

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



with contributions by

K. Aydin, S. Barbeaux, M. Bryan, S. Cleaver, C. Cunningham, O. Davis, M. Dorn, A. Dreary, K. Echave, C. Faunce, K. Fenske, B. Fissel, D. Hanselman, A. Havron, K. Holsman, P. Hulson, L. Hillier, J. Ianelli, M., Jaenicke, D. Jones, N. Lauffenburger, B. Laurel, S. Lowe, C. Lunsford, P. Malecha, C. McGilliard, D. Nichol, N. Nichols, A. Olson, O. Ormseth, W. Palsson, C. Rodgveller, L. Rogers, J. Rumble, K. Shotwell, K. Spalinger, P. Spencer, I. Spies, M. Szymkowiak, T. TenBrink, C. Tribuzio, B. Williams, K. Williams, K. Wood, Q. Yang, S. Zador

November 2019

**North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501**

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

GOA Introduction Contents

Summary	3
Overview of Stock Assessments.....	9
Economic Summary of the GOA commercial groundfish fisheries in 2018.....	11
Ecosystem Considerations summary	14
Stock summaries.....	16
1. Walleye pollock.....	16
2. Pacific cod.....	18
3. Sablefish.....	19
4. Shallow water flatfish	21
5. Deepwater flatfish complex (Dover sole and others)	22
6. Rex sole.....	23
7. Arrowtooth flounder	24
8. Flathead sole	25
9. Pacific ocean perch	25
10. Northern rockfish.....	27
11. Shortraker rockfish	28
12. Dusky rockfish.....	29
13. Rougheye and blackspotted rockfish	30
14. Demersal shelf rockfish	31
15. Thornyheads (from the 2018 assessment)	31
16. Other rockfish	33
17. Atka mackerel.....	34
18. Skates.....	35
19. Sculpins.....	36
20. Sharks (from the 2018 assessment)	36
21. Octopus	38
Tables.....	39

NOTE: full chapters are available through links within each summary.

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 North Pacific Fishery Management Council (Council) require that drafts of the SAFE reports be produced each year in time for the December 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 12-15, 2019 to review the status of stocks of nineteen 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, Marysia Szymkowiak, Paul Spencer, Sara Cleaver, 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) category 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 2019, the NPFMC took final action to amend the FMPs for the BSAI (Amendment 121) and GOA (Amendment 110) regions and moved the sculpin stock complex into the ecosystem component category and established an MRA of 20% for sculpins for all basis species in both the BSAI and GOA. If Amendments 121/110 and their implementing regulations are approved by the Secretary of Commerce,

Amendments 121/110 are anticipated to be effective in 2020. Until Amendment 110 is effective, NMFS will continue to publish OFLs, ABCs, and TACs for sculpins in the GOA groundfish harvest specifications.

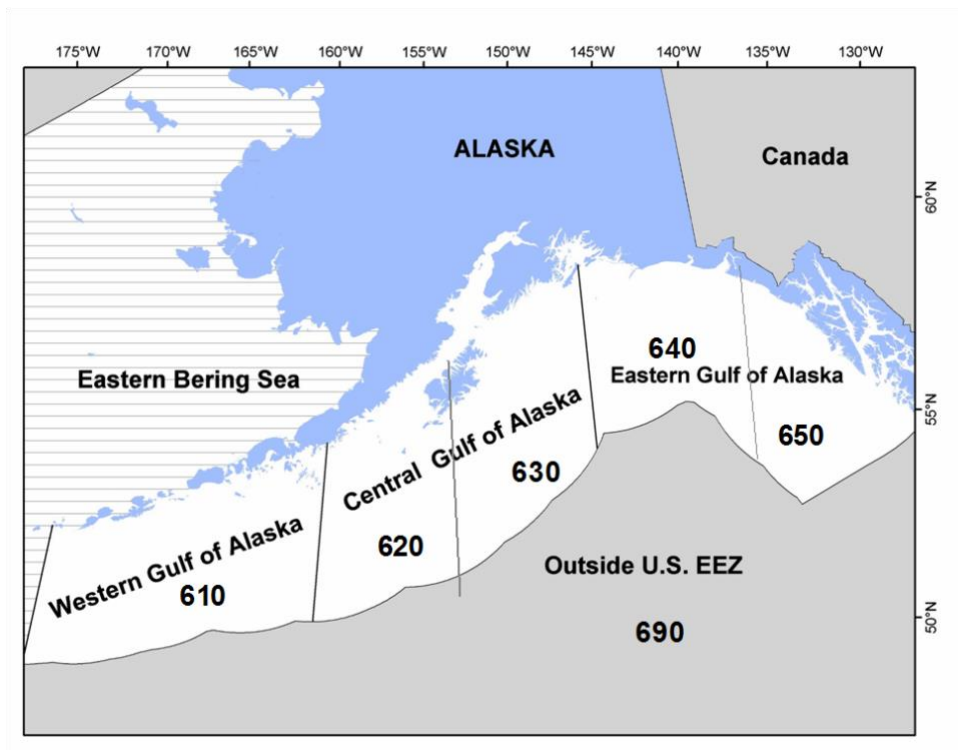


Figure 1. Gulf of Alaska statistical and reporting areas.

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 database 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 2020, sculpins will also be included in the Ecosystem Component.

- 3) **Grenadiers** – The grenadier complex (family Macrouridae), also known as “rattails”, are comprised of at least seven species of grenadier known to occur in Alaskan waters, but only three are commonly found at depths shallow enough to be encountered in commercial fishing operations or in fish surveys: giant grenadier (*Albatrossia pectoralis*), Pacific grenadier (*Coryphaenoides acrolepis*), and popeye grenadier (*Coryphaenoides cinereus*).
- 4) **Squids** – Beginning in 2019, squid is included as an Ecosystem Component, rather than in the Fishery as a target species. 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 and implemented in 2019

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

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

Groundfish catches are managed against TAC specifications for the EEZ and near coastal waters of the GOA. State of Alaska internal water groundfish populations are typically not covered by NMFS surveys and catches from internal water fisheries are 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 Plan Team deducted a value for the 2020 and 2021 PWS GHL (equal to 2.5% of the recommended 2020 and 2021 W/C/WY pollock ABCs) from the recommended 2020 and 2021 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 2020 and 2021 W/C/WY pollock apportioned ABCs are listed in the pollock summary under *Area apportionment*.

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

the 95% confidence limit from all three surveys. The rationale for providing a range was based on a desire to incorporate the variance surrounding the distribution of biomass for those species/complexes that could potentially be constrained by the recommended ABC splits.

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

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.

Acceptable Biological Catch 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.

Overfishing 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: <i>Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.</i> 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: <i>Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.</i> 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: <i>Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.</i> 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: <i>Reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.</i> $F_{OFL} = F_{35\%}$ $F_{ABC} \leq F_{40\%}$ 5) Information available: <i>Reliable point estimates of B and natural mortality rate M.</i> $F_{OFL} = M$ $F_{ABC} \leq 0.75 \times M$ 6) Information available: <i>Reliable catch history from 1978 through 1995.</i> $OFL =$ 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 $ABC \leq 0.75 \times OFL$
-------------	---

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

Overfished (listed in each assessment as scenario 6):

In all future years, F is set equal to F_{OFL} . (Rationale: This scenario determines whether a stock is overfished. If the stock is expected to be 1) above its MSY level in 2019 or 2) above $\frac{1}{2}$ of its MSY level in 2019 and above its MSY level in 2029 under this scenario, then the stock is not overfished.)

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

In 2020 and 2021, 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 2021 or 2) above $1/2$ of its MSY level in 2021 and expected to be above its MSY level in 2031 under this scenario, then the stock is not approaching an overfished condition.)

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

Overview of Stock Assessments

The status of individual groundfish stocks managed under the FMP is summarized in this section. The spawning biomass estimates of pollock, sablefish, 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 spawning biomass of Pacific cod is below the proxy for B_{MSY} . 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.

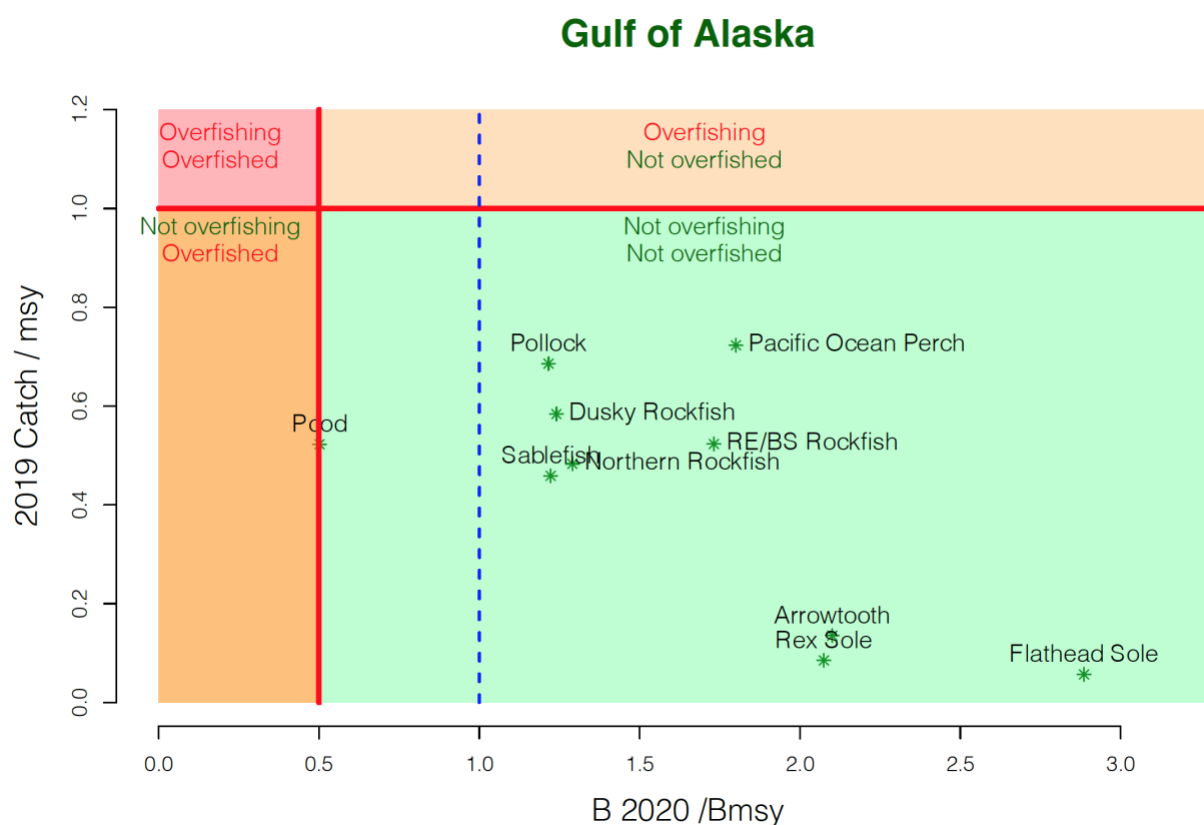


Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{MSY} ; horizontal axis) and current year catch relative to fishing at F_{MSY} (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

Summary and Use of Terms

Table 1 provides a summary of the status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2019, and recommendations for ABCs and overfishing levels (OFLs) for 2020 and 2021. Fishing mortality rates (F) and OFLs used to set these specifications are listed in Table 2. ABCs and TACs are specified for each of the Gulf of Alaska regulatory areas illustrated in Figure 1. Table 3 provides a list of species for which the ABC recommendations are below the maximum permissible. Table 4 provides historical groundfish catches in the GOA, 1956-2019.

The sums of the preliminary 2020 and 2021 ABCs for target species are 463,466 and 477,927 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 2020 and 2021 OFLs are 595,362 and 624,684 t, respectively. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2020 will be considerably under this upper limit. For perspective, the sum of the 2019 TACs was 430,569 t and the sum of the ABCs was 509,507 t (and catch through November 2nd, 2019 was 209,982 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 2018 and 2019 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 2020 and 2021 correspond to the Plan Team recommendations.
- (4) The exploitable biomass for 2018 and 2019 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2020 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 2020 and 2021 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).

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 2020 harvest specifications (from Council recommendations in December 2019) are in place to start the fishery on January 1, 2020, but these will be replaced by final harvest specifications that will be recommended by the Council in December 2019. The final 2020 and 2021 harvest specifications will become effective when final rulemaking occurs in February or March 2020. 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 2021 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2021 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	2019 Assessment status	Tier	Schedule (years)	Year of next Full Assessment	
Pollock	Full	3	1	2020	
Pacific cod	Full	3	1	2020	
Sablefish	Full	3	1	2020	
Northern and southern rock sole	Partial	3	4	2021	
Shallow water flatfish	Partial	5	4	2021	
Deepwater flatfish (Dover)	Full	3/6	4	2023	
Rex sole	Partial	5	4	2021	
Arrowtooth flounder	Full	3	2	2021	
Flathead sole	Partial	3	2	2021	
Pacific ocean perch	Full	3	2	2021	
Northern rockfish	Partial	3	2	2020	
Shortraker rockfish	Full	5	2	2021	
Other rockfish	Full	4/5/6	2	2021	
Rougheye & blackspotted rockfish	Full	3	2	2021	
Dusky rockfish	Partial	3	2	2020	
Demersal shelf rockfish	Partial	4/6	2	2020	
Thornyhead rockfish	None	5	2	2020	
Sharks	None	5/6	2	2020	
Sculpin	Partial	5	4	2021	
Skates	Full	5	2	2019	
Thornyhead rockfish	None	5	2	2020	
Atka mackerel	Full	6	2	2021	
Octopus	Full	6	2	2021	

Economic Summary of the GOA commercial groundfish fisheries in 2018

The ex-vessel value of all Alaska domestic fish and shellfish catch, which includes the amount paid to harvesters for fish caught, and the estimated value of pre-processed fish species that are caught by catcher/processors, decreased from \$2,039 million in 2017 to \$1,834 million in 2018. The first wholesale value of 2018 groundfish catch after primary processing was \$2,543 million. The 2018 total groundfish catch decreased by 2.5%, and the total first-wholesale value of groundfish catch decreased by 1%, relative to 2017.

The groundfish fisheries accounted for the largest share (54%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon fishery was second with \$551 million or 30% of the total

Alaska ex-vessel value. The value of the shellfish fishery amounted to \$182 million or 10% of the total for Alaska and exceeded the value of Pacific halibut with \$88 million or 5% 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, current year product price and ex-vessel price projections, an Amendment 80 fishery economic data report (EDR) summary, an Amendment 91 fishery economic data report (EDR), 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. The report will now also include a Gulf Trawl economic data report but will exclude the previous community participation summaries and the catch share fishery indicators, which will be moved into a separate report due to a time lag in data availability. Data tables are organized into four relatively distinct sections: (1) All Alaska, (2) BSAI, (3) GOA, and (4) Pacific halibut. 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. Generally, the data presented in this report cover 2014-2018, 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: <https://reports.psmfc.org/akfin> and <https://psesev.psmfc.org/PSESv-2/>

Decomposition of the change in first-wholesale revenues from 2017-18 in the GOA

The following brief analysis summarizes the overall changes that occurred between 2017-18 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2019 Economic SAFE report, the ex-vessel value of GOA groundfish decreased from \$213 million in 2017 to \$169 million in 2018 (values adjusted to 2018 dollars) (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the Gulf of Alaska (GOA) decreased between 2017 (\$375 million) and 2018 (\$297 million) (Figure 4). At the same time, the total quantity of groundfish products from the GOA decreased from 137 thousand metric tons to 114 thousand metric tons, a 17% decrease. The changes in first-wholesale revenues from processing and production in the GOA differ from those in the BSAI, which saw a 0.06% year-to-year decrease in groundfish products and 2% increase in first-wholesale value.

By species group, despite positive price effects the decrease in catch resulted in a 59% decrease in ex-vessel value to \$14.5 million for Pacific cod from the GOA for 2017-18 (Figure 5). For GOA pollock, despite the decrease in retained catch the ex-vessel value increased by 20% to \$42.25 million due to ex-vessel prices increases of 41% to \$0.12 per pound. Despite a 4.5% increase in retained catch for sablefish in GOA, ex-vessel values decreased by 24% to \$87.9 million due to a 27% decrease in ex-vessel prices due to the smaller average size of fish landed. In the GOA retained catch for all flatfish species decreased 23%, driven by a 35% decrease in arrowtooth flounder catch. For rockfish, a positive price and quantity effect provided for a 23% increase in ex-vessel values.

By product group, negative price and quantity effects in the whole and head and gut (whole-H&G) category resulted in a negative net effect of \$41.8 million in the GOA first-wholesale revenue decomposition for 2017-18, while positive price effects were not enough to offset negative quantity effects in the fillet category with a negative net value effect of \$25.9 million. A positive price effect offset a negative quantity effect in surimi, with a net effect of \$3 million.

In summary, first-wholesale revenues from the GOA groundfish fisheries decreased by about \$78 million from 2017-18. The main drivers of this were negative net revenue effects for sablefish and Pacific cod. In

comparison, first-wholesale revenues increased by \$47.1 million from 2017-18 in the BSAI due in large part to positive price and quantity effects for pollock and a strong positive price effect for Pacific cod.

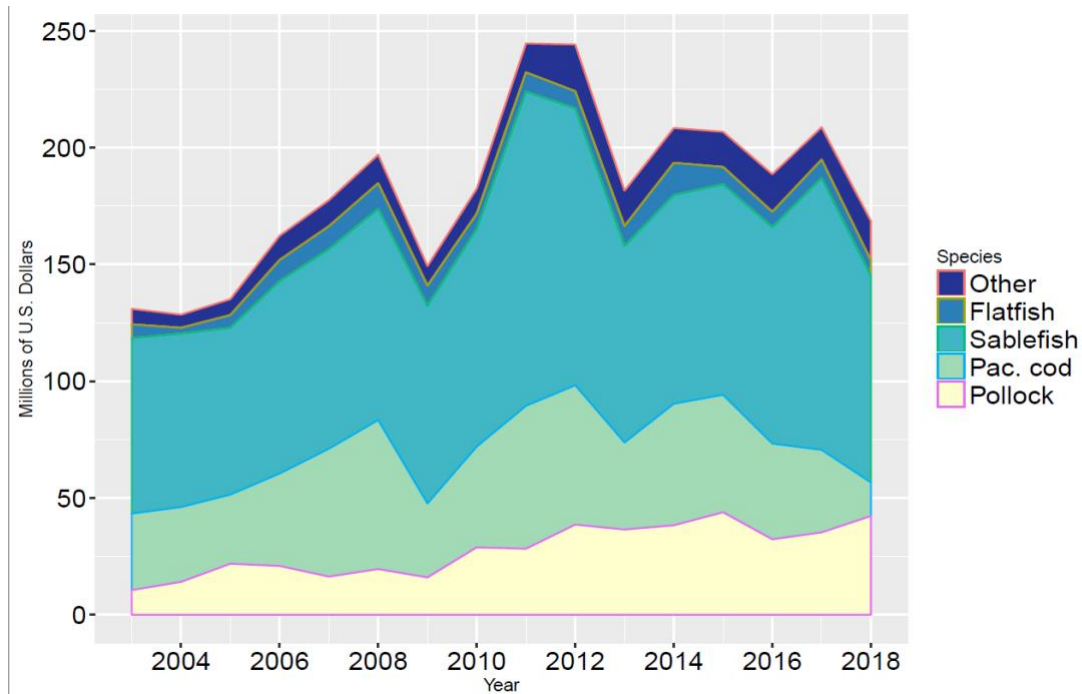


Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2003-2018 (base year = 2018).

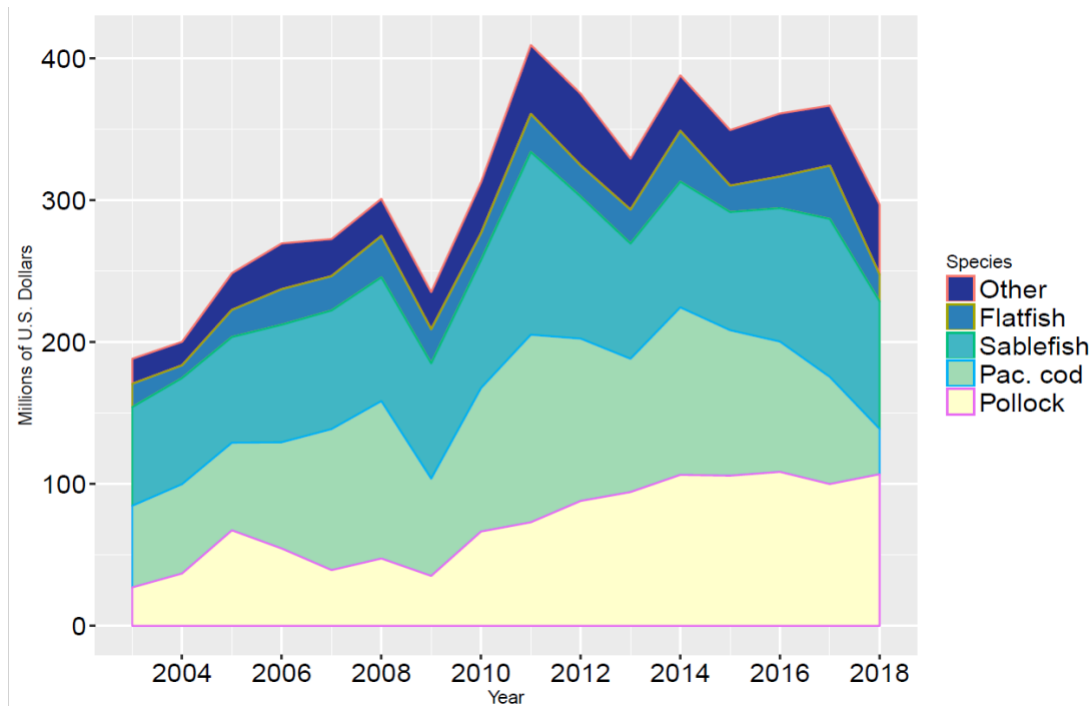


Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2003-2018 (base year = 2018).

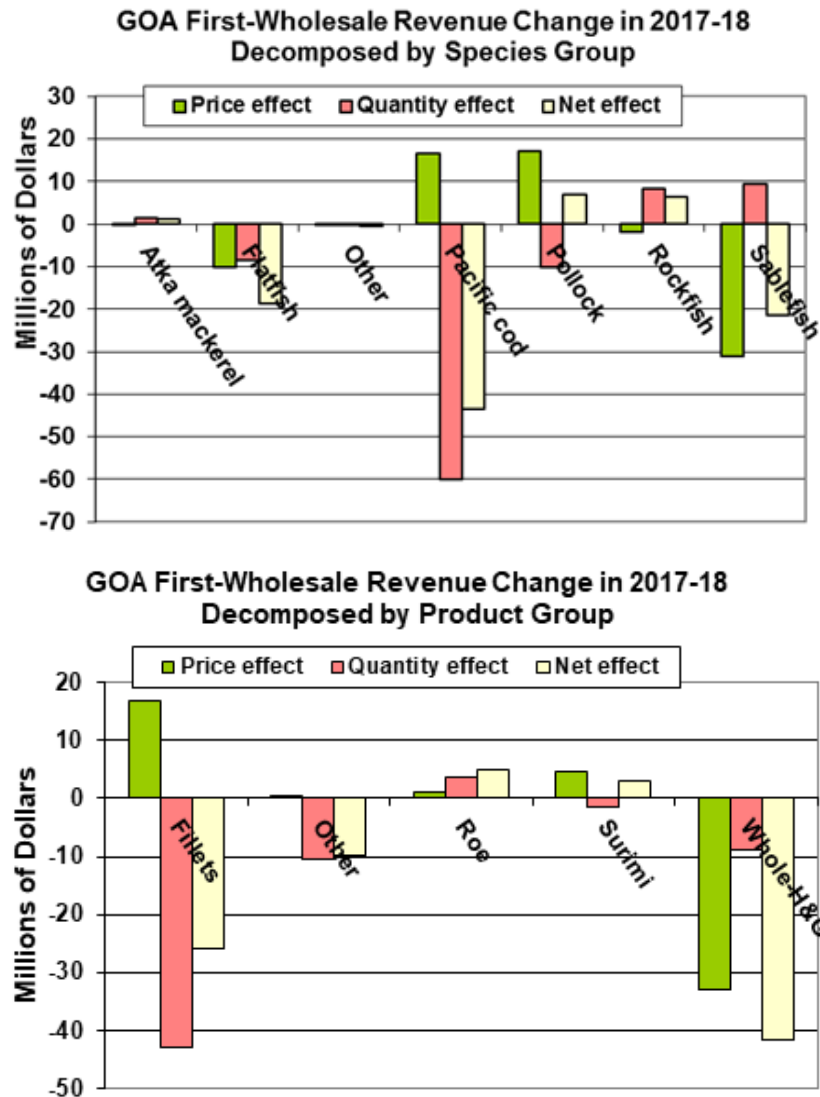


Figure 5. Decomposition of the change in first-wholesale revenues from 2017-18 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the 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

Western Gulf of Alaska 2019 Report Card

- The western Gulf of Alaska has been in a heatwave for most of 2019. Summer SST's were similar to the warmest temperatures in the 2014–2016 marine heatwave. The PDO declined to neutral, reflecting warm conditions across the NE Pacific.
- Mesozooplankton biomass declined in 2018 after increases from 2014–2017.

- Copepod community size was larger in 2017-2018 than it had been during 2014–2016, with more large species available. Lower biomass in 2018 could reduce foraging conditions for planktivores relative to 2017.
- Octopus biomass estimates from the 2019 NMFS bottom trawl survey were the highest value of the time series, while both hermit crabs and brittle stars decreased to below their survey averages.
- Capelin numbers from rhinoceros auklet diets at Middleton Island were abundant 2008-2013 but are minimal in chick diets in recent years. The decline coincided with the period of warm water in the GOA.
- Fish apex predator biomass during 2019 bottom trawl survey increased from 2017 to 2019 (13%) but remains well below the long-term mean. The trend is driven primarily by increases in Pacific cod and arrowtooth flounder which are both at their second lowest abundance in the survey time series, and increases in sablefish, which is above their long-term mean and at its third highest abundance in the survey time series.
- Black-legged kittiwakes in the Semidi Islands experienced reproductive failure in 2019 during chick-rearing, reflecting a potential decline in sea surface prey availability. Diving piscivorous seabirds in the western GOA had strong reproductive success in 2019.
- Model estimates of western GOA Steller sea lion non-pup counts were approaching the long-term mean in 2017, suggesting favorable conditions. A decline was seen 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.

Eastern Gulf of Alaska 2019 Report Card

- Weak-moderate El Niño last winter. Near-neutral El Niño expected for winter 2019–2020.
- Total zooplankton density in Icy Strait in 2019 was below average, a small decline from 2017 and 2018, suggesting average foraging conditions for planktivores.
- Copepod community size remained low due to below-average abundance of large copepods while small copepods were nearly average. This suggests below-average quality zooplankton prey, confirmed by low lipid content in all measured zooplankton groups.
- Motile epifauna was well above average in 2019 (BT survey, 2nd highest over the time series). Brittle stars are the largest contributor and increased 9% from 2017.
- A decrease in estimated herring biomass in southeastern Alaska has been observed since 2011. Modeling indicates that the declines may be related to lower survival.
- BT survey fish apex predator biomass increased 2% from 2017 to 2019 but is below the long-term mean. Arrowtooth flounder are the dominant biomass component and increased 7% from 2017. Other groups contributing to the increase are sablefish, big skate, and Pacific cod.
- Growth rates of piscivorous rhinoceros auklet chicks continue to be anomalously low, similar to the 2015–2016 heatwave years, suggesting insufficient prey for optimal chick growth.
- Model estimates of eastern Gulf of Alaska Steller sea lion non-pup counts were above average through 2017. Non-pup counts declined 12% in 2017 relative to 2015.
- Human populations in fishing communities in the GOA remain stable since 2000, with no significant population changes within large communities between 2010 and 2018.

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

Large gray whale mortality event was observed coast-wide in 2019. Dead whales were found to be emaciated and were likely attempting to return to their feeding grounds in the North Pacific/Chukchi Sea. Possible range expansion of market squid (*Doryteuthis opalescens*) to Alaska—egg cases found on crab pot gear around Kodiak in 2016 and 2018 and on trawl nets in Little Port Walter in 2015- 2016, and again in 2018 – 2019. This species was previously thought to spawn only south of BC, Canada. These squid were also observed in seabird chick diets.

Stock summaries

1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2020 and 2021. 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 2020 and 2021 are those recommended by the Plan Team. Catch data were through November 2 nd , 2019. 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 was computed as 2.5% of the total W/C/WYAK ABC.						
Area	Year	Biomass	OFL	ABC	TAC	Catch
W/C/WYAK	2018	1,124,930	187,059	161,492	157,455	154,286
	2019	1,126,750	194,230	135,850	132,454	117,019
	2020	1,007,850	140,674	108,494		
	2021		149,988	111,888		
SEO	2018	38,989	11,697	8,773	8,773	0
	2019	38,989	11,697	8,773	8,773	0
	2020	45,103	13,531	10,148		
	2021		13,531	10,148		
GOA-wide	2018	1,163,919	198,756	170,265	166,228	154,286
	2019	1,165,739	205,927	144,623	141,227	117,019
	2020	1,052,953	154,205	118,642		
	2021		163,519	122,036		

Changes from the previous assessment

This year's pollock assessment features the following new data: 1) 2018 total catch and catch-at-age from the fishery, 2) 2019 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2019 biomass and length composition from NMFS bottom trawl survey, 4) 2019 biomass from the ADFG crab/groundfish trawl survey, and 5) 2019 biomass and length composition from the summer GOA-wide acoustic survey.

The age-structured assessment model used for GOA W/C/WYAK pollock assessment (Model 19.1) was similar to the 2018 assessment (Model 18.3). Model 19.1 was the same as Model 18.3, with the addition of a larger penalty on catchability random walk for Shelikof Strait acoustic survey.

The changes to the catchability random walk were incorporated largely to prevent the catchability parameter estimate from going above 1, as the author noted that the Shelikof Strait time series is meant to reflect a dominant fraction of the GOA biomass. By imposing a stronger penalty on the random walk process, the time-varying catchability parameter was kept from exceeding 1. **The Team concurred with the assessment author to use Model 19.1, and recommended that a more direct method for bounding catchability be examined for future models.**

Spawning biomass and stock trends

The spawning stock is projected to continue to decline in 2020 as the 2012 year class is further reduced in abundance. However, the presence of two incoming year classes observed in the 2019 surveys should result in a stabilization in biomass as these fish mature and replace the 2012 fish. Survey data in 2019 were again mostly contradictory (similar to 2017 and 2018) with the Shelikof Strait acoustic survey showing a slight decrease but continuing to show an overall high biomass driven by the 2012 year class. A small decrease in the bottom trawl survey relative to 2017 was observed as was a small increase in the

ADF&G nearshore survey. These three surveys remain relatively unchanged from the previous assessment, continuing the contradictory trend issue. The B40% estimate of 194,000 t represents a 12% decrease from the B40% estimate of 221,000 t in the 2018 assessment. The model projection of female spawning biomass in 2020 is 206,664 t, which is 42.6% of unfished spawning biomass (based on average post-1977 recruitment) and above B40% (194,000 t).

To examine the divergence of the indices, the author presented a series of figures showing the vertical distribution of pollock derived from the four most recent summer acoustic surveys (2013-2019). The plots showed that vertical distribution varies by survey, but trends were inconsistent among areas and did not present a strong case for availability changes being responsible for recent diverging trends in surveys.

The 2019 assessment included a change in how maturity at length and age were estimated. Individual trawl sample data on maturity collected during the Shelikof Strait acoustic survey were weighted by estimated local abundance from the acoustics. This approach reduced influence of samples from low backscatter areas. The impacts of this change were relatively minor.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Because the model projection of female spawning biomass in 2020 is above $B_{40\%}$, the W/C/WYAK Gulf of Alaska pollock stock is in Tier 3a. The model estimated 2020 age-3+ biomass is 1,007,850 t (for the W/C/WYAK areas) and the maximum ABC for 2020 is 120,549 t.

This year's pollock assessment incorporated a risk assessment matrix for evaluating whether a reduction from the maximum permissible ABC is warranted. The author scored the current risk conditions as Level 2 for the first category, referring to elevated concern with the stock assessment. This was due primarily to data conflicts among survey indices. All other categories were scored at Level 1, indicating minimal concern. The Team agreed with the author's categorization of the risk factors. The author proposed a 10% reduction from $maxABC$ based on the risk analysis. As in the previous year, the Team noted a lack of clear rationale and guidance on how to derive an adjustment. The Team noted that the lower ABC was similar to what would result if the 5-year average F was applied. This alternative produced a 12% reduction from the $maxABC$ for 2020 which the Team noted was quite similar to the author's recommended reduction.

The Plan Team supported the author's recommendation of a 10% reduction from maximum permissible ABC for 2020. The resulting 2020 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 108,494 t which is a decrease of 20% from the 2019 ABC, and a 33% decrease from 2018 ABC. The ABC is expected to stabilize in 2021 as the 2017 and 2018 year classes recruit to the fishery. The OFL is 140,674 t for 2020. The 2019 Prince William Sound (PWS) GHF is 2,712 t (2.5% of the ABC)

Pollock in southeast Alaska (East Yakutat and Southeastern areas) are on Tier 5. The recommended ABC is 10,148 t for 2020 and 2021, which is a 16% increase from 2019 ABC. These recommendations are based on natural mortality (0.3) and the random effects model fit to the 1990-2019 bottom trawl survey biomass estimates in Southeast Alaska.

Status determination

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

Area apportionment

The assessment was updated to include the most recent data available for area apportionments within each season (Appendix C of the GOA pollock chapter). 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 (2,712 t in 2020 and 2,797 t in 2021) 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 2020 and 2021 pollock ABCs for the Gulf of Alaska (t).						
Year	610 Western	620 Central	630 Central	640 WYAK	650 SEO	Total
2020	19,175	54,456	26,597	5,554	10,148	115,930
2021	19,775	56,160	27,429	5,728	10,148	119,239

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 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 2 nd , 2019.					
Year	Age 0+ biomass	OFL	ABC	TAC	Catch
2018	170,565	23,565	18,000	13,096	10,899
2019	207,198	23,669	17,000	12,368	10,909
2020	203,373	17,794	14,621		
2021		30,099	24,820		

Changes from the previous assessment

Data updated from the 2018 assessment included federal and state fishery catch for 2018 and 2019 (preliminary catch projected through the end of 2019), federal and state fishery size composition for 2018 and 2019, 2019 AFSC longline survey abundance index (Relative Population Numbers, RPN) and size composition, 2019 AFSC bottom trawl survey biomass and length composition, and 2010-2011 fishery conditional length-at-age. The 2019 trawl survey biomass estimate increased from 2017 but was the second lowest in the time series and had the largest coefficient of variation in the time series. The longline survey RPN for 2019 decreased from 2018 and is now the lowest value in the time series.

The author evaluated several models. The models presented by the author included adding conditional length-at-age data prior to 2007, changing the plus age group from 20+ to 10+, including ageing error, and including ageing bias. The Team concurred with the model recommended by the author. This model fit the data well, included additional composition data to help inform the model's estimates, and accounted for ageing error and bias that is known to occur for this species.

Spawning biomass and stock trends

The $B_{40\%}$ estimate was 75,112 t, with a projected 2020 spawning biomass of 32,958 t. The 2017 and 2018 year classes are emerging in the population, but were estimated to be below average. Recruitment since 2013 is below the 1977-2015 average. Spawning biomass was projected to increase from 2020 to 2021.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

This stock was determined to be in Tier 3b and the 2019 estimated spawning biomass was 17.7% of $B_{100\%}$. The $F_{35\%}$ and $F_{40\%}$ values are 0.27 and 0.22, respectively. The maximum permissible ABC is 14,621 t. The Team concurred with the authors' recommended ABC and OFL values. The recommended ABC is a 14% decrease from the 2019 ABC of 17,000 t.

Status determination

The stock is not being subjected to overfishing and is neither overfished nor approaching an overfished condition. Given estimated recruitment and 2019 population age structure (and mean natural mortality rates), the stock is expected to be at about 22% of $B_{100\%}$ by 2021.

Area apportionment

Since the 2014 assessment, the random effects model applied to trawl survey biomass estimates has been used for Pacific cod apportionment. Using this method resulted in a large decrease in apportionment for the Western GOA for 2020 and an increase for the Central GOA that would be above what the ABC was in 2019 for this region. Due to the current depressed status of the stock, the movement potential of the species, and the availability of multiple indices that were not integrated into the random effects model, the Team recommended using the average of the apportionment values from 2017 and 2019 which gives the area-apportioned ABCs of:

Year	Western	Central	Eastern	Total
2020	4,942	8,458	1,221	14,621
2021	8,390	14,358	2,072	24,820

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 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 2 nd , 2019.					
Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2018	356,000	22,703	11,505	11,505	12,037
2019	264,000	25,227	11,571	11,571	12,219
2020	387,000	38,723	14,393		
2021		49,681	17,990		

Changes from the previous assessment

New data included in the assessment model were relative abundance and length data from the 2019 longline survey, relative abundance and length data from the 2018 fixed gear fishery, length data from the 2018 trawl fisheries, age data from the 2018 longline survey and 2018 fixed gear fishery, updated catch for 2018, and projected 2019 - 2021 catches. Estimates of killer and sperm whale depredation in the fishery were updated and projected for 2019 - 2021. Biomass estimates and length compositions from the 2019 NMFS bottom trawl survey were also added. There were no changes from the 2018 assessment methodology. This year the assessment had several appendices including an updated Ecosystem and Socioeconomic Profile (Appendix 3C) and one on a preliminary simulation modeling approach to evaluate apportionment alternatives (Appendix 3D).

Spawning biomass and stock trends

Projected female spawning biomass (combined areas) for 2020 is 113,368 t (43% of $B_{100\%}$), therefore sablefish were determined to be in Tier 3a. The longline survey abundance index increased 47% from 2018 to 2019 following a 14% increase in 2018 from 2017. The lowest point of the time series was 2015. The fishery catch-rate/abundance index stayed level from 2017 to 2018 and is at the time series low (the 2019 data were unavailable). Spawning biomass is projected to increase rapidly from 2020 to 2022, and then stabilize.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Sablefish are managed under Tier 3a of NPFMC harvest rules. Reference points were calculated using recruitments from 1977-2015. Instead of maximum permissible ABC, the authors recommended the 2020 ABC to be 25% higher than the 2019 ABC, which translates to a 57% reduction from the maximum ABC

The author recommended ABCs for 2020 and 2021 are lower than maximum permissible ABC for several reasons based on application of the risk table. The Team concurred with the application and the reduction, citing primarily issues related to year-class estimates expected to be revised downwards and lack of fits to abundance indices in recent years. The 2014 and 2016 year classes are expected to comprise about 33% and 14% of the 2020 spawning biomass, respectively, and the authors noted that this is unique in the time

series. Also, uncertainty about the environmental conditions and how they may affect these incoming year classes was highlighted.

The Teams discussed the amount of reduction from *maxABC* (57%) and agreed a recommended 25% increase from the 2019 ABC not only represents the largest increase in ABC from 1996 to present, but also serves to keep fishery effort stable relative to 2019. Limiting increased effort on young, relatively poorly estimated year-classes is precautionary given the history of sablefish population dynamics and current environmental conditions. The Teams also concurred with the additional (relatively minor) adjustment to account for the effects of whale depredation to arrive at the authors' recommended ABC.

Extensive discussion occurred regarding the determination of OFL by area and the relatively high bycatch of sablefish in the Bering Sea trawl fisheries in 2019. The authors provided a historical background of how the determination of OFL has evolved in sablefish and included OFL options requested by the SSC. Since 1996, sablefish have been managed Alaska-wide spanning both the BSAI and GOA FMPs with ABCs determined by sub-area. However, the sablefish OFL has been set separately for the Bering Sea (BS, Aleutian Islands (AI), and GOA since 1995 and does not necessarily reflect a biological or conservation concern for the stock. Three options were presented: 1) Status quo; 2) combine the BS and AI; and 3) an Alaska-wide specification. Some options may provide for more efficient management and operational benefits.

The Teams recognized that ABCs are area-specific and that stock structure uncertainty exists. If distinct stocks are identified, area-specific OFLs would be justified. However, concerns were expressed that area-specific management controls based on ABCs may be insufficient to limit regional bycatch. Considerable uncertainty exists on whether this is a biological concern or allocation issue.

The Teams recommended as a first step, combining the BS and AI OFLs. Combining these OFLs will make the sablefish OFLs more consistent with other stock assessments and aligned with FMP areas. NOAA General Counsel advised that National Standard One guidelines define "overfishing limit" at a stock or stock complex level but there is discretion under the National Standard guidelines that status determination criteria like OFL can be set to allow for operational feasibility, among other relevant criteria, and aligning OFL by FMP can be considered operationally feasible.

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	OFL	2019		2020		2021	
		ABC	TAC	OFL	ABC	OFL	ABC
W	--	1,581	1,581	--	1,942	--	2,427
C	--	5,178	5,178	--	6,445	--	8,055
*WYAK	--	1,828	1,828	--	2,343	--	2,687
*SEO	--	2,984	2,984	--	3,663	--	4,821
GOA	25,227	11,571	11,571	38,723	14,393	49,681	17,990

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

4. Shallow water flatfish

Status and catch specifications (t) of shallow water flatfish and projections for 2020 and 2021. 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 2 nd , 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	339,152	67,240	54,688	42,732	2,972
2019	343,755	68,309	55,587	43,217	2,377
2020	339,593	68,010	55,463		
2021		69,129	56,409		

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. The last full assessment was completed in 2017 which was the first year of the new schedule. This year a partial assessment was done. The 2019 assessment of the shallow-water flatfish complex excluding northern and southern rock sole used a random effects model to estimate current biomass. The random effects model was re-run with the 2019 Gulf of Alaska survey biomass. The random effects biomass estimates by area were also used for updated apportionments. The projection model for northern and southern rock sole was re-run and updated with 2018 catch and catch estimates for 2019.

Spawning biomass and stock trends

The shallow-water flatfish complex 2020 biomass estimate was 339,593 t, which is a slight (1.2%) decrease from the 2019 value of 343,755 t. This slight decrease 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 Team agreed 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 were combined with the ABC and OFL values for the rest of the shallow water flatfish complex. The 2020 ABC is 1.5% lower than the projected 2020 ABC from last year.

Status determination

Information was 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 (including the 2019 GOA survey) for ABC are:

Year	Western	Central	WYAK	SEO	Total
2020	23,849	27,732	2,773	1,109	55,463
2021	24,256	28,205	2,820	1,128	56,409

5. Deepwater flatfish complex (Dover sole and others)

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2020 and 2021. Biomass for each year is for Dover sole only and corresponds to the model estimate associated with the ABC for that year. Catch data are current through November 2 nd , 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	144,654	11,294	9,384	9,384	203
2019	145,926	11,434	9,501	9,501	106
2020	86,827	7,163	6,030		
2021		7,040	5,926		

Changes from the previous assessment

This year a full 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 the next full assessment is scheduled for 2023. Dover sole are assessed as a Tier 3a species. The 2019 model was updated to include the most recent data and the author implemented several model changes relative to the model used for the 2015 assessment based on Team and 2019 CIE recommendations. This year the author highlighted that Kamchatka flounder catch accrues towards the deepwater complex (since 2011) but has been excluded from any ABC/OFL calculations. The Team noted this, and **recommends that the SSC consider developing a Tier 6 approach for including this species going forward.** Presently, the ABCs are not constraining catch levels so the Team noted that implementing this change (which would increase the ABC slightly, perhaps between 10 and 50 t) could be done during a partial assessment year (in 2020). **The Team also recommends the author examine area apportionment relative to Kamchatka flounder and consider whether it's appropriate to apportion across the entire GOA or just WGOA.** The Team supported the author's recommended Model 19.3 for Dover sole.

Spawning biomass and stock trends

The model estimate of 2020 spawning stock biomass for Dover sole is 27,935 t, which is well above $B_{40\%}$ (7,613 t). Spawning stock biomass and total biomass are expected to remain stable through 2021. Stock trends for Greenland turbot and deepsea sole (and GOA Kamchatka flounder) are unknown.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

For ABC/OFL calculations, a Tier 3a approach was used for Dover sole and Tier 6 approaches were 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.

Status determination

The Gulf of Alaska Dover sole stock 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 2001-

2019. The ABC by area for the deepwater flatfish complex is the sum of the species-specific portions of the ABC. The area apportionment for 2020 and 2021 are as follows:

Area apportionments of deepwater flatfish ABCs for 2020 and 2021 based on the fraction of the survey biomass in each area for Greenland turbot, and deepsea sole (2001-2019) and from random effects model by area for Dover sole.					
Year	Western	Central	WYAK	SEO	Total
	3.8%	32.3%	34.9%	29.0%	100.0%
2020	226	1,948	2,105	1,751	6,030
2021	225	1,914	2,068	1,719	5,926

6. [Rex sole](#)

Status and catch specifications (t) of rex sole and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 2 nd , 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	97,982	18,706	15,373	15,373	1,750
2019	98,818	17,889	14,692	14,692	1,523
2020	100,198	18,127	14,878		
2021		18,799	15,416		

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 scheduled for 2021. 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 and western/central areas are stable.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Projected 2020 female spawning stock biomass is above $B_{40\%}$, therefore rex sole are in Tier 3a. The Team agreed with the author's recommended ABC and OFL from the updated model.

Status determination

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 ABCs for 2020 and 2021 are based on the random effects model applied to GOA bottom trawl survey biomass in each area. We note that the author used the 2019 survey biomass in the random effects model for apportionment. The Team agreed with this approach given that rex sole are on a 4-year cycle and the next full assessment will be in 2023.

Year	Western	Central	WYAK	SEO	Total
2020	2,901	8,579	1,174	2,224	14,878
2021	3,013	8,912	1,206	2,285	15,416

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 2nd, 2019.

Year	Age 1+ Biomass	OFL	ABC	TAC	Catch
2018	2,079,029	180,697	150,945	76,300	18,930
2019	1,391,460	174,598	145,841	99,295	23,632
2020	1,325,867	153,017	128,060		
2021		148,597	124,357		

Changes from the previous assessment

The last full assessment for arrowtooth flounder was in 2017. Data were updated to include the 2019 NMFS bottom trawl survey biomass estimates, the 2017 trawl survey age compositions, 2017-2019 fishery length compositions, and updated fishery catch data. Model changes for 2019 included removing the uncertain 1961 and 1975 surveys thus changing the start year from 1961 to 1977. The Team supported this change.

Spawning biomass and stock trends

Arrowtooth flounder biomass estimates decreased in scale relative to the 2017 assessment model. The trend in spawning biomass increased from about 720,000 t in 1977 to over 1.1 million t by 2008. Since then, the biomass estimate decreased to just below 800,000 t in 2019. The largest estimated age-1 recruitment occurred in 2000 (1.3 billion), but has been below average since 2007. The projected spawning biomass for 2020 was 756,100 t, down 7% from last year's projection for 2020.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Arrowtooth flounder is estimated to be in Tier 3a, and the Team accepted the recommended ABC and OFL. Consistent with the spawning biomass changes from the updated model and updated fishery selectivity, the 2020 ABC was 12% lower than the estimate from the 2018 projected value.

Status determination

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

Area apportionment

Area apportionments of arrowtooth flounder ABCs for 2020 and 2021 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	EYAK/SE	Total
2020	31,455	69,605	8,406	17,338	128,060
2021	31,764	67,592	8,163	16,838	124,357

8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 2 nd , 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	281,635	43,011	35,266	26,388	2,210
2019	283,285	44,865	36,782	26,489	2,553
2020	282,371	46,572	38,196		
2021		47,919	39,326		

Changes from the previous assessment

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

Spawning biomass and stock trends

The 2020 spawning biomass estimate was above $B_{40\%}$ and projected to increase through 2021. Biomass (age 3+) for 2020 was estimated to be 282,371 t and projected to slightly decrease in 2021.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Flathead sole are determined to be in Tier 3a. For 2020, the Team concurred with the authors' recommendation to use the maximum permissible ABC of 38,196 t from the updated projection. The F_{OFL} is set at $F_{35\%}$ (0.36) which corresponds to an OFL of 46,572 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 2020 and 2021 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2020	13,783	20,201	2,354	1,858	38,196
2021	14,191	20,799	2,424	1,912	39,326

9. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model; catch data are current through November 2, 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	511,924	34,762	29,236	29,236	24,758
2019	496,922	33,951	28,555	28,855	24,547
2020	544,569	37,092	31,238		
2021		35,600	29,983		

Changes from the previous assessment

This was a full assessment (biennial to coincide with the NMFS bottom trawl survey). The model was unchanged from the last assessment. Data were updated to include survey biomass estimates for 2019,

survey age compositions for 2017, fishery age compositions for 2018, and final catch for 2017 and 2018 and projected catch for 2019-2021.

Spawning biomass and stock trends

Spawning biomass was projected to increase and 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. The Team concurred with the authors' recommended ABC and OFL.

Status determination

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

Area apportionment

The following tables shows the recommended apportionment for 2020 and 2021 ABCs from the random effects model.

Area apportionment	Western	Central	Eastern	Total
2020 Area ABC (t)	1,437	23,678	6,123	31,238
2021 Area ABC (t)	1,379	22,727	5,877	29,983

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The Team and authors consider the biomass in the W. Yakutat area (between 147° W and 140° W) to be fishable hence estimate the proportion of biomass in this sub-region for ABC considerations. The proportion of biomass for the EGOA sub-area based on 2019 data is lower—24% compared to the 2017 estimate of 58%. This results in the following apportionment of the Eastern Gulf area:

Area apportionment	W.Yakutat	E.Yakutat/ Southeast	Total
2020 Area ABC (t)	1,470	4,653	6,123
2021 Area ABC (t)	1,410	4,467	5,877

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 (related to the stock rebuilding from an overfished determination) no longer applied. However, because of concerns over stock structure and the stationary (non-migratory) nature of this species, the OFL for SEO remained separate as an added management measure (and to ensure the EGOA OFL was restricted to that region). 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
2020 Area OFL (t)	31,567	5,525	37,092
2021 Area OFL (t)	30,297	5,303	35,600

10. Northern rockfish

Status and catch specifications (t) of northern rockfish and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 2 nd , 2019. Note that for management purposes, the northern rockfish from the EGOA ABC is combined with other rockfish. The ABC for 2020 and 2021 listed below deducts 1 t.					
Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2018	74,748	4,380	3,685	3,681	2,364
2019	87,409	5,402	4,529	4,528	2,609
2020	85,057	5,143	4,311		
2021		4,898	4,106		

Changes from the previous assessment

As this is a partial assessment, no changes were made to the assessment methodology. New data added to the projection model included updated catch data from 2018 (2,364 t), and new estimated catches for 2019-2021.

Spawning biomass and stock trends

The 2020 spawning biomass estimate (34,410 t) is above $B_{40\%}$ (30,480 t) and projected to decrease to 32,435 t in 2021. Total biomass (ages 2+) for 2020 is 85,057 t and is projected to decrease to 83,108 in 2021.

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 2020 ABC and OFL values of 4,312 t and 5,143 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 2020 and 2021 are based on the random effects model applied to GOA bottom trawl survey biomass estimates through 2017 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 2020 and 2021 are shown below:

Year	Western	Central	Eastern	Total
2020	1,133	3,178	1	4,312
2021	1,079	3,027	1	4,107

11. Shortraker rockfish

Status and catch specifications (t) of GOA shortraker rockfish and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data for 2019 are current through November 2nd, 2019.

Year	Biomass	OFL	ABC	TAC	Catch
2018	38,361	1,151	864	864	763
2019	38,361	1,151	863	863	672
2020	31,465	944	708		
2021		944	708		

Changes from the previous assessment

The last full assessment for Gulf of Alaska shortraker rockfish was in 2017. Data were updated to include: 1) 2019 bottom trawl survey biomass and length compositions; 2) 2018 and 2019 longline survey Relative Population Numbers (RPNs), Relative Population Weights (RPWs), and length compositions; 3) 2017-2018 fishery length compositions and preliminary 2019 fishery length compositions; and updated catch from trawl and longline fisheries. This year the random effects model was modified to use combined indices from the AFSC longline survey RPW index (1992 - 2019) and the AFSC bottom trawl survey biomass index (1984 – 2019).

Spawning biomass and stock trends

Applying the random effects model to trawl survey data from 1984–2019 and the longline survey RPW indices resulted in a 2020 biomass estimate of 31,465 t for shortraker rockfish, an 18% decrease from the previous estimate (38,361 t).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Shortraker rockfish are Tier 5 species for specifications where $F_{ABC} = 0.75M = 0.0225$, and $F_{OFL} = 0.03$; applying this definition to the biomass results in an ABC of 708 t and an OFL 944 t for 2020.

Status determination

Available data are insufficient to determine stock status relative to overfished criteria. This stock was not being subjected to overfishing in 2019.

Area apportionment

For area apportionment of ABC, the random effects model was fit to area-specific biomass and proportions of survey biomass by area were calculated. The following table shows the recommended area apportionment (t) for 2020 and 2021.

Year	Western	Central	Eastern	Total
2020 and 2021	52 (7.4%)	284 (40.1%)	372 (52.5%)	708 (100.0%)

12. Dusky rockfish

Status and catch specifications (t) of dusky rockfish and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data for 2019 are current through November 2, 2019.					
Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2018	56,103	4,841	3,957	3,957	2,911
2019	55,247	4,521	3,700	3,700	2,365
2020	54,626	4,492	3,676		
2021		4,396	3,598		

Changes in assessment methods and data

This year a partial assessment was presented for dusky rockfish. The projection model was run with new data which included final 2018 catch (2,909 t) and projected catches for 2019-2021. Future catches were estimated by updating the average of the ratio of catch to ABC for the last three complete catch years (2016-2018) and multiplying this to projected ABCs.

Spawning biomass and stock status trends

The estimates of spawning biomass for 2020 and 2021 from the projection model are 20,362 t and 19,631 t which are above the $B_{40\%}$ estimate of 18,535 t. Catch/biomass trends are stable around the long-term average of 0.05.

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 ABC and OFL values.

Status determination

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

Area apportionment

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
2020 Area ABC (t)	776	2,746	154	3,676
2021 Area ABC (t)	759	2,688	151	3,598

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
2020 Area ABC (t)	115	39
2021 Area ABC (t)	113	38

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2020 and 2021. Biomass (age-3+ from the age-structured model) for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data are current as of Nov 2, 2019.

Year	Biomass	OFL	ABC	TAC	Catch
2018	45,624	1,735	1,444	1,444	753
2019	45,363	1,715	1,428	1,428	719
2020	40,336	1,452	1,209		
2021		1,455	1,211		

Changes from the previous assessment

Updated catch estimates for 2018, projected catch estimates for 2019-2021, fishery lengths for 2015, trawl survey biomass estimates for 2019, trawl survey ages for 2017, and longline survey relative population numbers (RPN) and lengths for 2018 and 2019 were included this year. There were no changes to the assessment methodology. The 2015 model (15.4) was recommended and accepted by the Team for management advice.

Spawning biomass and stock status trends

The 2020 projected spawning biomass estimate (12,518 t) is above $B_{40\%}$ (8,263 t) and projected to slightly increase to 12,530 t in 2021.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The rougheye/blackspotted complex qualifies as a Tier 3a stock. For the 2020 fishery, the Plan Team accepted the authors' recommended maximum permissible ABC of 1,209 t ($F_{ABC} = F_{40\%} = 0.04$) and OFL ($F_{OFL} = F_{35\%} = 0.048$) of 1,452 t.

Status determination

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

Area apportionment

The apportionment percentages have changed with the addition of the 2019 trawl survey biomass. In past assessments the apportionment was based on a 4:6:9 weighted average of the proportion of biomass in each area from the three most recent bottom trawl surveys. At the Plan Team's and SSC's request, the authors used the random effects model applying both the longline and trawl survey relative abundance indices (equally weighted). This resulted in the following apportionments (with minor adjustments for rounding error):

	WGOA	CGOA	EGOA	Total
2020 ABC (t)	168	455	586	1,209
2021 ABC (t)	169	455	587	1,211

14. Demersal shelf rockfish

Status and catch specifications (t) of GOA demersal shelf rockfish and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 2, 2019.

Year	Biomass	OFL	ABC	TAC	Catch
2018 ₁	11,508	394	250	250	138
2019 ₁	12,029	411	261	261	140
2020 ₁	10,903	375	238		
2021 ₁		375	238		

¹ For 2018–2021, 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 2019. Relative abundance estimates from the ROV survey were updated for the SSEO, CSEO, and NSEO regions. ROV surveys were completed for SSEO but density estimates were unavailable in time for this assessment.

Spawning biomass and stock trends

The yelloweye rockfish biomass estimate decreased from 12,029 t to 10,903 t from 2019 to 2020. The decrease in biomass is driven by a decrease in average weight of yelloweye sampled in the CSEO, NSEO, and SSEO management areas, as well as a decrease in yelloweye density estimates from the CSEO and NSEO 2018 ROV surveys.

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 375 t for 2020. As in the past, F_{ABC} is based on $F=M=0.02$ rather than the maximum permissible F_{ABC} . This resulted in an ABC for 2020 (and 2021) of 238 t, down slightly from the recommended 2019 ABC.

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 (from the 2018 assessment)

In accordance with the approved schedule, no assessment was conducted for the shark stock complex this year. However, a full stock assessment will be conducted in 2020. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2020 specifications. Please refer to last year's stock assessment for details regarding the rolled over estimates. Additional information listed below summarizes the 2018 assessment.

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 current through November 2nd, 2019.

Year	Biomass	OFL	ABC	TAC	Catch
2018	90,570	2,717	2,038	2,038	1,189
2019	89,609	2,688	2,016	2,038	764
2020	NA	2,688	2,016		
2021		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

Status and catch specifications (t) of other rockfish. Biomass estimates for 2020 and 2021 are based on the random effects model for Tier 4 and 5 species. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Note that 1 t of northern rockfish has been added for management purposes to “other rockfish” in the EGOA. Catch data are current through November 2 nd , 2019.					
Year	Survey biomass	OFL	ABC	TAC	Catch
2018	96,107	7,356	5,594	2,305	1,205
2019	96,107	7,356	5,594	2,305	835
2020	70,687	5,320	4,054		
2021		5,320	4,054		

Changes from the previous assessment

Other rockfish (OR) are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. New data included in the assessment are 2019 Gulf of Alaska survey biomass estimates and updated total catch for 2003 – 2019. The random effects models for the Tiers 4 and 5 species were updated to include the 2019 survey data. Also, aurora and shortbelly rockfish are now included and reported in this complex. These two species have been counted within the OR complex for the catch estimates but have not previously been reported in this summary.

ABC and OFL calculations are based on different models for the Tier 4, 5, and 6 species. There are no changes to the methods used in this assessment. However, the two new species that were not previously included in the assessment, aurora and shortbelly rockfish, are now included in the Tier 6 calculations.

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

Spawning biomass and stock trends

For the Tier 4 and 5 species, the estimated biomass of 70,687 t is based on the random effects model, and is a 28% decrease from 2019. There is considerable variation in individual species biomass estimates that can mostly be attributed to sampling variation as many of these species are poorly sampled by the trawl survey.

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

The Plan Team agreed with the author’s recommendation of an ABC of 4,053 t and OFL of 5,320 t for the OR complex. There is no evidence to suggest that overfishing is occurring for the OR complex in the GOA because the OFL has not been exceeded.

The Plan Team revisited the option to move the demersal sub-group of other rockfish into the DSR assessment (i.e., the Tier 6 species) and make the DSR assessment GOA-wide. The Team continues to support an earlier recommendation that the demersal sub-group be moved into the DSR assessment and make the DSR assessment GOA-wide pending Council evaluation of management and economic implications following the Council’s Stock Structure and Spatial Management Policy. The authors, Plan Team, and SSC previously recommended that the ABCs for the WGOA and CGOA be combined and recommend continuing with this method, as data do not suggest any developing conservation concerns that would be alleviated by splitting the ABCs.

Status determination

The OR 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 and 5 species) and catch history (Tier 6 species) by region. The Plan Team again recommends a single ABC for the combined WGOA and CGOA areas to address concerns about the ability to manage smaller ABCs in the WGOA. The apportionments recommended for 2020 and 2021 are:

Year	Other Rockfish	W/C GOA	WYAK	EYAK/SE	Total
2020	ABC (t)	940	369	2,745	4,054
2021	ABC (t)	940	369	2,745	4,054

17. Atka mackerel

Status and catch specifications (t) of Atka mackerel in recent years. Atka mackerel are managed under Tier 6 because reliable estimates of biomass are not available. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 2 nd , 2019.						
Year	Biomass	OFL	ABC	TAC	Catch	
2018	-	6,200	4,700	2,000	1,437	
2019	-	6,200	4,700	3,000	1,254	
2020	-	6,200	4,700			
2021	-	6,200	4,700			

Changes from the previous assessment

There are no changes to the assessment methodology. Atka mackerel are assessed on a biennial schedule to coincide with the timing of survey data. The last full assessment was conducted in 2017. New information in this year's full assessment includes updated catch data, biomass estimates and length frequency data from the 2019 GOA bottom trawl survey, age data from the 2017 and 2018 GOA fisheries, and age data from the 2017 GOA trawl survey.

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable for Atka mackerel. The very patchy distribution of GOA Atka mackerel results in highly variable estimates of abundance. The 2019 survey estimated 68% of the biomass in the Shumagin area which was largely based on 8 fish caught in the WGOA. 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 2020 ABC for GOA Atka mackerel equal to the maximum permissible value of 4,700 t. The 2020 OFL is 6,200 t under Tier 6.

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

Status determination

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

18. Skates

Status and catch specifications (t) of skates in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 2 nd , 2019.						
Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2018	50,857	5,086	3,814	3,814	1,367
	2019	37,975	3,797	2,848	2,848	1,192
	2020	42,779	4,278	3,208		
	2021		4,278	3,208		
Longnose Skate	2018	42,737	4,274	3,206	3,206	870
	2019	47,632	4,763	3,572	3,572	983
	2020	34,487	3,449	2,587		
	2021		3,449	2,587		
Other Skates	2018	25,580	2,558	1,919	1,919	758
	2019	18,454	1,845	1,384	1,384	867
	2020	11,662	1,166	875		
	2021		1,166	875		

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 2019, there were no changes in methodology.

New inputs this year include updated fishery catch and length composition data, biomass estimates and length composition data from the 2019 GOA bottom trawl survey and noncommercial catch data through 2018. Also, the assessment now includes information from four additional surveys: the AFSC longline survey, the IPHC longline survey, and three bottom trawl surveys conducted by the Alaska Department of Fish and Game.

Spawning biomass and stock trends

Big skate survey biomass increased relative to 2017 based on new survey estimates while the longnose skate survey biomass decreased. The biomass of the other skates continued a decline from a peak in 2013.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Skates are managed in Tier 5. Applying $M=0.1$ and $0.75M$ to the estimated biomass from the random effects models for each stock component gives stock specific OFLs and ABCs. The Team concurred with the author's recommendations.

Status determination

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

Area apportionment

The author continued the use of the random effects (RE) model, a separate RE model was run for each managed group, and for each regulatory 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			Total
		Western	Central	Eastern	
2020 and 2021	Big skate	758	1,560	890	3,208
	Longnose skate	158	1,875	554	2,587
	other skates				875

19. [Sculpins](#)

Status and catch specifications (t) of GOA sculpins and projections for 2020 and 2021. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data for 2019 are current through November 2nd, 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	34,943	6,958	5,301	5,301	631
2019	33,134	6,958	5,301	5,301	574
2020	33,010	6,932	5,199		
2021		6,932	5,199		

Changes from the previous assessment

This assessment is a partial assessment in accordance with the current assessment schedule. GOA sculpins are assessed on a 4-year cycle to coincide with the timing of the NMFS bottom trawl survey; prior to 2017, GOA sculpins were assessed biennially. However, this is the last year sculpins will be assessed as a target species as recent Council action recommended moving sculpins to the non-target ecosystem component category. This precludes the establishment of OFL, ABC, and TAC, and prohibits directed fishing for sculpins. Removal of sculpins from both FMPs is scheduled for 2020.

There were no changes to the assessment methodology used in 2019. New information includes 2019 trawl survey biomass estimates and updated catch.

Spawning biomass and stock trends

Applying the random effects model to 2019 bottom trawl survey data results in a 2020 biomass of 33,010 t for the total sculpin complex in the GOA. This represents a small decrease from the last full assessment in 2017.

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

The sculpin complex is a Tier 5 stock complex for specifications where $F_{ABC} = 0.16$ and $F_{OFL} = 0.21$; applying this definition to the biomass results in an ABC of 5,199 t and an OFL 6,932 t for 2020.

Status determination

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

Area apportionment

GOA sculpins are managed as one stock for the entire Gulf of Alaska region.

20. [Sharks](#) (from the 2018 assessment)

In accordance with the approved schedule, no assessment was conducted for the shark stock complex this year. However, a full stock assessment will be conducted in 2020. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2020 specifications. Please refer to last

year's stock assessment for details regarding the rolled over estimates. Additional information listed below summarizes the 2018 assessment.

Status and catch specifications (t) of the GOA shark complex and projections for 2020 and 2021. 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 2019 are current through November 2nd, 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	56,181	6,020	4,514	4,514	3,090
2019	54,301	10,913	8,184	4,514	1,728
2020	54,301	10,913	8,184		
2021		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
- $F_{max} = 0.04$ 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.

Status determination

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. Octopus

Status and catch specifications (t) of GOA octopus. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. 2019 catches current through November 2 nd , 2019.					
Year	Biomass	OFL	ABC	TAC	Catch
2018	1,539	1,300	975	975	201
2019	12,257	1,300	975	975	316
2020	12,257	1,307	980		
2021		1,307	980		

Changes from the previous assessment

For 2019, the author followed the 2017 SSC recommendation to use max historical catch to recommend OFL. New information includes updated 2017 and 2018 catches and biomass estimates from the 2019 bottom trawl survey.

Spawning biomass and stock trends

The most recent data from the 2019 GOA trawl survey suggested an increase in octopus biomass that was an order of magnitude larger than the 2017 survey biomass. The 2019 survey also encountered octopus at a rate that was the second largest (after 2015) in the time-series. The random effects (RE) model estimate of 2019 biomass is 12,257 t compared to the 2017 RE model estimate of 1,848 t. Catch continues the recent trend of relatively low catches since 2015.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Team continues to recommend octopus be managed as Tier 6 with OFL set as maximum catch. The period recommended by the author for determining maximum catch was 2005-2016 and the Team concurs. For 2020, the OFL is 1,307 t and ABC is 980 t.

Status determination

Biomass estimates for octopuses are unreliable so determination of spawning biomass or stock status is unavailable. GOA octopus are managed in Tier 6 and it is not possible to make a status determination of whether the stock is overfished or approaching an overfished condition. Because 2018 catch was below the 2018 OFL, the stock is not being subjected to overfishing. This stock is managed Gulf-wide.

Area apportionment

GOA octopus are managed Gulf-wide.

Tables

Table 1. Gulf of Alaska groundfish 2020 - 2021 OFLs and ABCs, 2019 TACs, and 2019 catch (reported through November 2nd, 2019).

Species	Area	2019				2020		2021	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pollock	State GHF	n/a	3,396	0	0	n/a	2,712	n/a	2,797
	W(61)	n/a	24,875	24,875	21,867	n/a	19,175	n/a	19,775
	C(62)	n/a	67,388	67,388	64,079	n/a	54,456	n/a	56,160
	C(63)	n/a	34,443	34,443	24,461	n/a	26,597	n/a	27,429
	WYAK	n/a	5,748	5,748	6,612	n/a	5,554	n/a	5,728
	Subtotal	194,230	135,850	132,454	117,019	140,674	108,494	149,988	111,888
	EYAK/SEO	11,697	8,773	8,773	0	13,531	10,148	13,531	10,148
Total		205,927	144,623	141,227	117,019	154,205	118,642	163,519	122,036
Pacific Cod	W	n/a	7,633	5,343	5,017	n/a	4,942	n/a	8,390
	C	n/a	7,667	5,750	5,705	n/a	8,458	n/a	14,358
	E	n/a	1,700	1,275	187	n/a	1,221	n/a	2,072
	Total	23,669	17,000	12,368	10,909	17,794	14,621	30,099	24,820
Sablefish	W	n/a	1,581	1,581	1,438	n/a	1,942	n/a	2,427
	C	n/a	5,178	5,178	5,970	n/a	6,445	n/a	8,055
	WYAK	n/a	1,828	1,828	1,774	n/a	2,343	n/a	2,687
	SEO	n/a	2,984	2,984	3,037	n/a	3,663	n/a	4,821
	Total	25,227	11,571	11,571	12,219	38,723	14,393	49,681	17,990
Shallow Water Flatfish	W	n/a	25,620	13,250	72	n/a	23,849	n/a	24,256
	C	n/a	25,731	25,731	2,303	n/a	27,732	n/a	28,205
	WYAK	n/a	2,279	2,279	1	n/a	2,773	n/a	2,820
	EYAK/SEO	n/a	1,957	1,957	1	n/a	1,109	n/a	1,128
	Total	68,309	55,587	43,217	2,377	68,010	55,463	69,129	56,409
Deep water flatfish	W	n/a	416	416	2	n/a	226	n/a	225
	C	n/a	3,443	3,443	92	n/a	1,948	n/a	1,914
	WYAK	n/a	3,280	3,280	8	n/a	2,105	n/a	2,068
	EYAK/SEO	n/a	2,362	2,362	4	n/a	1,751	n/a	1,719
	Total	11,434	9,501	9,501	106	7,163	6,030	7,040	5,926
Rex Sole	W	n/a	2,951	2,951	74	n/a	2,901	n/a	3,013
	C	n/a	8,357	8,357	1,447	n/a	8,579	n/a	8,912
	WYAK	n/a	1,657	1,657	2	n/a	1,174	n/a	1,206
	EYAK/SEO	n/a	1,727	1,727	0	n/a	2,224	n/a	2,285
	Total	17,889	14,692	14,692	1,523	18,127	14,878	18,779	15,416
Arrowtooth flounder	W	n/a	35,994	14,500	683	n/a	31,455	n/a	30,545
	C	n/a	70,995	70,995	22,840	n/a	68,669	n/a	66,683
	WYAK	n/a	15,911	6,900	85	n/a	10,242	n/a	9,946
	EYAK/SEO	n/a	22,941	6,900	24	n/a	17,694	n/a	17,183
	Total	174,598	145,841	99,295	23,632	153,017	128,060	148,597	124,357
Flathead sole	W	n/a	13,234	8,650	210	n/a	13,783	n/a	14,191
	C	n/a	21,109	15,400	2,343	n/a	20,201	n/a	20,799
	WYAK	n/a	2,016	2,016	0	n/a	2,354	n/a	2,424
	EYAK/SEO	n/a	423	423	0	n/a	1,858	n/a	1,912
	Total	44,865	36,782	26,489	2,553	46,572	38,196	47,919	39,326

Table 1. (continued) Gulf of Alaska groundfish 2019 - 2020 OFLs and ABCs, 2019 TACs, and 2019 catch (reported through November 2nd 2019).

Species	Area	2019				2020		2021	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pacific Ocean Perch	W	n/a	3,227	3,227	3,145	n/a	1,437	n/a	1,379
	C	n/a	19,646	19,646	18,114	n/a	23,678	n/a	22,727
	WYAK	n/a	3,296	3,296	3,288	n/a	1,470	n/a	1,410
	W/C/WYAK	31,113	26,169	26,169	24,547	31,567	26,585	30,297	25,516
	SEO	2,838	2,386	2,386	0	5,525	4,653	5,303	4,467
	Total	33,951	28,555	28,555	24,547	37,092	31,238	35,600	29,983
Northern Rockfish	W	n/a	1,190	1,190	819	n/a	1,133	n/a	1,079
	C	n/a	3,338	3,338	1,790	n/a	3,178	n/a	3,027
	E	n/a	1	0	0	n/a	1	n/a	1
	Total	5,402	4,529	4,528	2,609	5,143	4,311	4,898	4,106
Shortraker rockfish	W	n/a	44	44	55	n/a	52	n/a	52
	C	n/a	305	305	226	n/a	284	n/a	284
	E	n/a	514	514	391	n/a	372	n/a	372
	Total	1,151	863	863	672	944	708	944	708
Dusky Rockfish	W	n/a	781	781	198	n/a	776	n/a	759
	C	n/a	2,764	2,764	2,071	n/a	2,746	n/a	2,688
	WYAK	n/a	95	95	93	n/a	115	n/a	113
	EYAK/SEO	n/a	60	60	3	n/a	39	n/a	38
	Total	4,521	3,700	3,700	2,365	4,492	3,676	4,396	3,598
Rougheye and Blacspotted rockfish	W	n/a	174	174	78	n/a	168	n/a	169
	C	n/a	550	550	433	n/a	455	n/a	455
	E	n/a	704	704	208	n/a	586	n/a	587
	Total	1,715	1,428	1,428	719	1,452	1,209	1,455	1,211
DSR	GOA-wide	411	261	261	140	375	238	375	238
Thornyhead rockfish	W	n/a	326	326	124	n/a	326	n/a	326
	C	n/a	911	911	375	n/a	911	n/a	911
	E	n/a	779	779	265	n/a	779	n/a	779
	Total	2,688	2,016	2,016	764	2,688	2,016	2,688	2,016
Other rockfish	WC	n/a	1,737	1,737	684	n/a	940	n/a	940
	WYAK	n/a	368	368	180	n/a	369	n/a	369
	EYAK/SEO	n/a	3,489	3,489	50	n/a	2,745	n/a	2,745
	Total	7,356	5,594	5,594	914	5,320	4,054	5,320	4,054
Atka mackerel	GOA-wide	6,200	4,700	3,000	1,254	6,200	4,700	6,200	4,700
Big Skate	W	n/a	504	504	114	n/a	758	n/a	758
	C	n/a	1,774	1,774	977	n/a	1,560	n/a	1,560
	E	n/a	570	570	101	n/a	890	n/a	890
	Total	3,797	2,848	2,848	1,192	4,278	3,208	4,278	3,208
Longnose Skate	W	n/a	149	149	59	n/a	158	n/a	158
	C	n/a	2,804	2,804	616	n/a	1,875	n/a	1,875
	E	n/a	619	619	308	n/a	554	n/a	554
	Total	4,763	3,572	3,572	983	3,449	2,587	3,449	2,587
Other Skates	GOA-wide	1,845	1,384	1,384	867	1,166	875	1,166	875
Sculpins	GOA-wide	6,958	5,301	5,301	574	6,932	5,199	6,932	5,199
Sharks	GOA-wide	10,913	8,184	8,184	1,728	10,913	8,184	10,913	8,184
Squids	GOA-wide	0	0	0	0	na	na	0	0
Octopuses	GOA-wide	1,300	975	975	316	1,307	980	1,307	980
Total		664,889	509,507	430,569	209,982	595,362	463,466	624,684	477,927

Table 2. Gulf of Alaska 2020 and 2021 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 2020 abundance for the age+ range reported in the summary.

Stock or Assemblage	Tier	Area	Biomass	2020				2021			
				OFL	F_{OFL}	ABC	F_{ABC}	OFL	F_{OFL}	ABC	F_{ABC}
Pollock ^a	3a	W(61)			0.33	19,175	0.23		0.30	19,775	0.28
		C(62)				54,456				56,160	
		C(63)				26,597				27,429	
		WYAK				5,554				5,728	
		Subtotal	1,007,850	140,674		105,782		149,988		109,091	
	5	EYAK/SEO	45,103	13,531	0.30	10,148	0.23	13,531	0.30	10,148	0.23
		Total	1,052,953	154,205		115,930		163,519		119,239	
Pacific Cod	3b	W			0.27	4,942	0.22		0.36	8,390	0.29
		C				8,458				14,358	
		E				1,221				2,072	
		Total	203,373	17,794		14,621		30,099		24,820	
Sablefish	3b	W			0.121	1,942	0.043		0.121	2,427	0.042
		C				6,445				8,055	
		WYAK				2,343				2,687	
		EYAK/SEO				3,663				4,821	
		Total	387,000	38,723		14,393		49,681		17,990	
Shallow Water* Flatfish	3a, 5	W			0.462, 0.326 ^b	23,849	0.382, 0.271 ^b		0.462, 0.326 ^b	24,256	0.382, 0.271 ^b
		C				27,732				28,205	
		WYAK				2,773				2,820	
		EYAK/SEO				1,109				1,128	
		Total	339,593	68,010		55,463		69,129		56,409	
Deepwater Flatfish	3a, 6	W			0.11	226	0.09		0.11	225	0.09
		C				1,948				1,914	
		WYAK				2,105				2,068	
		EYAK/SEO				1,751				1,719	
		Total	86,827	7,163		6,030		7,040		5,926	
Rex Sole*	3a	W			0.29 ^c 0.31	2,901	0.23 ^c 0.25		0.29 ^c 0.31	3,013	0.23 ^b 0.25
		C				8,579				8,912	
		WYAK				1,174				1,206	
		EYAK/SEO				2,224				2,285	
		Total	100,198	18,127		14,878		18,799		15,416	
Arrowtooth Flounder	3a	W			0.234	32,711	0.193		0.234	31,764	0.193
		C				69,605				67,592	
		WYAK				8,406				8,163	
		EYAK/SEO				17,338				16,838	
		Total	1,325,867	153,017		128,060		127,773		124,357	
Flathead Sole*	3a	W			0.36	13,783	0.28		0.36	14,191	0.28
		C				20,201				20,799	
		WYAK				2,354				2,424	
		EYAK/SEO				1,858				1,912	
		Total	282,371	46,572		38,196		47,919		39,326	

* Partial assessment

^a The Prince William Sound GH (2.5% of ABC; 2,712 t in 2020, 2,797 t in 2021) is deducted from the ABC prior to apportionment.

^b F_{OFL} and F_{ABC} values for shallow water flatfish are for Tier 3 northern and southern rock sole.

^c Rex sole is assessed separately for two different areas (Western-Central and Eastern).

Table 2. Continued... Gulf of Alaska 2020 and 2021 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	2020				2021			
				OFL	FOFL	ABC	FABC	OFL	FOFL	ABC	FABC
*Pacific Ocean Perch	3a	W			0.108	1,437	0.090		0.108	1,379	0.090
		C				23,678				22,727	
		WYAK				1,470				1,410	
		W/C/WYAK		31,567		26,585		30,297		25,516	
		EYAK/SEO		5,525		4,653		5,303		4,467	
		Total	544,569	37,092		31,238		35,600		29,983	
Northern Rockfish*	3a	W			0.073	1,133	0.061		0.073	1,079	0.061
		C				3,178				3,027	
		E				--				--	
		Total	85,057	5,143		4,311		4,989		4,106	
Shortraker	5	W			0.03	52	0.0225		0.03	52	0.0225
		C				284				284	
		E				372				372	
		Total	31,465	944		708		944		708	
Dusky Rockfish*	3a	W			0.118	776	0.095		0.118	759	0.095
		C				2,746				2,688	
		WYAK				115				113	
		EYAK/SEO				39				38	
		Total	54,626	4,492		3,676		4,396		3,598	
Rougheye / Blackspotted Rockfish	3a	W			0.048	168	0.040		0.048	169	0.040
		C				455				455	
		E				586				587	
		Total	40,336	1,452		1,209		1,455		1,211	
DSR*	4, 6	Total	10,903 _f	375	0.032 _f	238	0.02 _f	375	0.032 _f	238	0.02 _f
Thornyhead rockfish	5	W	No Assessment		0.03	326	0.0225		0.03	326	0.0225
		C				911				911	
		E				779				779	
		Total				2,016		2,688		2,016	
Other Rockfish	4, 5, 6	W/C			0.079 _d	940	0.065 _e		0.079 _d	940	0.065 _e
		WYAK				369				369	
		EYAK/SEO			0.073 _d	2,745	0.055 _e	5,320	0.073 _d	2,745	0.055 _e
		Total	70,687	5,320		4,054				4,054	
Atka Mackerel	6		--	6,200	--	4,700	--	6,200	--	4,700	--
Big Skates	5	W			0.1	758	0.075		0.1	758	0.075
		C				1,560				1,560	
		E				890				890	
		Total	42,779	4,278		3,208		4,278		3,208	
Longnose Skates	5	W			0.1	158	0.075		0.1	158	0.075
		C				1,875				1,875	
		E				554				554	
		Total	34,487	3,449		2,587		3,449		2,587	
Other Skates	5		11,662	1,166	0.1	875	0.075	1,166	0.1	875	0.075
Sculpins*	5		33,010	6,932	0.21	5,199	0.16	6,932	0.21	5,199	0.16
Sharks	6	No Assessment	54,301 _g	10,913	0.04 _g	8,184	0.03 _g	10,913	0.04 _g	8,184	0.03 _g
Squid	Moved to ecosystem component										
Octopus	6		12,257	1,307	--	980	--	1,307	--	980	--
Total		Total	4,828,726	595,362		460,754		624,684		477,927	

* Partial assessments

_d FOFL equal to 0.079 for Tier 4 sharpchin and 0.73 for 17 Tier 5 other rockfish species.

_e FABC equal to 0.065 for Tier 4 sharpchin rockfish and 0.055 for 17 Tier 5 other rockfish species.

_f Values listed are for Tier 4 yelloweye rockfish.

_g Values listed are for spiny dogfish. Spiny dogfish are Tier 5 but remainder of complex is in Tier 6.

_h No assessments were provided for thornyheads or sharks. Values in the table are from the 2018 assessment and the 2019 harvest specifications.

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 2020 and 2021 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum permissible.

2020					
Species	Tier	$Max F_{ABC}$	$Max ABC$	F_{ABC}	ABC
Pollock ₁ (W/C/WYAK)	3a	0.28	120,549 t	0.23	108,494
Sablefish	3a	0.102	33,949	0.043	14,393
Demersal shelf rockfish	4, 6	0.026	303	0.02	238
2021					
Species	Tier	$Max F_{ABC}$	$Max ABC$	F_{ABC}	ABC
Pollock ₁ (W/C/WYAK)	3a	0.26	124,320	0.28	111,888
Sablefish	3a	0.102	43,598	0.042	17,990
Demersal shelf rockfish	4, 6	0.026	303	0.02	238

¹ The Plan Team recommended 2020 and 2021 W/C/WYK pollock ABCs of 108,494 and 11,888 t listed here, have not been reduced to accommodate the Prince William Sound (PWS) GHL. The 2020 PWS GHL values are 2.5% of the W/C/WYK pollock ABCs (2,712 t for 2020, 2,797 t for 2021). These values are deducted from the ABC values listed here, for apportionments which are listed in the pollock summary in the *Area apportionment* table.

Table 4. Groundfish landings (metric tons) in the Gulf of Alaska, 1956-2019.

Year	Pollock	Pacific cod	sablefish	Flatfish	Arrowtooth Flounder	Slope rockfish ^a
1956			1,391			
1957			2,759		a Catch defined as follows: (1) 1961-78, Pacific ocean perch (<i>S. alutus</i>) 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.	16,000
1958			797			65,000
1959			1,101			136,300
1960			2,142			
1961			897			
1962			731			
1963			2,809			
1964	1,126	196	2,457	1,028	b Catch from Southeast Outside District.	243,385
1965	2,749	599	3,458	4,727		348,598
1966	8,932	1,376	5,178	4,937	c Thornyheads were included in the other species category, and are foreign catches only.	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	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.	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	e Atka mackerel was added to the Other Species category in 1988 and separated out in 1994	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	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)	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	g Does not include at-sea discards.	19,002
1990	90,490	72,517	25,701	15,411		21,114
1991	107,500	76,997	19,580	20,068	h Catch data reported through November 4th, 2017.	13,994
1992	93,904	80,100	20,451	28,009		16,910
1993	108,591	55,994	22,671	37,853	i Includes all species except arrowtooth.	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		14,288
1997	89,892	68,474	14,129	17,179		15,304
1998	123,751	62,101	12,758	11,263		14,402
1999	95,637	68,613	13,918	8,821		18,057
2000	71,876	54,492	13,779	13,052		15,683
2001	70,485	41,614	12,127	11,817		16,479
2002	49,300 ^j	52,270	12,246	12,520		17,128
2003	49,300	52,500	14,345	10,750		18,678
2004	62,826	43,104	15,630	7,634		18,194
2005	80,086	35,205	13,997	9,890		17,306
2006	70,522	37,792	13,367	14,474		20,492
2007	51,842	39,473	12,265	15,077		18,718
2008	51,721	43,481	12,326	16,393		18,459
2009	42,389	39,397	10,910	17,360		18,621
2010	75,167	58,003	10,086	13,556		21,368
2011	79,789	62,475	11,148	10,043		19,612
2012	101,356	56,520	11,914	8,909		22,334
2013	93,733	51,792	11,945	12,283		19,367
2014	140,260	62,223	10,422	11,236		23,360
2015	163,065	55,260	10,313	7,572		24,915
2016	173,226	42,517	9,354	8,214		29,265
2017	184,167	35,204	10,500	6,363		26,268
2018	155,142	10,899	12,037	7,135		28,638
2019	43,771	10,909	12,219	7,976		28,547

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	2,911	138	1,189	1,437	2,995	3,965	245,416
2019	2,365	140	764	1,254	3,042	2,618	137,237