications are listed in Table 3. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. Table 4 provides a list of species for which the ABC recommendations are below the maximum permissible. Table 5 provides historical groundfish catches in the GOA, 1956-2018.

The sums of the preliminary 2019 and 2020 ABCs for target species are 509,507 and 487,218 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 2019 and 2020 OFLs are 664,889 and 627,049 t, respectively. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2019 will be considerably under this upper limit. For perspective, the sum of the 2018 TACs was 427,512 t, and the sum of the ABCs was 536,921 t (and catch through November 8th, 2018 was just above 240,955 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 2017 and 2018 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 2019 and 2020 correspond to the Plan Team recommendations.

(4) The exploitable biomass for 2017 and 2018 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2019 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 2019 and 2020 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 a significant change with respect to the stock assessment process requiring proposed and final specifications for a period of at least two years. This requires providing ABC and OFL levels for the next two years in this cycle (Table 1). The 2019 harvest specifications (from Council recommendations in December 2018) are in place to start the fishery on January 1, 2019, but these will be replaced by final harvest specifications that will be recommended by the Council in December 2018. The final 2019 and 2020 harvest specifications will become effective when final rulemaking occurs in February or March 2019. This process allows the Council to use the most current survey and fishery data in stock assessment models for setting quotas for the next two years, while having no gap in harvest specifications.

The 2020 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2020 because of new information (e.g., survey) that is incorporated into the assessments. In the case of stocks managed under Tier 3, ABC and OFL projections for the second year in

the cycle 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 4-6, projections for the second year in the cycle are set equal to the Plan Team's recommended values for the first year in the cycle.

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

Economic Summary of the GOA commercial groundfish fisheries in 2016-17

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, increased from $1,752 million in 2016 to $2,007 million in 2017. The first wholesale value of 2017 groundfish catch after primary processing was $2,518 million. The 2017 total groundfish catch decreased by 0.2%, and the total first-wholesale value of groundfish catch increased by 3%, relative to 2016.

The groundfish fisheries accounted for the largest share (47%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon (*Oncorhynchus spp.*) fishery was second with $744 million or 37% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to $183 million or

9% of the total for Alaska and exceeded the value of Pacific halibut (*Hippoglossus stenolepis*) with $117 million or 6% 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, current year ex-vessel price projections, 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. Data tables are organized into four relatively distinct sections: (1) All Alaska, (2) BSAI, (3) GOA, and (4) Pacific halibut. Additionally, flatfish and rockfish data are incorporated into the main data tables (rather than in the appendices as was done prior to 2017). 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 2013-2017, 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 2016-17 in the GOA
The following brief analysis summarizes the overall changes that occurred between 2016-17 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2018 Economic SAFE report, the ex-vessel value of GOA groundfish increased from $192 million in 2016 to $209 million in 2017 (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the Gulf of Alaska (GOA) were relatively flat between 2016 ($368 million) and 2017 ($367 million) (Figure 4). At the same time, the total quantity of groundfish products from the GOA slightly increased from 135 thousand metric tons to 137 thousand metric tons, a 1% increase. The changes in first-wholesale revenues from processing and production in the GOA differ from those in the BSAI, which saw a 2% year-to-year increase in groundfish products and 4% decrease in first-wholesale value.

By species group, negative quantity effects were only slightly offset by small positive price effects for Pacific cod, resulting in a $16 million net decrease in first-wholesale revenues from the GOA for 2016-17 (Figure 5). Further, negative price effects and a small positive quantity effect resulted in a $9 million negative net effect for pollock. The Pacific cod and pollock net effects were countered by positive price and quantity effects for sablefish and flatfish resulting in positive net effects of $17 million and $15 million, respectively. For rockfish, negative price and positive quantity effects mostly canceled each other out, resulting in a small negative net effect of less than $1 million.

By product group, a very large positive price effect coupled with a small positive quantity effect in the whole and head and gut (whole-H&G) category resulted in a positive net effect of $35 million in the GOA first-wholesale revenue decomposition for 2016-17, while negative price and quantity effects in the fillets and surimi categories resulted in a negative net effect of $30 million combined.

In summary, first-wholesale revenues from the GOA groundfish fisheries increased by about $6 million from 2016-17. The main drivers of this was a positive net revenue effect for sablefish and flatfish being offset by negative net effects for Pacific cod and pollock. In comparison, first-wholesale revenues

increased by $124 million from 2016-17 in the BSAI due in large part to positive price and quantity effects for Atka mackerel and a strong positive price effect for Pacific cod.
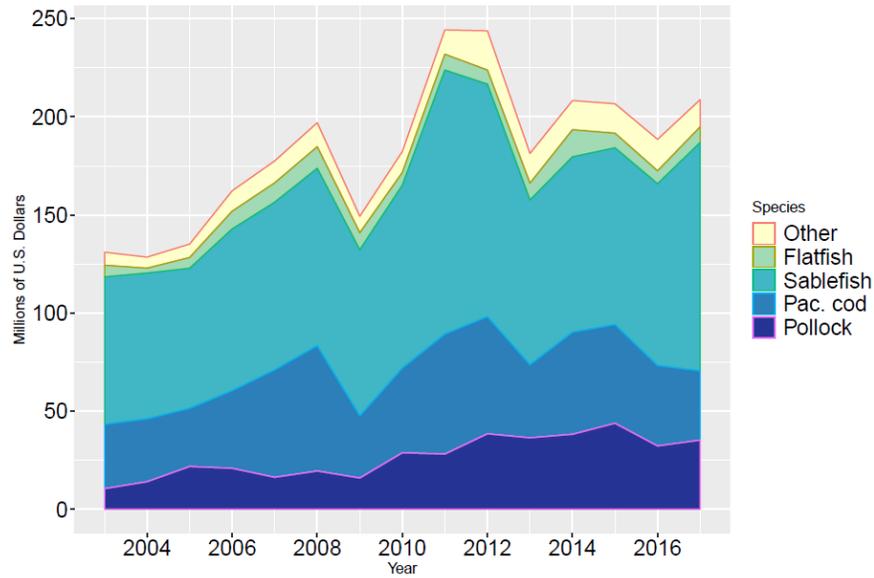
Figure 3.   Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2003-2017 (base year = 2017).
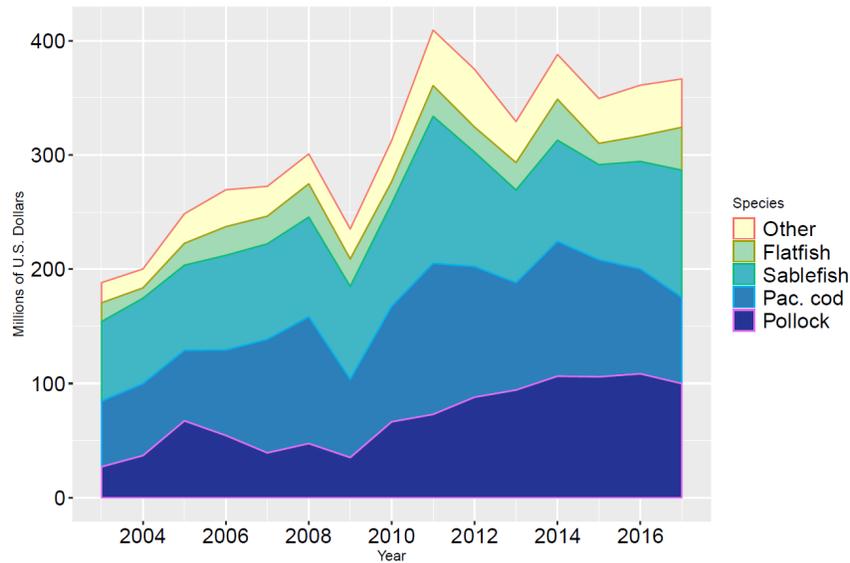
Figure 4.   Real gross product value of the groundfish catch in the GOA area by species, 2003-2017 (base year = 2017).

GOA First-Wholesale Revenue Change in 2016-17
Decomposed by Species Group

GOA First-Wholesale Revenue Change in 2016-17
Decomposed by Product Group
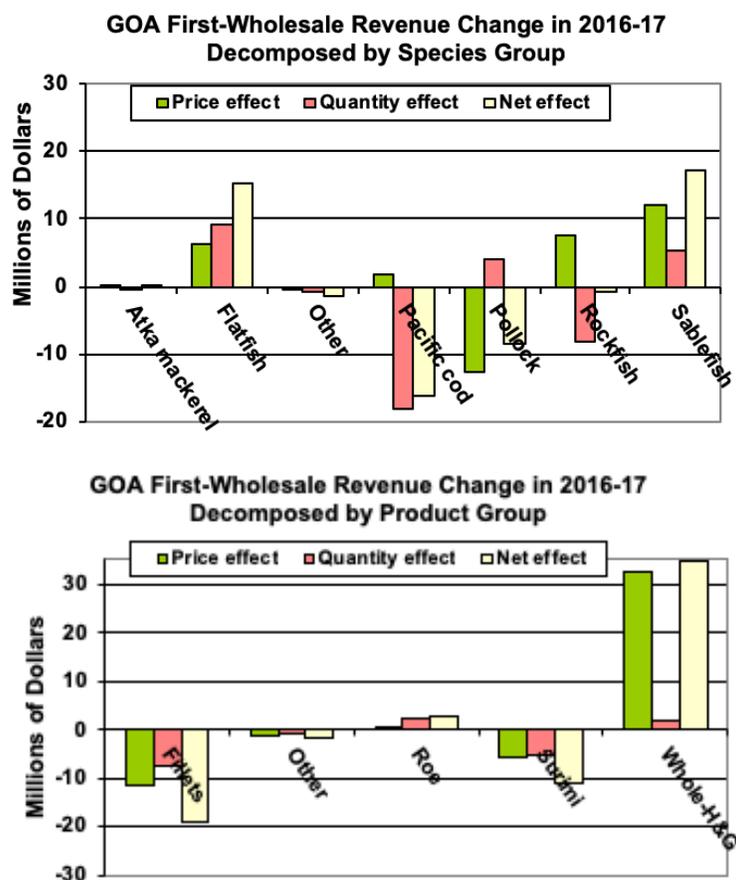
Figure 5. Decomposition of the change in first-wholesale revenues from 2016-17 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the 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 2018: Status of Alaska's Marine Ecosystems* chapter consists of four main components:

1) an executive summary with separate Eastern and Western GOA ecosystem report cards showing and physical, environmental, ecosystem, fishing, and fisheries trends,
2) a recap of the 2017 Ecosystem state with updated data sources,
3) a current (2018) Western and Eastern GOA ecosystem state summary, and
4) a listing of the 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 2018 Western and Eastern Gulf of Alaska Report Cards.

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 2018 remained characterized by warm conditions which have moderated since the extreme heatwave of 2014-2016. The PDO declined toward neutral.
- The freshwater runoff into the GOA appears to have been enhanced during winter 2017/2018 and suppressed during the spring of 2018.
- Mesozooplankton biomass measured by the continuous plankton recorder has often shown a largely biennial trend, however biomass has remained greater than average in 2014-2017. Multiple indicators support a pattern of plentiful, but smaller, zooplankton during the heatwave.
- Copepod community size increased in 2017, indicating that there were more large species available. This suggests an improvement in foraging conditions for planktivorous predators.
- 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 during the warm years of 2015-2016 and continue to be minimal in seabird chick diets. Their apparent abundance coincided with the period of cold-water temperatures in the Gulf of Alaska.
- 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 above average reproductive success in 2018 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 in the western GOA have had strong reproductive success in 2018
- Modelled estimates of western Gulf of Alaska Steller sea lion non-pup counts were approaching the long-term mean in 2017, 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 fishing communities in the western Gulf of Alaska have increased since 1990 largely in urban areas.

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

- A weak-moderate El Nino and warm sea surface temperatures are expected through next winter.
- The North Pacific Gyre Oscillation declined, implying that follows in the Alaska portion of the Subarctic Gyre weakened, which was consistent with weakly directional surface currents.
- Total zooplankton density in Icy Strait in 2018 was above average and the 5th highest density over the 22-year time series. This suggests improved foraging conditions for planktivorous fish, seabirds, and mammals relative to the below-average densities during 2013-2016.
- However, this increase was due to increased small copepod abundances in 2018 whereas large copepod abundance declined, leading to an overall decrease in mean size.
- 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 were 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 during the heatwave, and there were no chicks to measure in 2018, 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 2017. 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 heatwave of recent years.
- Human populations in fishing communities in the eastern Gulf of Alaska have increased in large (>1,500 people) communities but have decreased in small communities since 1990.

Ecosystem authors expect that these broad-based indicators will be refined over time. Current indicators were reviewed with the Plan Team and alternative indicators were discussed.

There were two items highlighted as Noteworthy (formerly "hot topics") for the GOA this year:

Fall 2018 marine heatwave - The Gulf of Alaska is currently (as of 21 October 2018) experiencing a marine heatwave. Impacts of this heatwave to the ecosystem are currently unknown but will likely depend on its extent and duration.

Local Environmental (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 were and were encouraged by the Council and SSC to continue exploring the utilization of this framework in future reports. 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 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year (age 3+ for W/C/WYAK and survey biomass for SEO). The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Catch data are current through November 8th, 2018. 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.

Area	Year	Biomass	OFL	ABC	TAC	Catch
W/C/WYAK	2017	1,391,290	235,807	203,769	198,675	184,167
	2018	1,124,930	187,059	161,492	157,455	154,286
	2019	1,126,750	194,230	135,850		
	2020		148,968	108,892		
SEO	2017	44,087	13,226	9,920	9,920	0
	2018	38,989	11,697	8,773	8,773	0
	2019	38,989	11,697	8,773		
	2020		11,697	8,773		
GOA-wide	2017	1,435,377	249,033	213,689	208,595	184,167
	2018	1,163,919	198,756	170,265	166,228	154,286
	2019	1,165,739	205,927	144,623		
	2020		160,665	117,665		

Changes from the previous assessment

This year's pollock assessment features the following new data: 1) 2017 total catch and catch-at-age from the fishery, 2) 2018 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2017 age composition from NMFS bottom trawl survey, 4) 2018 biomass from the ADFG crab/groundfish trawl survey, and 5) 2017 age composition from the summer GOA-wide acoustic survey.

The age-structured assessment model used for GOA W/C/WYAK pollock assessment was similar to the 2017 assessment (Model 17.2). The 2018 assessment compared 3 models to the Model 17.2 with the new data:

Model 18.1 Net-selectivity corrected acoustic estimates, age-1 and age-2 indices for 2009-2018 for Shelikof + Shumagin surveys.

Model 18.2 Same as 18.1, but age-1 and age-2 indices for 2008-2018 Shelikof surveys only.

Model 18.3 Same as 18.2, but without a power term for age-1 index.

The main difference in the 2018 suite of models is that the winter acoustic survey time series includes a net-selectivity correction, which results in increased estimates of abundance of age-1 and to a lesser degree age-2 fish, while the estimates for adult (3+) fish are slightly reduced. The effects on overall survey biomass are small. The abundance estimates for age-1 and age-2 pollock from these surveys were used as separate indices in the model. Net-selectivity corrected data were only available starting in 2008 for Shelikof Strait and 2009 for the Shumagin Islands survey. Model 18.1 did not use the net corrected estimate for Shelikof Strait in 2008 for consistency with the Shumagin Islands time series. Model 18.2 does not incorporate the Shumagin Islands survey time series in favor of extending net-selectivity corrected estimates for Shelikof Strait back to 2008. Model 18.3 removed a power term on the age-1 pollock index, which was thought to no longer be structurally appropriate given the net- selectivity

corrected data which greatly increased age-1 abundance estimates. **The Team concurred with the assessment author to use Model 18.3.**

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 decline in 2019 as the 2012 year class starts to decline in size. Survey data in 2018 are contradictory, similar to 2017, with acoustic surveys indicating the 2nd largest biomass in 30 years and the ADF&G bottom trawl survey showing a slight increase but still remaining near historic lows. These divergent trends are likely due to changes in the availability of pollock to different surveying methods. The model estimate of female spawning biomass in 2019 is 345,352 t, which is 62% of unfished spawning biomass (based on average post-1977 recruitment) and above the $B_{40\%}$ estimate of 221,000 t.

Author recommended reduction in ABC based on risk assessment matrix

This year's pollock assessment also incorporated a risk assessment matrix for evaluating whether a reduction from the maximum permissible ABC is warranted. This represents a trial approach in assessing additional risks to the stock that may be missed within the stock assessment model. The author scored the current risk conditions as Level 2 across all categories indicating a substantially increased level of concern, with the details of the scoring rationale provided in the document. In general, the Team agreed with the author's categorization of the risk factors. The author proposed a 15% reduction from *maxABC* based on the risk analysis. This was meant as a measured response consistent with past reductions. The Team noted the effort in developing the table and appreciated the work towards making concerns about the resource status more transparent. However, after extensive discussions, the Team noted a lack of guidance on how best to recommend an adjustment. As such, a method more commonly used for such situations was adopted. This involved averaging the projection of the current *maxABC* from last year's assessment with the *maxABC* for 2019. This alternative produced a 14.3% reduction over the *maxABC* for 2019 which the Team noted was quite similar to the author's recommended reduction.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Because the model projection of female spawning biomass in 2019 is above $B_{40\%}$, the W/C/WYAK Gulf of Alaska pollock stock is in Tier 3a. The model estimated 2019 age-3+ biomass is 1,126,750 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 2023.

The Plan team agreed to a 14.3% reduction from maximum permissible ABC for 2019. This percent reduction was also used in projections for 2020.

The 2019 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 135,850 t which is a decrease of 16% from the 2018 ABC. The OFL is 194,230 t for 2019. The 2019 Prince William Sound (PWS) GHL is 3,396 t (2.5% of the ABC).

For pollock in southeast Alaska (East Yakutat and Southeastern areas), the ABC is 8,773 t for 2019 and 2020. 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. However, concerns remain about diverging stock survey indices, unusual age structure of the population, and increased potential for adverse environmental conditions to negatively impact the stock in the near future (i.e., the marine heatwave and near-term forecast).

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). For winter seasons, model estimates of biomass for winter acoustic surveys conducted were used as a basis for apportionment. Apportionments for the C and D seasons were based on a 3-year weighted average of the sum of the AFSC bottom trawl survey and the gulf-wide acoustic summer survey (unchanged from the previous assessment). Area apportionments, reduced by 2.5% of the ABC (3,396 t in 2019 and 2,722 t in 2020) 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 2019 and 2020 pollock ABCs for the Gulf of Alaska (t).						
	610	**620**	**630**	**640**	**650**	
Year	**Western**	**Central**	**Central**	**WYAK**	**SEO**	**Total**
2019	24,875	67,388	34,443	5,748	8,773	141,227
2020	19,939	54,016	27,608	4,607	8,773	114,943

Note shaded values were initially incorrect (values were 71,459 and 30,372 for 620 and 630 respectively for 2019 and 57,279 and 24,345 for 2020)

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 2019 and 2020 are those recommended by the Plan Team. Catch data are current through November 8th, 2018.					
Year	**Age 0+ biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2017	426,384	105,378	88,342	64,442	35,204
2018	170,565	23,565	18,000	13,096	9,595
2019	266,066	23,669	17,000		
2020		26,078	21,592		

Changes from the previous assessment

Data updated from the 2017 assessment included federal and state fishery catch for 2017 and 2018 (preliminary catch projected through the end of 2018), federal and state fishery size composition for 2017 and 2018, 2018 AFSC longline survey abundance index (Relative Population Numbers, RPN) and size composition, 2017 AFSC bottom trawl survey age composition and conditional length-at-age, and 2012-2017 fishery age composition and conditional length-at-age. 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 for 2018 dropped 40% from 2017 to 2018 and was 73% lower than the 2015 RPN estimate.

The author evaluated several models and presented a subset of eight models that included the model configuration from 2017 with updated data (Model 17.09.35). The models presented by the author included changes to the version of Stock Synthesis, age- or length-based maturity, whether to include pre-2007 age composition data (or any at all), using the marine heatwave index as a covariate to natural mortality, and the prior CVs on natural mortality or the von Bertalanffy growth parameters. Model 18.10.44 was recommended by the author and the Team concurred. This model fit the data well, had less influential priors on natural mortality, and was most consistent with last year's reference model. This model differed from last year's model as age composition data before 2007 were omitted and length-based rather than age-based maturity was applied due to a bias discovered in age readings prior to 2007.

Spawning biomass and stock trends
The $B_{40\%}$ estimate was 68,896 t, with projected 2019 spawning biomass of 34,701 t. The 2012 year-class remains the strongest in the recent period, followed closely by the 2013 year-class. Recruitment since 2013 is below the 1977-2015 average. Spawning biomass was projected to decline through 2020.

Tier determination/Plan Team discussion and resulting ABCs and OFLs
This stock is in Tier 3b. The 2018 spawning biomass is estimated to be at 20.4% of $B_{100\%}$. The $F_{35\%}$ and $F_{40\%}$ values are 0.76 and 0.62, respectively. The maximum permissible ABC is 19,665 t but the authors recommended that it be reduced so that the projected biomass is above 20% of $B_{100\%}$ in 2019 (if the stock is below $B_{20\%}$, directed fishing is prohibited due to Steller sea lion regulations). The Plan Team concurred with the authors' recommended ABC and OFL values. The recommended ABC is 17,000 t for 2019 which is a 6% decrease from the 2018 ABC of 18,000 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
2019	7,633	7,667	1,700	17,000
2020	9,695	9,738	2,159	21,592

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 2018 and 2019 are those recommended by the Plan Team. Catch data are current through November 8th, 2018.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2017	139,000	11,885	10,074	10,074	10,500
2018	356,000	22,703	11,505	11,505	11,716
2019	264,000	25,227	11,571		
2020		34,782	15,462		

Changes from the previous assessment
New data included in the assessment model were relative abundance and length data from the 2018 longline survey, relative abundance and length data from the 2017 fixed gear fishery, length data from the 2017 trawl fisheries, age data from the 2017 longline survey and 2017 fixed gear fishery, updated catch for 2017, and projected 2018-2020 catches. In addition, estimates of killer and sperm whale depredation in the fishery were updated and projected for 2018-2020. Relative to the 2017 assessment there were no changes to the assessment methodology. This year the assessment included several appendices including a new Ecosystem and Socioeconomic Profile (ESP) (Appendix 3C), and documents on apportionment (Appendix 3D) and modeling explorations (Appendix 3E) that were presented and reviewed at the September 2018 Groundfish Plan Team meeting.

Spawning biomass and stock trends
Projected 2019 spawning biomass is 33% of unfished spawning biomass. The longline survey abundance index increased 9% from 2017 to 2018 following a 14% increase between 2016 and 2017. However, the lowest point of the time series occurred in 2015. The fishery abundance index was level from 2016 to 2017 and is at the time series low (the 2018 data are not available yet). Spawning biomass is projected to

increase rapidly from 2019 to 2022, and then stabilize. It was noted that the AFSC longline survey RPN increase is considerably higher than the RPW and understanding why they are trending differently now was highlighted (the assessment model only uses the RPN values).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Sablefish are managed under Tier 3b of NPFMC harvest rules. Reference points were calculated using recruitments from 1977-2014. The authors recommended the 2019 ABC be equal to the 2018 recommendation, **which equates to a 45% reduction from maximum permissible ABC.**

While there are clearly positive signs of incoming recruitment, concerns regarding stock status remain. The 2018 spawning biomass was estimated to be lower than the 2017 estimate. Uncertainty of the magnitude of the 2014 year class estimate was high (the 2018 estimate was 30% lower than the value from the 2017 assessment), and the retrospective pattern has increased in the last two years (with a positive pattern). The 2014 year class was estimated to comprise 10% of the 2019 spawning biomass, despite being less than 20% mature. Also, uncertainty about the environmental conditions and how they may affect the 2014 year class was highlighted. The authors' examined the risk matrix approach and arrived at an overall score of 4 (extreme concern). This supports their recommended added buffer for ABC lower than *maxABC*. The Teams concurred with this large adjustment and an additional (relatively minor) adjustment to account for the effects of whale depredation to arrive at the authors' recommended ABC.

The Teams discussed the constraint of sablefish being placed on PSC status in other groundfish fisheries early in the year. This results in additional discarding and waste. While the problem was acknowledged, it was noted that allocation issues and regulatory constraints appears to limit the flexibility for minimizing discards.

Status determination

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

Area apportionment

Apportionments have been held constant since the 2013 fishery and the Teams concurred. Apportionment values presented here include whale depredation adjustments:

Region	2018			2019		2020	
	OFL	ABC	TAC	OFL	ABC	OFL	ABC
W	--	1,544	1,544	--	1,581	--	2,105
C	--	5,158	5,158	--	5,178	--	6,931
*WYAK	--	1,829	1,829	--	1,828	--	2,433
*SEO	--	2,974	2,974	--	2,984	--	3,993
GOA	22,703	11,505	11,505	25,227	11,571	34,782	15,462

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

4. [Shallow water flatfish](#) (Northern and southern rock sole and others)

Status and catch specifications (t) of shallow water flatfish and projections for 2019 and 2020. 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 8th, 2018.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2017	299,858	54,583	44,514	36,843	2,570
2018	339,152	67,240	54,688	42,732	2,722
2019	343,755	68,309	55,587		
2020		69,167	56,308		

Changes from the previous assessment

Northern and southern rock sole are Tier 3a species and assessed separately from the other shallow water flatfish. The shallow water flatfish stock complex has been moved to a 4-year assessment cycle. Last year, 2017, was the first year of the new schedule and a full assessment was completed. This year a partial assessment was done. The 2017 assessment of the shallow-water flatfish complex excluding northern and southern rock sole used a random effects model to estimate current biomass. The projection model for northern and southern rock sole was re-run and updated with 2017 catch and catch estimates for 2018 and 2019.

Spawning biomass and stock trends

The complex total 2019 biomass estimate was 343,755 t, which is a slight (1.4%) increase from the 2018 value of 339,152 t. This slight increase is due to updated biomass for northern and southern rock sole from the projection model. Overall, biomass for shallow water flatfish is stable.

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 author's 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.

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**
2019	25,620	25,731	2,279	1,957	55,587
2020	25,952	26,065	2,308	1,983	56,308

5. Deepwater flatfish complex (Dover sole and others)

	Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2019 and 2020. 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 8th, 2018.				
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2017	143,333	11,182	9,292	9,292	259
2018	144,654	11,294	9,385	9,385	195
2019	145,926	11,434	9,501		
2020		11,581	9,624		

Changes from the previous assessment

This year a partial assessment was conducted. The deepwater flatfish complex is comprised of Dover sole, Greenland turbot, and deepsea sole. This complex is on a four-year cycle and a full assessment is due in 2019. For Dover sole, a single species projection model was run using parameter values from the accepted 2015 assessment model and using updated 2017 and estimated 2018 catch.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

For ABC/OFL calculations, a Tier 3a approach was used for Dover sole and a Tier 6 approach was used for Greenland turbot and deepsea sole. OFLs and ABCs for the individual species in the deepwater flatfish complex are determined and then summed for calculating complex-level OFLs and ABCs.

The Team supports the author's recommendation to continue this approach.

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 as recommended by the 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. The area apportionment for 2019 and 2020 are as follows:

Year	Western	Central	WYAK	SEO	Total
2019	416	3,443	3,280	2,362	9,501
2020	420	3,488	3,323	2,393	9,624

6. Rex sole

Status and catch specifications (t) of rex sole and projections for 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 8th, 2018.

Year	Biomass	OFL	ABC	TAC	Catch
2017	75,359	10,860	8,311	8,311	1,483
2018	97,982	18,706	15,373	15,373	1,638
2019	98,818	17,889	14,692		
2020		17,942	14,725		

Changes from the previous assessment

This year a partial assessment was conducted. This stock is on a four-year cycle and a full assessment is due in 2019. The projection model was run using updated catches.

Spawning biomass and stock trends

The model estimates of female spawning biomass and total biomass (3+) for the eastern area is stable and the western area appears to be increasing slightly.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The recommended model produces reliable estimates of $F_{40\%}$ and $F_{35\%}$ which places rex sole in Tier 3a.

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 2019 and 2020 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2019	2,951	8,357	1,657	1,727	14,692
2020	2,956	8,371	1,664	1,734	14,725

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 8th, 2018.

Year	Age 1+ Biomass	OFL	ABC	TAC	Catch
2017	2,103,090	219,327	186,093	103,300	26,863
2018	2,079,029	180,697	150,945	76,300	17,498
2019	1,391,460	174,598	145,841		
2020		168,634	140,865		

Changes from the previous assessment

Arrowtooth flounder is assessed on a biennial basis, with assessments done in odd years. The last full assessment was done in 2017. In partial assessment years, parameter values from the previous year's assessment model and updated catch information are used to make projections. Final catch for 2018 was

estimated by adding the average catch between October 9 and December 31 from 2013-2017 to the 2018 catch through October 8, 2018. The average catch over 2014-2018 (using the estimated 2018 catch level for 2018) was used as the 2019 catch level.

Spawning biomass and stock trends

Arrowtooth flounder biomass estimates using the 2017 model parameters have increased slightly relative to the projection model estimates in 2017. The projected spawning biomass for 2019 was 869,399 t, which is 4% higher than the projected 2019 biomass from the 2017 assessment. The projected estimate of total biomass for 2019 of 1,391,460 t was less than 1% higher than the estimate from 2017 projection model.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The 2019 ABC of 145,841 t is less than 1% higher than the estimate from the 2017 projection model. Arrowtooth flounder is assessed in Tier 3a. The Team continued with this recommendation as this is a partial assessment.

Status determination

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

Area apportionment

The area apportionment from the random effects model was used to provide apportionments for the 2019 and 2020 ABCs:

Year	Western	Central	WYAK	SEO	Total
2019	35,994	70,995	15,911	22,941	145,841
2020	34,765	68,575	15,368	22,157	140,865

8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 8th, 2018.					
Year	Biomass	OFL	ABC	TAC	Catch
2017	269,638	43,128	35,243	27,856	2,051
2018	281,635	43,011	35,266	26,388	2,045
2019	283,285	44,865	36,782		
2020		46,666	38,273		

Changes from the previous assessment

The flathead sole stock is assessed on a four-year schedule. This year was an off-year thus a partial assessment was presented. The projection model was run using updated catches.

Spawning biomass and stock trends

The 2019 spawning biomass estimate was above $B_{40\%}$ and projected to increase through 2020. Biomass (age 3+) for 2019 was estimated to be 283,285 t and projected to slightly decrease in 2020.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Flathead sole are determined to be in Tier 3a. For 2019, the Team concurred with the authors' recommendation to use the maximum permissible ABC of 36,782 t from the updated projection. The F_{OFL} is set at $F_{35\%}$ (0.36) which corresponds to an OFL of 44,865 t.

Status determination

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

Area apportionment

Area apportionments of flathead sole ABCs for 2019 and 2020 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2019	13,234	21,109	2,016	423	36,782
2020	13,771	21,965	2,097	440	38,273

9. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model; catch data are current through November 8th, 2018.

Year	Biomass	OFL	ABC	TAC	Catch
2017	445,672	27,826	23,918	23,918	23,881
2018	511,924	34,762	29,236	29,236	24,221
2019	496,922	33,951	28,555		
2020		32,876	27,652		

Changes from the previous assessment

This was a partial assessment (biennial to coincide with the NMFS bottom trawl survey). The catches were updated for the projection model.

Spawning biomass and stock trends

Spawning biomass was projected to decrease slightly (~2%) but the stock remains well above $B_{40\%}$.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA Pacific ocean perch stock was estimated to be in Tier 3a.

Status determination

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

Area apportionment

The apportionment percentages are the same as in the 2017 full assessment. The following tables shows the recommended apportionment for 2019 and 2020 from the random effects model.

Area apportionment	Western	Central	Eastern	Total
2019 Area ABC (t)	3,227	19,646	5,682	28,555
2020 Area ABC (t)	3,125	19,024	5,503	27,652

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 the same as last year at 0.58. This results in the following apportionment of the Eastern Gulf area:

Area apportionment	W.Yakutat	E.Yakutat/Southeast	Total
2019 Area ABC (t)	3,296	2,386	5,682
2020 Area ABC (t)	3,192	2,311	5,503

In 2012, the Plan Team and SSC recommended combined OFLs for the Western, Central, and West Yakutat areas (W/C/WY) 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
2019 Area OFL (t)	31,113	2,838	33,951
2020 Area OFL (t)	30,128	2,748	32,876

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 2019 and 2020 are those recommended by the Plan Team. Catch data are current through November 8th, 2018. Note that for management purposes, the northern rockfish from the EGOA ABC is combined with other rockfish. The ABC for 2019 and 2020 listed below deducts 1 t.

Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2017	75,028	4,522	3,786	3,786	1,835
2018	74,748	4,380	3,685	3,685	2,344
2019	87,409	5,402	4,528		
2020		5,093	4,269		

Changes from the previous assessment

Full assessments for GOA northern rockfish occur in even years, with partial assessments in odd years. The input data was updated to include the 2017 GOA trawl survey biomass estimate, the 2015 and 2017 GOA survey age compositions, updated catches, fishery age compositions from 2014 and 2016, and fishery size compositions from 2015 and 2017. The Vector Autoregressive Spatio-Temporal (VAST) model was used produce estimates of survey biomass, and accounts for spatial correlation in catch per unit effort among survey tows. Because the VAST model produces lower variances of the survey biomass estimates, the weight given to the survey biomass component of the likelihood function was lowered in order to maintain consistent likelihood contributions from all data components.

Spawning biomass and stock trends
The 2019 spawning biomass estimate (36,365 t) is above $B_{40\%}$ (30,480 t) and projected to decrease to 34,046 t in 2020. Total biomass (2+) for 2019 is 87,409 t and is projected to decrease to 84,326 in 2020.

Tier determination/Plan Team discussion and resulting ABCs and OFLs
Northern rockfish are estimated to be in Tier 3a. The Plan Team agreed with the authors' recommendation to use the maximum permissible 2019 ABC and OFL values of 4,529 t and 5,402 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 2019 and 2020 are based on the random effects model applied to GOA bottom trawl survey biomass for the Western, Central, and Eastern Gulf of Alaska resulting in the following percentage area apportionments: Western 26.28%, Central 73.70% and Eastern 0.02%. 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 2019-2020:

Year	Western	Central	Eastern	Total
2019	1,190	3,338	1	4,529
2020	1,122	3,147	1	4,270

11. Shortraker rockfish [from the 2017 Assessment]

In accordance with the approved schedule, no assessment was conducted for shortraker rockfish this year, however, a full stock assessment will be conducted in 2019. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2019 specifications. Additional information listed below summarizes the 2017 assessment.

Year	Biomass	OFL	ABC	TAC	Catch
Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Catch data are current as of November 8th, 2018.					
2017	57,175	1,715	1,286	1,286	552
2018	38,361	1,151	863	863	755
2019	38,361	1,151	863		
2020		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).

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 8th, 2018.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2017	57,307	5,233	4,278	4,278	2,587
2018	56,103	4,841	3,957	3,957	2,899
2019	55,247	4,521	3,700		
2020	54,551	4,484	3,670		

Changes in assessment methods and data
The schedule for dusky rockfish changed in 2017 from a full assessment in odd years to a full assessment in even years, and partial assessments in odd years. The model and methods were unchanged from the accepted 2015 assessment. The input data were updated to include survey age compositions for 2015 and 2017, final catch for the past three years, preliminary catch for 2018, fishery age compositions from 2014 and 2016, and fishery size compositions for 2015 and 2017. Model-based trawl survey biomass estimates for 2017 were updated and included.

Spawning biomass and stock status trends
Estimates of spawning biomass for 2019 and 2020 from the current year (2018) projection model are 20,342 t and 20,106 t, respectively. Both estimates are above the $B_{40\%}$ estimate of 18,535 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs
The dusky rockfish stock is in Tier 3a. The Team concurred with the authors' recommended model and values as shown above.

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

Apportionments are based on the random effects model applied to the trawl survey biomass estimates. The following table shows the recommended ABC apportionment for 2019 and 2020.

Area Apportionment	Western	Central	Eastern	Total
2019 Area ABC (t)	781	2,764	155	3,700
2020 Area ABC (t)	774	2,742	154	3,670

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
2019 Area ABC (t)	95	60
2020 Area ABC (t)	94	60

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2019 and 2020. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Total biomass estimates are age-3+ from the age-structured model; catch data are current as of November 8th, 2018.

Year	Biomass	OFL	ABC	TAC	Catch
2017	41,650	1,594	1,327	1,327	538
2018	45,624	1,735	1,444	1,444	716
2019	45,363	1,715	1,428		
2020		1,699	1,414		

Changes from the previous assessment
Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rougheye and blackspotted rockfish in alternate (even) years, a partial assessment is provided to recommend harvest levels for the next two years. New data added to the projection model included updated catch through Oct 6, 2018.

Spawning biomass and stock status trends
Female spawning biomass (14,995 t) is above $B_{40\%}$ (8,998 t) and projected to remain stable.

Tier determination/Plan Team discussion and resulting ABCs and OFLs
The rougheye/blackspotted complex qualifies as a Tier 3a stock. For 2019 and 2020, the Plan Team accepted the authors' recommended maximum permissible ABCs and the OFLs as provided in the table above.

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

Apportionments have been based on a 4:6:9 weighted average of the proportion of biomass in each area from the three most recent bottom trawl surveys. Inn 2017 (which was the last full assessment), the Plan Team and SSC requested that the random effects model be applied to the bottom trawl survey data in future assessments. In the interim, apportionments of the 2019 and 2020 ABCs provided below are based on three survey-weighted average used in 2017, until the next full assessment where multiple survey apportionment options will be evaluated.

	WGOA	CGOA	EGOA	Total
2019 ABC (t)	174	550	704	1,428
2020 ABC (t)	172	545	697	1,414

14. [Demersal shelf rockfish](#)

Status and catch specifications (t) of GOA demersal shelf rockfish and projections for 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Catch data for 2018 are current through November 8th, 2018.

Year	Biomass	OFL	ABC	TAC	Catch
2017[1]	10,347	357	227	227	130
2018[1]	11,508	394	250	250	133
2019[1]	12,029	411	261		
2020[1]		411	261		

[1] For 2017–2020, 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 2018. ROV surveys were completed for NSEO, CSEO, and SSEO, however video analysis is in progress and density estimates were not updated for this assessment.

Spawning biomass and stock trends

The yelloweye rockfish biomass estimate increased from 11,508 t to 12,029 t from 2018 to 2019. The increase in abundance is driven by increases in mean fish weight in CSEO and EYKT 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 411 t for 2019. 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 2019 (and 2020) of 261 t, up slightly from that recommended for 2018.

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

Year	Biomass	OFL	ABC	TAC	Catch
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 2018 are current through November 8th, 2018.					
2017	87,155	2,615	1,961	1,961	1,021
2018	90,570	2,717	2,038	2,038	1,150
2019	89,609	2,688	2,016		
2020		2,688	2,016		

Changes from previous assessment

In 2017, the 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. New information in this full assessment includes: 1) catch estimates (though 10 October 2018); 2) length compositions from the 2016, 2017, and 2018 longline and trawl fisheries; 3) length compositions from the 2017 GOA bottom trawl survey; 4) updated Relative Population Numbers (RPNs), Relative Population Weights (RPW), and size compositions from the 2016, 2017, and 2018 AFSC annual longline surveys; and 5) updated RPWs from the 1992-2018 GOA longline survey for use in the random effects model.

The methodology used to estimate exploitable biomass to calculate ABC and OFL values for the 2019 fishery has changed. In the recommended Model 18.1, the regional AFSC longline survey RPW index is added to the random effects model so that the model utilizes the both the bottom trawl survey biomass index (1984-2017) and the AFSC longline survey RPW index (1992-2018).

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable for thornyheads. The most recent 2017 trawl survey estimate was 10% lower than the 2015 estimate, whereas the 2017 longline survey RPN was 38% higher than the 2016 estimate, and then decreased by 18% in 2018. The thornyhead complex is a Tier 5 stock, and biomass is estimated by applying the random effects method to the trawl and longline survey biomass time series by region and depth in order to compensate for missing data (i.e., thornyheads are found down to 1000m, but deep survey strata are not sampled in in each trawl survey). The biomass estimates from the random effects model show a slightly increasing trend from about 2010-2017 and a projected stable trend after 2017.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team concurred with the author's recommendations for OFL and ABC for 2019 and 2020. Gulf-wide catch of thornyheads in 2017 was 52% of the ABC.

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 and the 1992-2018 longline survey RPW index. Subarea ABCs for 2019 and 2020 ABCs are:

2019 and 2020	Western	Central	Eastern	Total
ABC	326	911	779	2,016

16. Other rockfish [from the 2017 Assessment]

In accordance with the approved schedule, no assessment was conducted for other rockfish this year, however, a full stock assessment will be conducted in 2019. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2019 specifications. Additional information listed below summarizes the 2017 assessment.

Year	Survey biomass	OFL	ABC	TAC	Catch
Status and catch specifications (t) of other rockfish. The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Catch data are current through November 8th, 2018. Note that 1 t of northern rockfish has been added for management purposes to "other rockfish" in the EGOA.					
2017	104,826	7,424	5,773	2,308	1,078
2018	96,107	7,356	5,594	2,305	1,207
2019	96,107	7,356	5,594		
2020		7,356	5,594		

Changes from the previous assessment

There were no changes in assessment inputs or methodology since this was an off-cycle year.

Spawning biomass and stock trends

The estimated biomass of 104,826 t is based on the random effects model applied to survey biomass for the Tier 4 and 5 species in the complex. Surveys indicate stability for this complex.

Tier determination/ Plan Team discussion and resulting ABCs and OFLs

GOA other rockfish are managed as a Tier 4/5/6 stock complex. The Plan Team agreed with the authors' recommendation of an OFL of 7,424 t and a maximum permissible ABC of 5,773 t for 2017 and 2018 (including the 4 t from the northern rockfish category).

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. As in previous recent assessment, a single ABC for the combined WGOA and CGOA areas is used to address concerns about the ability to manage smaller ABCs in the WGOA.

The apportionments recommended for 2019 and 2020 are:

Other Rockfish	W/C GOA	WYAK	EYAK/SE	Total
ABC (t)	1,737	368	3,489*	5,594
OFL (t)				7,356

*Note for management purposes this includes 1 t of northern rockfish

17. [Atka mackerel](#) [from the 2017 Assessment]

In accordance with the approved schedule, no assessment was conducted for Atka mackerel this year, however, a full stock assessment will be conducted in 2019. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2019 specifications. Additional information listed below summarizes the 2017 assessment.

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 2019 and 2020 are those recommended by the Plan Team. Catch data are current through November 8th, 2018.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2017	-	6,200	4,700	2,000	1,074
2018	-	6,200	4,700	2,000	1,431
2019	-	6,200	4,700		
2020	-	6,200	4,700		

Changes from the previous assessment
New information includes updated 2014 and 2015 catches. Since the 2015 stock assessment, ages from the 2014 and 2015 GOA fisheries have become available. In addition, new survey age information is available from the 2015 summer bottom trawl survey, and these data are comprised of fish from the Western and Central Gulf of Alaska.

Spawning biomass and stock trends
Estimates of spawning biomass are unavailable for Gulf of Alaska 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 2017 ABC for GOA Atka mackerel equal to the maximum permissible value of 4,700 t. The 2017 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 [from the 2017 Assessment]

In accordance with the approved schedule, no assessment was conducted for skates this year, however, a full stock assessment will be conducted in 2019. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2019 specifications. Additional information listed below summarizes the 2017 assessment.

Species	Year	Biomass	OFL	ABC	TAC	Catch
		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 2019 and 2020 are those recommended by the Plan Team. Catch data are current through November 8th, 2018.				
Big Skate	2017	50,857	5,086	3,814	3,814	1,656
	2018	50,857	5,086	3,814	3,814	1,262
	2019	37,975	3,797	2,848		
	2020		3,797	2,848		
Longnose Skate	2017	42,737	4,274	3,206	3,206	1,206
	2018	42,737	4,274	3,206	3,206	843
	2019	47,632	4,763	3,572		
	2020		4,763	3,572		
Other Skates	2017	25,580	2,558	1,919	1,919	1,573
	2018	25,580	2,558	1,919	1,919	681
	2019	18,454	1,845	1,384		
	2020		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

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.

| Years | Species | ABC | | | |
		Western	Central	Eastern	Total
	Big skate	504	1,774	570	2,848
2019 and 2020	Longnose skate	149	2,804	619	3,572
	other skates				1,384

19. Sculpins [from the 2017 Assessment]

In accordance with the approved schedule, no assessment was conducted for sculpins this year, however, a full stock assessment will be conducted in 2021. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2019 specifications. Additional information listed below summarizes the 2017 assessment.

Status and catch specifications (t) of GOA sculpins and projections for 2019 and 2020. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2019 and 2020 are those recommended by the Plan Team. Catch data for 2018 are current through November 8th, 2018.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2017	33,550	7,448	5,569	5,569	1,316
2018	34,943	6,958	5,301	5,301	550
2019	33,134	6,958	5,301		
2020		6,958	5,301		

20. Sharks

Status and catch specifications (t) of the GOA shark complex and projections for 2019 and 2020. 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 2018 are current through November 8th, 2018.

Year	Biomass	OFL	ABC	TAC	Catch
2017	56,181	6,020	4,514	4,514	1,635
2018	56,181	6,020	4,514	4,514	2,886
2019	54,301	10,913	8,184		
2020		10,913	8,184		

Changes from the previous assessment
The GOA shark complex (spiny dogfish, Pacific sleeper shark, salmon shark, and other/unidentified sharks) is assessed on a biennial stock assessment schedule. The 2017 assessment was delayed until 2018 to coincide with the Bering Sea Aleutian Islands (BSAI) shark stock complex assessment; the next full assessment is scheduled for 2020. New information for this assessment includes updated 2017 and estimated 2018 GOA shark catch, as well as the following updated survey indices:
- NMFS bottom trawl (through 2017);
- NMFS longline (through 2018);
- International Pacific Halibut Commission (IPHC) longline (through 2017); and
- Alaska Department of Fish and Game (ADF&G) trawl and longline (through 2018).

There were no changes to assessment methodology for the Tier 6 shark species (Pacific sleeper shark, salmon shark, and other/unidentified sharks). The random effects approach was used to estimate the biomass of spiny dogfish for the ABC/OFL calculations. The author recommended a spiny dogfish model (15.3A) which incorporates the following changes from the previously accepted model (15.1):

- The minimum biomass is adjusted by catchability $q = 0.21$ (Model 15.1 assumes $q = 1$); and
- *Fmax* $= 0.04$ is used (Model 15.1 used Tier 5 $F_{max} = M = 0.097$).

Spawning biomass and stock trends
Reliable total biomass estimates for the shark complex were unavailable, hence spawning biomass and stock trend estimates are unavailable.

Tier determination/Plan Team discussion and resulting ABC and OFL recommendations
For ABC/OFL estimates, spiny dogfish have been elevated to Tier 5, while the other components remain in Tier 6 s. The Team supports the authors' recommendation that spiny dogfish are Tier 5 with the new approach.

Sharks are caught incidentally in other target fisheries. Catches of sharks from 1992 through 2017 have been well below the ABC first established for the shark complex in 2011. There were insufficient data to determine if the shark complex is in an overfished condition, but the complex is not currently being subjected to overfishing.

Area apportionment
GOA sharks are managed Gulf-wide.

21. Squid (moved to Ecosystem Component)

As noted above, the squid complex was added to both FMPs as an Ecosystem Component in 2018. Information on the squid complex can be found in the report on Forage Fish.

22. Octopus [from the 2017 Assessment]

In accordance with the approved schedule, no assessment was conducted for octopus this year, however, a full stock assessment will be conducted in 2019. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2019 specifications. Additional information listed below summarizes the 2017 assessment.

Year	Biomass	OFL	ABC	TAC	Catch
\multicolumn{6}{l}{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 2019 and 2020 are those recommended by the Plan Team. 2018 catches current through November 8th, 2018.}					
2017	12,270	6,504	4,878	4,878	231
2018		1,300	975	975	139
2019		1,300	975		
2020		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 2019 - 2020 OFLs and ABCs, 2018 TACs, and 2018 catch (reported through November 8th, 2018).

Species	Area	2018 OFL	2018 ABC	2018 TAC	2018 Catch	2019 OFL	2019 ABC	2020 OFL	2020 ABC
Pollock	State GHL	n/a	4,037	0	0	n/a	3,396	n/a	2,722
	W(61)	n/a	30,188	30,188	30,676	n/a	24,875	n/a	19,939
	C(62)	n/a	79,495	79,495	79,974	n/a	67,388	n/a	54,016
	C(63)	n/a	40,939	40,939	39,511	n/a	34,443	n/a	27,608
	WYAK	n/a	6,833	6,833	4,125	n/a	5,748	n/a	4,607
	Subtotal	187,059	161,492	157,455	154,286	194,230	135,850	148,968	108,892
	EYAK/SEO	11,697	8,773	8,773	0	11,697	8,773	11,697	8,773
	Total	198,756	170,265	166,228	154,286	205,927	144,623	160,665	117,665
Pacific Cod	W	n/a	8,082	5,657	4,374	n/a	7,633	n/a	9,695
	C	n/a	8,118	6,089	5,120	n/a	7,667	n/a	9,738
	E	n/a	1,800	1,350	101	n/a	1,700	n/a	2,159
	Total	23,565	18,000	13,096	9,595	23,669	17,000	26,078	21,592
Sablefish	W	n/a	1,544	1,544	1,351	n/a	1,581	n/a	2,105
	C	n/a	5,158	5,158	5,617	n/a	5,178	n/a	6,931
	WYAK	n/a	1,829	1,829	1,804	n/a	1,828	n/a	2,433
	SEO	n/a	2,974	2,974	2,944	n/a	2,984	n/a	3,993
	Total	22,703	11,505	11,505	11,716	25,227	11,571	34,782	15,462
Shallow Water Flatfish	W	n/a	25,206	13,250	56	n/a	25,620	n/a	25,952
	C	n/a	25,315	25,315	2,664	n/a	25,731	n/a	26,065
	WYAK	n/a	2,242	2,242	1	n/a	2,279	n/a	2,308
	EYAK/SEO	n/a	1,925	1,925	1	n/a	1,957	n/a	1,983
	Total	67,240	54,688	42,732	2,722	68,309	55,587	69,167	56,308
Deep water flatfish	W	n/a	413	413	3	n/a	416	n/a	420
	C	n/a	3,400	3,400	181	n/a	3,443	n/a	3,488
	WYAK	n/a	3,239	3,239	6	n/a	3,280	n/a	3,323
	EYAK/SEO	n/a	2,332	2,332	5	n/a	2,362	n/a	2,393
	Total	11,294	9,385	9,385	195	11,434	9,501	11,581	9,624
Rex Sole	W	n/a	3,086	3,086	83	n/a	2,951	n/a	2,956
	C	n/a	8,739	8,739	1,553	n/a	8,357	n/a	8,371
	WYAK	n/a	1,737	1,737	2	n/a	1,657	n/a	1,664
	EYAK/SEO	n/a	1,811	1,811	0	n/a	1,727	n/a	1,734
	Total	18,706	15,373	15,373	1,638	17,889	14,692	17,942	14,725
Arrowtooth flounder	W	n/a	37,253	14,500	1,043	n/a	35,994	n/a	34,765
	C	n/a	73,480	48,000	16,391	n/a	70,995	n/a	68,575
	WYAK	n/a	16,468	6,900	39	n/a	15,911	n/a	15,368
	EYAK/SEO	n/a	23,744	6,900	25	n/a	22,941	n/a	22,157
	Total	180,697	150,945	76,300	17,498	174,598	145,841	168,634	140,865
Flathead sole	W	n/a	12,690	8,650	151	n/a	13,234	n/a	13,771
	C	n/a	20,238	15,400	1,894	n/a	21,109	n/a	21,965
	WYAK	n/a	1,932	1,932	0	n/a	2,016	n/a	2,097
	EYAK/SEO	n/a	406	406	0	n/a	423	n/a	440
	Total	43,011	35,266	26,388	2,045	44,865	36,782	46,666	38,273

Note shaded values were initially incorrect (values were 71,459 and 30,372 for 620 and 630 respectively for 2019 and 57,279 and 24,345 for 2020)

Table 1. (continued) Gulf of Alaska groundfish 2019 - 2020 OFLs and ABCs, 2018 TACs, and 2018 catch (reported through November 8th, 2018).

Species	Area	2018				2019		2020	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pacific Ocean Perch	W	n/a	3,312	3,312	3,225	n/a	3,227	n/a	3,125
	C	n/a	20,112	20,112	17,644	n/a	19,646	n/a	19,024
	WYAK	n/a	3,371	3,371	3,352	n/a	3,296	n/a	3,192
	W/C/WYAK	31,860	26,795	26,795	24,221	31,113	26,169	30,128	25,341
	SEO	2,902	2,441	2,441	0	2,838	2,386	2,748	2,311
	Total	34,762	29,236	29,236	24,221	33,951	28,555	32,876	27,652
Northern Rockfish	W	n/a	420	420	297	n/a	1,190	n/a	1,122
	C	n/a	3,261	3,261	2,047	n/a	3,338	n/a	3,147
	E	n/a	4	0	0	n/a	1	n/a	1
	Total	4,380	3,685	3,681	2,344	5,402	4,529	5,093	4,270
Shortraker rockfish	W	n/a	44	44	38	n/a	44	n/a	44
	C	n/a	305	305	315	n/a	305	n/a	305
	E	n/a	514	514	402	n/a	514	n/a	514
	Total	1,151	863	863	755	1,151	863	1,151	863
Dusky Rockfish	W	n/a	146	146	50	n/a	781	n/a	774
	C	n/a	3,502	3,502	2,831	n/a	2,764	n/a	2,742
	WYAK	n/a	232	232	11	n/a	95	n/a	94
	EYAK/SEO	n/a	77	77	7	n/a	60	n/a	60
	Total	4,841	3,957	3,957	2,899	4,521	3,700	4,484	3,670
Rougheye and Blacspotted rockfish	W	n/a	176	176	79	n/a	174	n/a	172
	C	n/a	556	556	434	n/a	550	n/a	545
	E	n/a	712	712	203	n/a	704	n/a	697
	Total	1,735	1,444	1,444	716	1,715	1,428	1,699	1,414
DSR	GOA-wide	394	250	250	133	411	261	411	261
Thornyhead rockfish	W	n/a	344	344	160	n/a	326	n/a	326
	C	n/a	921	921	665	n/a	911	n/a	911
	E	n/a	773	773	325	n/a	779	n/a	779
	Total	2,717	2,038	2,038	1,150	2,688	2,016	2,688	2,016
Other rockfish	WC	n/a	1,737	1,737	1,030	n/a	1,737	n/a	1,737
	WYAK	n/a	368	368	126	n/a	368	n/a	368
	EYAK/SEO	n/a	3,489	200	51	n/a	3,489	n/a	3,489
	Total	7,356	5,594	2,305	1,207	7,356	5,594	7,356	5,594
Atka mackerel	GOA-wide	6,200	4,700	3,000	1,431	6,200	4,700	6,200	4,700
Big Skate	W	n/a	504	504	312	n/a	504	n/a	504
	C	n/a	1,774	1,774	880	n/a	1,774	n/a	1,774
	E	n/a	570	570	70	n/a	570	n/a	570
	Total	3,797	2,848	2,848	1,262	3,797	2,848	3,797	2,848
Longnose Skate	W	n/a	149	149	58	n/a	149	n/a	149
	C	n/a	2,804	2,804	553	n/a	2,804	n/a	2,804
	E	n/a	619	619	232	n/a	619	n/a	619
	Total	4,763	3,572	3,572	843	4,763	3,572	4,763	3,572
Other Skates	GOA-wide	1,845	1,384	1,384	681	1,845	1,384	1,845	1,384
Sculpins	GOA-wide	6,958	5,301	5,301	550	6,958	5,301	6,958	5,301
Sharks	GOA-wide	6,020	4,514	4,514	2,886	10,913	8,184	10,913	8,184
Squids	GOA-wide	1,516	1,137	1,137	41	na	na	na	na
Octopuses	GOA-wide	1,300	975	975	139	1,300	975	1,300	975
Total		655,707	536,921	427,512	240,955	664,889	509,507	627,049	487,218

Table 2. Gulf of Alaska 2019 and 2020 stock abundance (biomass, t), overfishing levels (OFL, t), acceptable biological catch (ABC, t), fishing mortality rate corresponding to ABC (F_{ABC}), and fishing mortality rate corresponding to OFL (F_{OFL}) for the Western, Central, Eastern, West Yakutat, and East Yakutat/Southeast Outside regulatory areas. "Biomass" corresponds to projected 2019 abundance for the age+ range reported in the summary.

Stock or Assemblage	Tier	Area	Biomass	2019				2020			
				OFL	F_{OFL}	ABC	F_{ABC}	OFL	F_{OFL}	ABC	F_{ABC}
Pollock[*]	3a	W(61)				24,875				19,939	
		C(62)				67,388				54,016	
		C(63)			0.32	34,443	0.22		0.32	27,608	0.22
		WYAK				5,748				4,607	
		Subtotal	1,126,750	194,230		132,454		148,968		106,170	
	5	EYAK/SEO	38,989	11,697		8,773		11,697		8,773	
		Total				141,227				114,063	
Pacific Cod	3b	W				7,633				9,695	
		C			0.36	7,667	0.25		0.36	9,738	0.29
		E				1,700				2,159	
		Total	266,066	23,669		17,000		26,078		21,592	
Sablefish	3b	W				1,581				2,105	
		C				5,178				6,931	
		WYAK			0.096	1,828	0.081		0.117	2,433	0.099
		EYAK/SEO				2,984				3,993	
		Total	264,000	25,227		11,571		34,782		15,462	
Shallow water Flatfish	3a, 5	W				25,620				25,952	
		C			0.462, 0.326[a]	25,731	0.382, 0.271[a]		0.462, 0.326[a]	26,065	0.382, 0.271[a,]
		WYAK				2,279				2,308	
		EYAK/SEO				1,957				1,983	
		Total	343,755	68,309		55,587		69,167		56,308	
Deepwater Flatfish	3a, 6	W				416				420	
		C				3,443				3,488	
		WYAK			0.12	3,280	0.1		0.12	3,323	0.1
		EYAK/SEO				2,362				2,393	
		Total	145,926	11,434		9,501		11,581		9,624	
Rex sole	3a	W				2,951				2,956	
		C			0.29[b] 0.31	8,357	0.23[b] 0.25		0.29[b] 0.31	8,371	0.23[b] 0.25
		WYAK				1,657				1,664	
		EYAK/SEO				1,727				1,734	
		Total	98,818	17,889		14,692		17,942		14,725	
Arrowtooth Flounder	3a	W				35,994				34,765	
		C				70,995				68,575	
		WYAK			0.238	15,911	0.196		0.238	15,368	0.196
		EYAK/SEO				22,941				22,157	
		Total	1,391,460	174,598		145,841		168,634		140,865	
Flathead sole	3a	W				13,234				13,771	
		C				21,109				21,965	
		WYAK			0.36	2,016	0.28		0.36	2,097	0.28
		EYAK/SEO				423				440	
		Total	283,285	44,865		36,782		46,666		38,273	

[*] The Prince William Sound GHL (2.5% of ABC; 3,396 t in 2019, 2,722 t in 2020) is deducted from the ABC prior to apportionment.

[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 separately for two different areas (Western-Central and Eastern).

Note shaded values were initially incorrect (values were 71,459 and 30,372 for 620 and 630 respectively for 2019 and 57,279 and 24,345 for 2020)

Table 2.   Continued… Gulf of Alaska 2019 and 2020 ABCs, biomass, and overfishing levels (t) for the Western, Central, Eastern, West Yakutat, and East Yakutat/Southeast Outside regulatory areas.

Stock or Assemblage	Tier	Area	Biomass	2019				2020			
				OFL	F_{OFL}	ABC	F_{ABC}	OFL	F_{OFL}	ABC	F_{ABC}
Pacific Ocean Perch	3a	W				3,227				3,125	
		C				19,646				19,024	
		WYAK			0.113	3,296	0.094		0.113	3,192	0.094
		EYAK/SEO				2,386				2,311	
		Total	496,922	33,951		28,555		32,876		27,652	
Northern Rockfish	3a	W				1,190				1,122	
		C			0.073	3,338	0.061		0.073	3,147	0.061
		E				1				1	
		Total	87,409	5,402		4,529		5,093		4,270	
Shortraker*	5	W				44				44	
		C			0.03	305	0.0225		0.03	305	0.0225
		E				514				514	
		Total	38,361	1,151		863		1,151		863	
Dusky Rockfish	3a	W				781				774	
		C				2,764				2,742	
		WYAK			0.118	95	0.095		0.118	94	0.095
		EYAK/SEO				60				60	
		Total	55,247	4,521		3,700		4,484		3,670	
Rougheye / Blackspotted Rockfish	3a	W				174				172	
		C			0.048	550	0.040		0.048	545	0.040
		E				704				697	
		Total	45,363	1,715		1,428		1,699		1,414	
DSR	4, 6	Total	12,029[c]	411	0.032[c]	261	0.02[c]	411	0.032[c]	261	0.02[c]
Thornyhead rockfish	5	W				326				326	
		C			0.03	911	0.0225		0.03	911	0.0225
		E				779				779	
		Total	89,609	2,688		2,016		2,688		2,016	
Other rockfish*	4, 5, 6	W				1,737				1,737	
		C			0.079[a]	368	0.065[b]		0.079[a]	368	0.065[b]
		E			0.073[a]	3,489	0.055[b]		0.073[a]	3,489	0.055[b]
		Total	96,107	7,356		5,594		7,356		5,594	
Atka mackerel	6		--	6,200	--	4,700	--	6,200	--	4,700	--
Big Skates*	5	W				504				504	
		C			0.1	1,774	0.075		0.1	1,774	0.075
		E				570				570	
		Total	37,975	3,797		2,848		3,797		2,848	
Longnose* Skates	5	W				149				149	
		C			0.1	2,804	0.075		0.1	2,804	0.075
		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	7,757	0.16	6,958	0.21	5,301	0.16
Sharks	6		54,301[d]	10,913	0.04[d]	8,184	0.03[d]	10,913	0.04[d]	8,184	0.03[d]
Squid						*Moved to ecosystem component*					
Octopus	6*			1,300	--	975	--	1,300	--	975	--
Total		Total		664,889		509,507		627,049		487,218	

* Assessments for shortraker rockfish, other rockfish, skates, sculpins, and octopus in will be done in future years.

[a] F_{OFL} equal to 0.079 for Tier 4 sharpchin and 0.73 for 17 Tier 5 other rockfish species.

[b] F_{ABC} equal to 0.065 for Tier 4 sharpchin rockfish and 0.055 for 17 Tier 5 other rockfish species.

[c] Values listed are for Tier 4 yelloweye rockfish.

[d] 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 2019 and 2020 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum permissible.

Species	Tier	*Max F_{ABC}*	*Max* ABC	F_{ABC}	ABC
2019					
Pollock (W/C/WYK)	3a	0.27	158,518	0.22	135,850
Pacific cod	3b	0.29	19,655	0.25	17,000
Sablefish	3b	0.081	21,704	0.044	11,571
Demersal shelf rockfish	4, 6	0.026	333	0.02	261
2020					
Pollock (W/C/WYK)	3a	0.27	123,870	0.23	108,892
Sablefish	3a	0.099	29,982	0.051	15,462
Demersal shelf rockfish	4, 6	0.026	333	0.02	261

Table 4.	Groundfish landings (metric tons) in the Gulf of Alaska,1956-2018.

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	184,167	35,204	10,500	6,363	26,863	26,268
2018	154,286	9,595	11,716	6,600	17,498	27,320

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.

Table 4. (cont'd) Groundfish landings (t) in the Gulf of Alaska,1956-2018. 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	2,622	130	1,021	1,074	4,435	4,930	303,577
2018	2,899	133	1,150	1,431	2,786	5,541	240,955