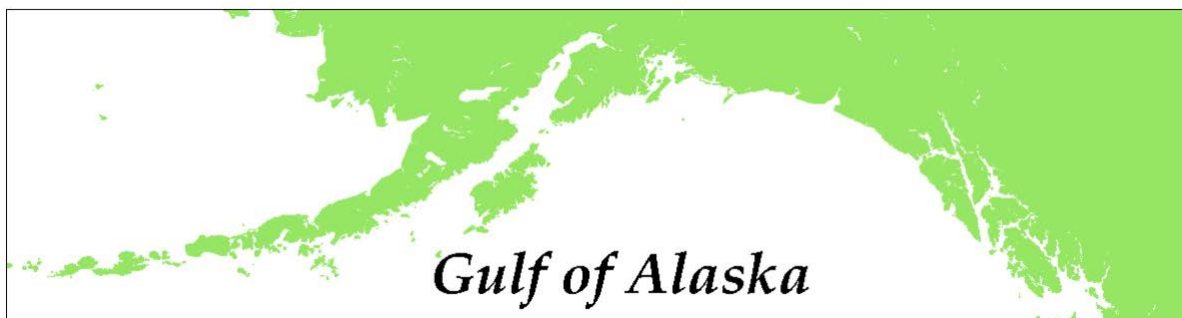


STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUNDFISH RESOURCES OF THE GULF OF ALASKA

Compiled by

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

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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 virtually over Adobe Connect on November 16-20, 2020 to review the status of stocks of eighteen 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, 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.

Amendments 121/110 and their implementing regulations were approved by the Secretary of Commerce effective August 10, 2020.

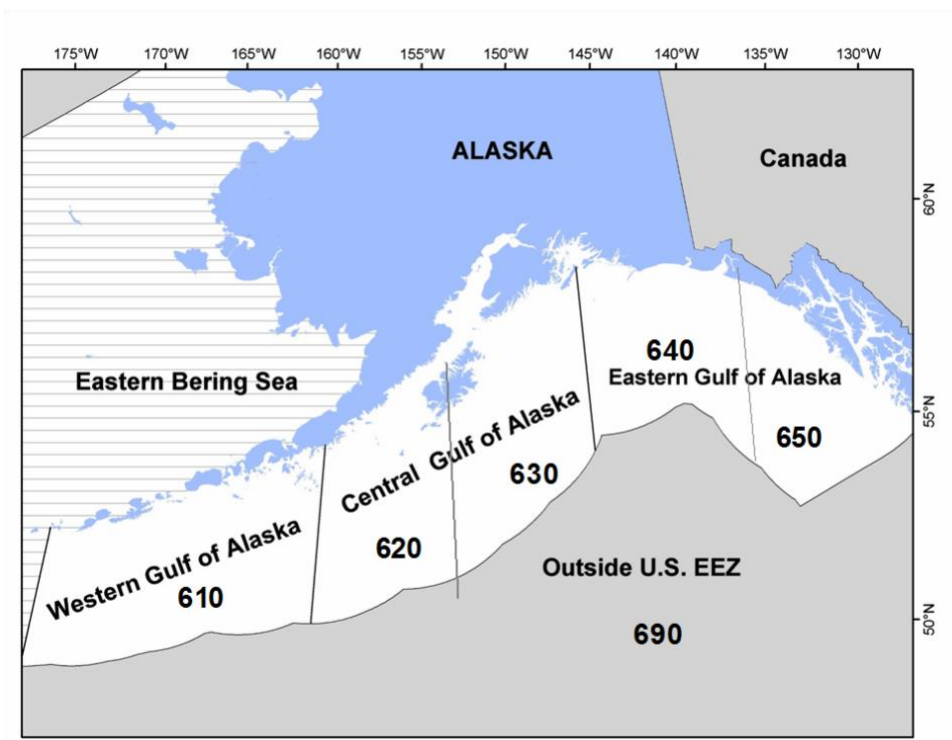


Figure 1. Gulf of Alaska statistical and reporting areas.

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, shorttraker rockfish, rougheye/blackspotted rockfish, northern rockfish, “other” rockfish, dusky rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, 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.

- 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.
- 5) Sculpins – Beginning in 2020, sculpin is included as an Ecosystem Component, rather than in the Fishery as a target species.

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, roughey/blackspotted rockfish, other rockfish, dusky rockfish, demersal shelf rockfish ³ , thornyhead rockfish), Atka mackerel, skates (big skates, longnose skates, and other skates), 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,
Sculpins	Families: Cottidae, Hemitriptidae, Psychrolutidae, and Rhamphocottidae

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

⁷ Sculpins were added to both FMPS as an Ecosystem Component in 2020.

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

106/117 moved squid to the Ecosystem Component category of the FMP in GOA and BSAI FMPs in 2018. Amendments 121/110 moved sculpins to the Ecosystem Component category of the FMP in 2020.

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

The GOA FMP recognizes single species and species complex management strategies. Single species specifications are set for stocks individually, recognizing that different harvesting sectors catch an array of species. In the Gulf of Alaska these species include pollock, Pacific cod, sablefish, Pacific ocean perch, flathead sole, rex sole, arrowtooth flounder, northern rockfish, shortraker rockfish, dusky rockfish, Atka mackerel, big skates, and longnose skates. Other groundfish species that are usually caught in groups have been managed as complexes (also called assemblages). For example, other rockfish, rougheye and blackspotted rockfish, demersal shelf rockfish, thornyhead rockfish, deep water flatfish, shallow water flatfish, 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 2021 and 2022 PWS GHL (equal to 2.5% of the recommended 2021 and 2022 W/C/WY pollock ABCs) from the recommended 2021 and 2022 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 2021 and 2022 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		
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	<p>1) Information available: <i>Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.</i></p> <p>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</p> <p>1b) Stock status: $\alpha < B/B_{MSY} \leq 1$ $F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$ $F_{ABC} \leq \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$</p> <p>1c) Stock status: $B/B_{MSY} \leq \alpha$ $F_{OFL} = 0$ $F_{ABC} = 0$</p> <p>2) Information available: <i>Reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.</i></p> <p>2a) Stock status: $B/B_{MSY} > 1$ $F_{OFL} = F_{MSY}$ $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$</p> <p>2b) Stock status: $\alpha < B/B_{MSY} \leq 1$ $F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$ $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$</p> <p>2c) Stock status: $B/B_{MSY} \leq \alpha$ $F_{OFL} = 0$ $F_{ABC} = 0$</p> <p>3) Information available: <i>Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.</i></p> <p>3a) Stock status: $B/B_{40\%} > 1$ $F_{OFL} = F_{35\%}$ $F_{ABC} \leq F_{40\%}$</p> <p>3b) Stock status: $\alpha < B/B_{40\%} \leq 1$ $F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$ $F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$</p> <p>3c) Stock status: $B/B_{40\%} \leq \alpha$ $F_{OFL} = 0$ $F_{ABC} = 0$</p> <p>4) Information available: <i>Reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.</i> $F_{OFL} = F_{35\%}$ $F_{ABC} \leq F_{40\%}$</p> <p>5) Information available: <i>Reliable point estimates of B and natural mortality rate M.</i> $F_{OFL} = M$ $F_{ABC} \leq 0.75 \times M$</p> <p>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 $ABC \leq 0.75 \times OFL$</p>
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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 2020 or 2) above $\frac{1}{2}$ of its MSY level in 2020 and above its MSY level in 2030 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, roughey 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), shorttraker rockfish, other rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, skates, octopus, and sharks are unknown.

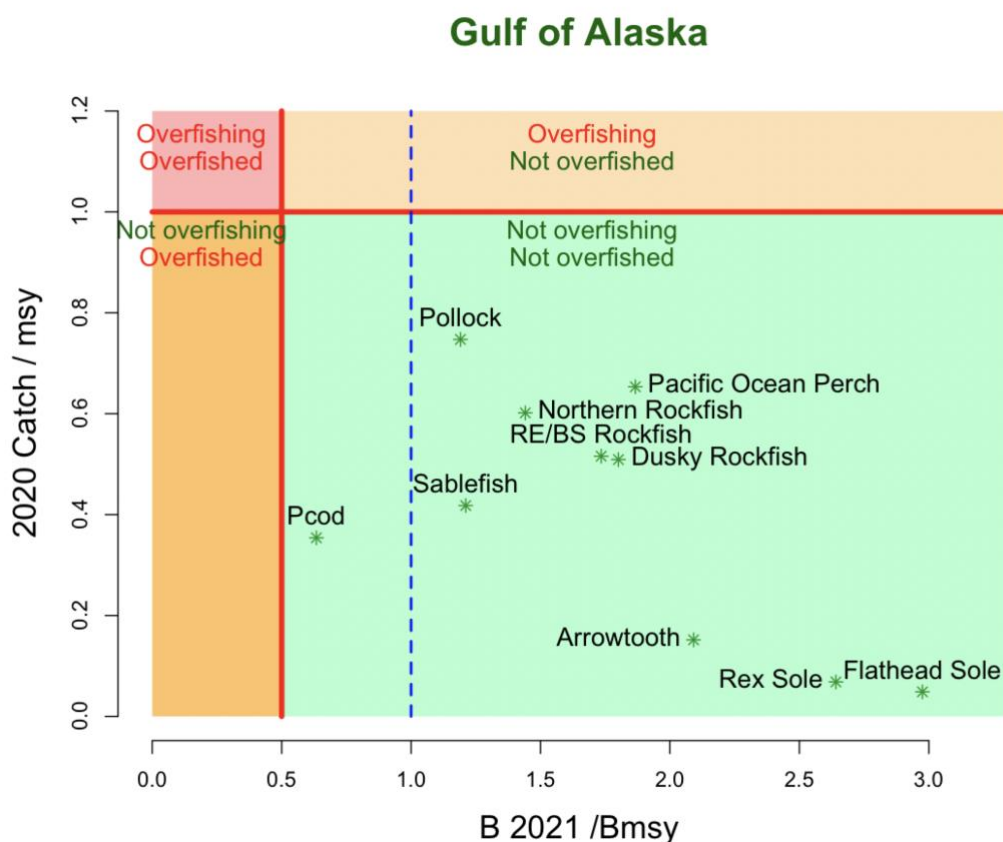


Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{MSY} ; horizontal axis) and current year catch relative to fishing at F_{MSY} (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

Summary and Use of Terms

Table 1 provides a summary of the status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2020, and recommendations for ABCs and overfishing levels (OFLs) for 2021 and 2022. 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, 1956-2020.

The sum of the Plan Team's recommended 2021 ABC for target species (excluding sablefish) is 456,274 t (452,656 t for 2022). The Joint groundfish Plan Teams recommended a range of sablefish ABC apportionments between the BSAI and GOA FMPs. Accordingly for 2021, the GOA sum of ABCs *including* sablefish ranges from 469,543 t to 473,360 t. The corresponding 2022 sum of ABC ranges with sablefish included are 470,145 t and 475,176 t (for more details see section below on sablefish). These sums are all within the FMP-approved optimum yield (OY) of 116,000 - 800,000 t for the Gulf of Alaska. The sums of the 2021 and 2022 OFLs are 610,917 and 616,921 t, respectively. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2021 will be considerably under this upper limit. For perspective, the sum of the 2020 TACs was 399,239 t and the sum of the ABCs was 465,956 t (and catch through November 12th, 2020 was 186,497 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 2019 and 2020 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 2021 and 2022 correspond to the Plan Team recommendations.
- (4) The exploitable biomass for 2019 and 2020 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2021 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 2021 and 2022 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 2021 harvest specifications (from Council recommendations in December 2019) are in place to start the fishery on January 1, 2021, but these will be replaced by final harvest specifications that will be recommended by the Council in December 2020. The final 2021 and 2022 harvest specifications will become effective when final rulemaking occurs in February or March 2021. 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 2022 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2022 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	2020 Assessment status	Tier	Schedule (years)	Year of next Full Assessment
Pollock	Full	3	1	2021
Pacific cod	Full	3	1	2021
Sablefish	Full	3	1	2021
Northern and southern rock sole	Partial	3	4	2021
Shallow water flatfish	Partial	5	4	2021
Deepwater flatfish (Dover)	Partial	3/6	4	2023
Rex sole	Partial	5	4	2021
Arrowtooth flounder	Partial	3	2	2021
Flathead sole	Partial	3	4	2021
Pacific ocean perch	Full	3	2	2021
Northern rockfish	Full	3	2	2022
Shortraker rockfish	None	5	2	2021
Other rockfish	None	4/5/6	2	2021
Rougheye & blackspotted rockfish	Partial	3	2	2021
Dusky rockfish	Full	3	2	2022
Demersal shelf rockfish	Partial	4/6	2	2021
Thornyhead rockfish	Full	5	2	2022
Sharks	Full	5/6	2	2022
Skates	None	5	2	2021
Atka mackerel	None	6	2	2021
Octopus	None	6	2	2021
Forage species (including squid)	Report	eco	1	2022
Grenadiers (BSAI/GOA)	Report	eco	1	2024

Economic Summary of the GOA commercial groundfish fisheries in 2019

The ex-vessel value of all Alaska domestic fish and shellfish catch, which includes the amount paid to harvesters for fish caught, and the estimated value of pre-processed fish species that are caught by catcher/processors, increased from \$1,963 in 2018 to \$1,968 in 2019 in real 2019 dollars. The first wholesale value of 2019 groundfish catch after primary processing was \$2,500 million. The 2019 total groundfish catch decreased by 1.8%, and the total first-wholesale value of groundfish catch decreased by 3%, relative to 2018.

The groundfish fisheries accounted for the largest share (50%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon fishery was second with \$684 million or 35% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to \$193 million or 10% of the total for Alaska and exceeded the value of Pacific halibut with \$94 million or 10% 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, and a Gulf Trawl economic data report. The report will now also include a section summarizing in-season harvest and revenue estimates for groundfish and halibut through Sept. 2020. The previous section covering community participation has been moved into a separate report titled the Annual Community Engagement and Participation Overview report (ACEPO). 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 2015-2019, 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 publicly available online at: <https://reports.psmfc.org/akfin> and <https://psesev.psmfc.org/PSESV-2/>.

Decomposition of the change in first-wholesale revenues from 2018-19 in the GOA

The following brief analysis summarizes the overall changes that occurred between 2018-19 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2020 Economic SAFE report, the ex-vessel value of GOA groundfish continued to decrease from \$171 million in 2018 to \$142 million in 2019 (values adjusted to 2019 dollars) (Figure 3), and first-wholesale revenues from the processing and production of groundfish in the Gulf of Alaska (GOA) also continued to decrease between 2018 (\$301 million) and 2019 (\$251 million) (Figure 4). At the same time, the total quantity of groundfish products from the GOA decreased from 114 thousand metric tons to 100 thousand metric tons, a 14% decrease. The changes in first-wholesale revenues from processing and production in the GOA differ from those in the BSAI, which saw a 1% year-to-year increase in groundfish products and 1% increase in first-wholesale value.

By species group, despite a negative price effect, a positive quantity effect resulted in a 9% increase in ex-vessel value to \$15.7 million for Pacific cod from the GOA for 2018-19 (Figure 5). For GOA pollock, a substantial decline in harvests drove a decline in ex-vessel values of 14.5% to \$36.12 million. For sablefish, despite an increase in harvests ex-vessel values declined to \$68.05 million due to continued substantial declines in ex-vessel prices from 2017, with a year-over-year decrease in price of 26.5% due to the continued harvest of smaller average size fish landed. In the GOA, retained catch for all flatfish species increased by 19.5%, driven by a 38.7% increase in arrowtooth flounder catch. For rockfish, a negative price and quantity effect led to a 10.7% 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 \$35.2 million in the GOA first-wholesale revenue decomposition for 2018-19, while positive price effects were not enough to offset negative quantity effects in the fillet category with a negative net value effect of \$5 million or in surimi with a net effect of \$4.2 million.

In summary, first-wholesale revenues from the GOA groundfish fisheries decreased by about \$50 million from 2018-19, continuing a decline in values that began in 2016 and amounts to a \$130 million (or 34%) decrease from 2016 to 2019. The main drivers of this were negative net revenue effects for pollock, rockfish and sablefish. In comparison, first-wholesale revenues increased by about \$3.5 million from 2018-19 as positive net revenue effects for pollock were largely offset by negative net revenue effects in Pacific cod and Atka mackerel.

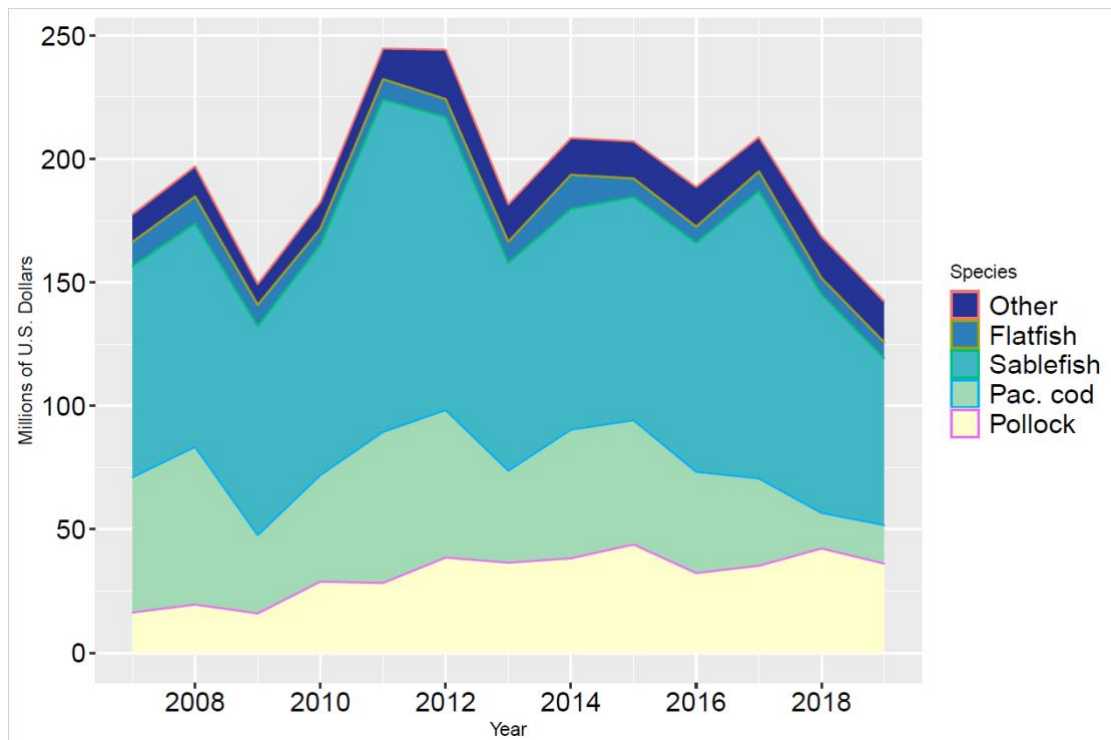


Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2007-2019 (base year = 2019)

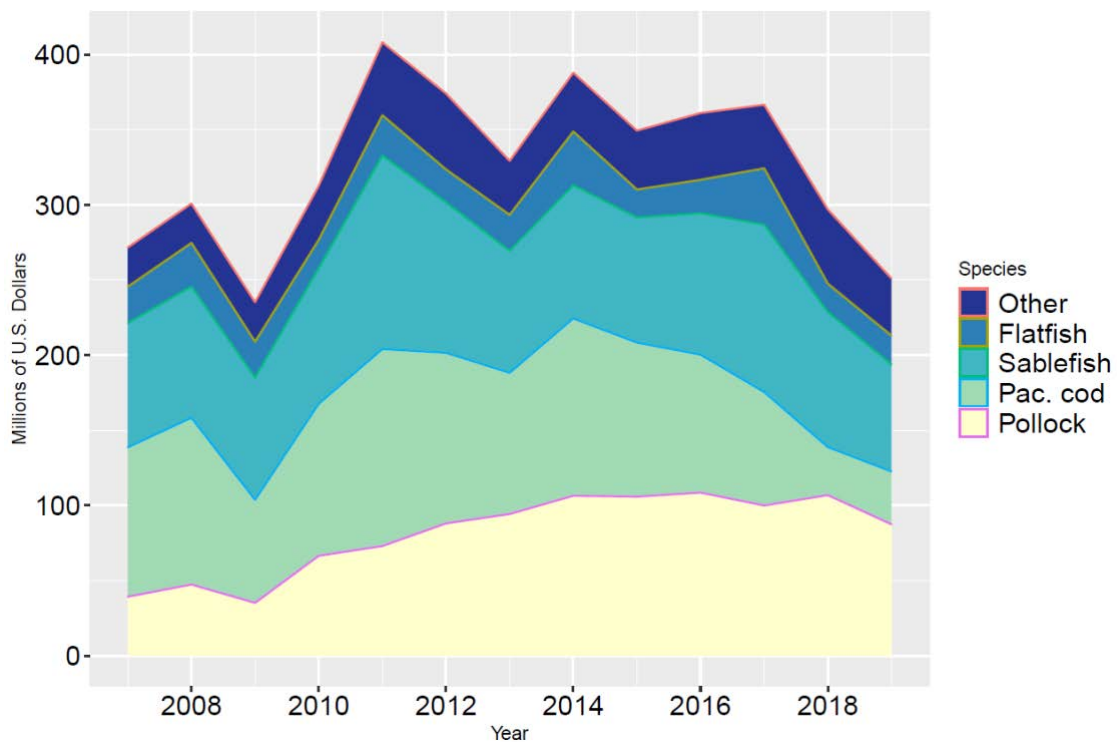


Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2007-2019 (base year = 2019).

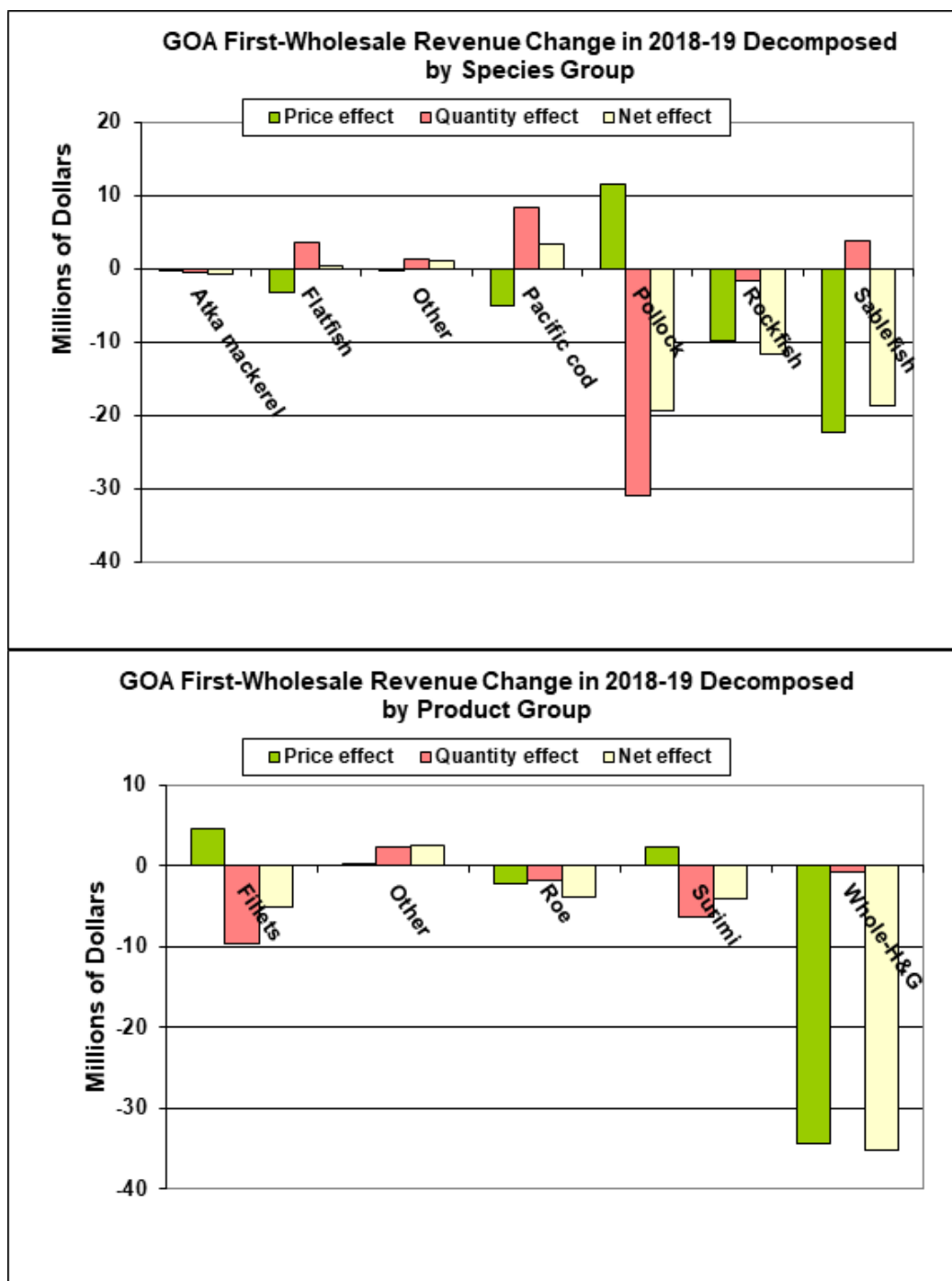


Figure 5. Decomposition of the change in first-wholesale revenues from 2018-19 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the 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 2020 Report Card

- The PDO declined to slightly negative in the winter of 2020, reflecting cooling sea surface temperatures in the GOA.
- Summer 2020 sea surface temperatures in the western GOA were generally lower than 2019 but summer and fall temperatures were still elevated, oscillating around marine heat wave thresholds, following average temperatures in the winter and spring.
- Trends in capelin, as sampled by rhinoceros auklets at Middleton Island, have indicated that capelin were abundant from 2008 to 2013, but continue to be minimal in seabird chick diets in recent years, including 2020. Their apparent decline coincided with the period of warm water temperatures in the GOA.

Eastern Gulf of Alaska 2020 Report Card

- There was a weak-moderate El Niño in winter 2019. Moderate La Niña conditions are predicted for winter 2020-2021.
- Summer 2020 sea surface temperatures in the eastern GOA cooled from 2019, remaining around the long-term mean for the winter, spring, and summer (different from the warm summer temperatures observed in the western GOA).
- Total zooplankton density in Icy Strait in 2020 was approximately average, similar to 2019. This suggests average foraging conditions for planktivorous fish, seabirds, and mammals.
- The overall copepod community size (ratio of large calanoid copepods to total calanoid copepods) increased in 2020 due to increased densities of large copepods and decreased densities of small copepods. This suggests above-average quality zooplankton prey, supported by measures of average and elevated lipid content in large and small copepods respectively.

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

- The COVID-19 pandemic and resulting impacts to the fisheries sector in Alaska, which are further discussed in the Economic SAFE.
- The 2020 commercial harvest (mt) of salmon in the GOA (excluding the Alaska Peninsula harvests) were at the lowest levels since 1980. Increasing juvenile abundance since 2017 indicates harvests will increase in coming years although may still be below average.
- Large gray whale mortality event was observed coast-wide in 2019-2020. Dead whales were found to be emaciated and were likely attempting to return to their feeding grounds in the North Pacific/Chukchi Sea. Gray whale strandings remained elevated in 2020, but at slightly lower numbers than in 2019 (Table 1, Figure 4).

Stock summaries

1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2021 and 2022. 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 2021 and 2022 are those recommended by the Plan Team. Catch data were through November 12, 2020. 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	2019	1,126,750	194,230	135,850	132,454	117,261
	2020	1,007,850	140,674	108,494	105,782	105,118
	2021	1,097,340	123,455	105,722		
	2022		106,767	91,934		
SEO	2019	38,989	11,697	8,773	8,773	0
	2020	45,103	13,531	10,148	10,148	0
	2021	45,103	13,531	10,148		
	2022		13,531	10,148		
GOA-wide	2019	1,165,739	205,927	144,623	141,227	117,261
	2020	1,052,953	154,205	118,642	115,930	105,118
	2021	1,142,443	136,986	115,870		
	2022		120,298	102,082		

Changes from the previous assessment

This year's pollock assessment features the following new data: 1) 2019 total catch and catch-at-age from the fishery, 2) 2020 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2020 biomass from the ADFG crab/groundfish trawl survey, and 4) age compositions for the 2019 NMFS bottom trawl survey and the 2019 GOA-wide summer acoustic survey.

The age-structured assessment model used for GOA W/C/WYAK pollock assessment (Model 19.1) was identical to the 2019 assessment (Model 19.1).

Spawning biomass and stock trends

The spawning stock is projected to continue to decline in 2021 as the 2012 year class is further reduced in abundance. The presence of incoming year classes should result in a stabilization in biomass, however, the 2020 Shelikof Strait survey showed a substantial and unexpected reduction in the 2018 year class (aged 2) relative to their abundance in the 2019 survey. The 2017 year class (aged 3) was slightly more abundant than expected. Overall, the Shelikof Strait survey data in 2020 showed a substantial decline in biomass (64%), due to the expected reduction in abundance of the 2012 year class, and showing closer agreement with the ADF&G survey, as well as the NMFS bottom trawl and GOA-wide summer acoustic survey surveys from 2019. The 2020 B40% estimate of 177,000 t represents an 8.7% decrease from the B40% estimate of 194,000 t in the 2019 assessment. The model projection of female spawning biomass in 2021 is 184,530 t, which is above B40% (177,000 t).

The intent of this year's assessment was to provide a straightforward update without considering major changes to the model. In general, the addition of new data did not strongly affect the estimates of recent spawning biomass, unlike a similar analysis that was conducted last year. This suggests that the new data are reasonably consistent with previous modeling and with each other.

The 2020 assessment continued to implement a local abundance weighted approach to estimate maturity at length and age as described in the 2019 SAFE. In addition, maturity at age by cohort was examined, although the results were not incorporated in the current assessment.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Because the model projection of female spawning biomass in 2021 is above $B_{40\%}$, the W/C/WYAK Gulf of Alaska pollock stock is in Tier 3a. The model estimated 2021 age-3+ biomass is 1,097,340 t (for the W/C/WYAK areas) and the maximum ABC for 2021 is 105,722 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 1 for all four risk categories, and thus did not recommend a reduction from maximum permissible ABC. One issue highlighted in the risk matrix under the population dynamics considerations category was the conflicting signals concerning the size of the 2018 year class.

The Plan Team supported the authors' recommendation using the assessment derived maximum permissible ABC for 2021. The resulting 2021 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 105,722 t which is a decrease of 2.6% from the 2020 ABC, and a 22% decrease from 2019 ABC. The ABC is expected to reduce further in 2022 in part due to the reduced abundance of the 2018 year class and very small 2019 year class. The OFL is 123,455 t for 2021. The 2021 Prince William Sound (PWS) GHF is 2,643 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 2021 and 2022, which is the same as the 2020 ABC, as there was no new survey data for this region. 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 B1 and B2 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, including the 2.5% of the ABC (2,643 t in 2021 and 2,298 t in 2022) for the State of Alaska managed pollock fishery in Prince William Sound, are as follows:

	Area apportionments for 2021 and 2022 pollock ABC's for the Gulf of Alaska (including the Prince William Sound GHF)						
Year	610 Western	620 Central	630 Central	640 WYAK	650 SEO	PWS GHF	Total
2021	18,477	54,870	24,320	5,412	10,148	2,643	115,870
2022	16,067	47,714	21,149	4,706	10,148	2,298	102,082

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 2021 and 2022 are those recommended by the Plan Team. Catch data are current through November 12 th , 2020.					
Year	Age 0+ biomass	OFL	ABC	TAC	Catch
2019	207,198	23,669	17,000	12,368	11,214
2020	203,373	17,794	14,621	6,431	3,980
2021	265,661	28,977	23,627		
2022		46,587	38,141		

Changes from the previous assessment

Data updated from the 2019 assessment included federal and state fishery catch for 2019 and 2020 (preliminary catch projected through the end of 2020), federal and state fishery size composition for 2019 and preliminary size compositions for 2020, 2020 AFSC longline survey abundance index (Relative Population Numbers, RPN) and size composition, 2019 AFSC bottom trawl survey conditional length-at-age, and all length composition samples with less than 30 fish were excluded. The longline survey RPN for 2020 increased from 2019 by 30%, but remains the second lowest in the time series.

The author evaluated and presented two models: (1) the model configuration from 2019 with updated data (Model 19.1), and (2) an exploratory model that includes temperature dependent growth and a parameter that scales R_0 with the spawning marine heatwave cumulative index (20.1). The author concluded that the relationships described in Model 20.1 are not well enough established and, therefore, Model 19.1 was recommended by the author and the Team concurred.

Spawning biomass and stock trends

The $B_{40\%}$ estimate was 72,045 t, with projected 2021 spawning biomass of 39,977 t. Spawning biomass is projected to increase from 2021 to 2022 due to a stronger 2018 recruitment and reduction in fishing mortality.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

This stock is in Tier 3b and the 2018 through 2020 estimated spawning biomass were likely below $B_{20\%}$, but the 2021 spawning biomass is estimated to be above $B_{20\%}$. The $F_{35\%}$ and $F_{40\%}$ values are 0.41 and 0.33, respectively. The maximum permissible ABC is 23,627 t. The Plan Team concurred with the authors' recommended ABC and OFL values. The recommended ABC is a 62% increase from the 2020 ABC of 14,621 t.

Status determination

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

Area apportionment

Since the 2014 assessment, the random effects model has been used for Pacific cod apportionment. Using this method with the trawl survey biomass estimates through 2019 resulted in a large decrease in apportionment for the Western GOA. In 2019 the Team recommended using average apportionment between 2017 and 2019 (rescaled), and this apportionment was also recommended in this year's assessment in anticipation of a 2021 survey. Using this method the area-apportioned ABCs are:

Year	Western	Central	Eastern	Total
2021	7,986	13,656	1,985	23,627
2022	12,892	22,045	3,204	38,141

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 2021 and 2022 are those recommended by the Plan Team. Beginning in 2020, the OFL was specified Alaska-wide (for both BSAI and GOA). Catch data are current through November 12, 2020.					
Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2019	264,000	25,227	11,571	11,571	12,759
2020	387,000	50,481*	16,883	14,393	12,095
2021	390,000	60,426*	(see below)		
2022		70,710*			

*Alaska-wide OFL

Changes from the previous assessment

New data included in the assessment model were relative abundance and length data from the 2020 longline survey, relative abundance and length data from the 2019 fixed gear fishery, length data from the 2019 trawl fisheries, age data from the 2019 longline survey and 2019 fixed gear fishery, updated catch for 2019, and projected 2020-2022 catches. Updated and projected 2020-2022 estimates of killer and sperm whale depredation in the fishery were included. There were no changes from the 2019 assessment methodology. The risk table was updated with new rationale. The authors recommended ABC be set equal to the 2019 values, which are considerably lower than the maximum permissible. This reduction was based on points raised in the risk table. The authors noted that this recommendation is 17% higher than their recommendation from last year.

The appendices to the assessment have been updated with new information and analyses. The Ecosystem and Socioeconomic Profile (ESP), Appendix 3C, was updated with new 2020 data. The catch apportionment appendix (3D) has been significantly revised and updated to address requested changes to the operating model and apportionment strategies based on SSC and Plan Team comments. An appendix (3E) was added which discusses the large increase of sablefish trawl fishery CPUE in the Bering Sea.

Spawning biomass and stock trends

The longline survey abundance index increased 32% from 2019 to 2020 following a 47% increase in 2019 from 2018. The lowest point of the time series was 2015. Similarly, the trawl survey biomass was at a time series low in 2013, but more than tripled since then. The fishery catch-rate/abundance index increased 20% in 2019 from 2018, which was the time series low (the 2020 data were unavailable). However, increases were primarily driven by uncertain and limited information from fisheries in the western areas, while the region-wide increase in use of pot gear has yet to be incorporated into the CPUE index used in the model. Spawning biomass is projected to increase rapidly through 2022 due to estimated large, but highly uncertain year classes becoming of mature age.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The reference values of $B_{100\%}$, $B_{35\%}$ and $B_{40\%}$ increased relative to 2019 by 19.7%. Projected female spawning biomass (combined areas) for 2020 is 134,400 t (42% of this year's $B_{100\%}$, 51% of $B_{100\%}$ from 2019). Given spawning biomass estimates relative to reference points, sablefish fall under Tier 3a of the BSAI and GOA FMPs. Reference points were calculated using recruitments from the 1977-2016 year classes. The authors recommended maintaining the ABC equal to the 2020 specified ABC of 22,551 t, which is less than half of the maximum permissible ABC (57% reduction). Adjusting for updated whale depredation estimates results in a 2021 ABC of 22,237 t (slightly higher than the 2020 ABC due to changes in whale depredation).

The authors explained that their recommended ABCs were lower than maximum permissible ABC for several reasons based on application of the risk table. They noted that although there are clearly positive signs of strong recruitment, they were concerned about the lack of older fish contributing to the spawning

biomass, the uncertainty surrounding the estimates of the strength of the 2014, 2016, and 2017 year-classes, and ambiguity related to how existing environmental conditions may affect future survival of these year classes. Although survey and fishery indices of abundance show positive signs consistent with recent strong recruitment, the model fits to these indices are poor. Lastly, there are substantial concerns over the strong retrospective bias exhibited by the model, which increased dramatically since the 2019 assessment.

The Team reviewed the risk table and the concerns contributing to the authors' recommended ABC. While the Plan Teams agreed that there are considerable concerns there was a robust discussion reflecting a range of opinions on the appropriate level of reduction from maximum permissible ABC.

The Team was generally reluctant to support the authors' recommended reduction from the maximum permissible ABC. First, the stock is increasing and maintaining a constant ABC (similar to a constant F rate) ignores the fact that the 2020 fishing mortality rate was well below F_{ABC} . The ABC has been increasing since 2016 (the average year-year ABC increase 2016-2020 was 12%). The Teams discussed general model problems and noted that it has more of a retrospective pattern than previously.

The Team discussed the options provided by the author: ABCs based on standard Model 16.5 with the authors' reduction, and the same projection model with average recruitment assumed for the 2016 and 2017 year classes. The authors' recommended ABC is similar to the average recruitment-based ABC. The Team discussed that the model is likely optimistic, as the recent high recruitments are still downgraded in subsequent years, and noted there is precedent for reducing ABCs based on assuming average recruitment for highly uncertain strong year classes.

While noting the concerns expressed above, the discussion centered on there being no compelling case for recommending a specific reduction below maximum permissible ABC. The harvest specifications from the average recruitment assumption are very similar to the authors' recommended combined area ABCs and OFLs (adjusted for whale depredation) noting that OFLs apply Alaska-wide and ABCs for the GOA depend on the apportionment decision (see below).

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 assessment. The 2016 CIE review panel concurred that there does not appear to be a biological concern with this apportionment approach, given the high mixing rates of the stock. However, several above average year classes of sablefish are entering the population following a long period of lower than average recruitment. The long period of low recruitment led to increased fishing pressure on the spawning biomass due to their relative predominance in the harvestable population and increased value over smaller fish. Now, recent large recruitments have created concerns about removing too many young fish before they have had a chance to mature and contribute to the spawning population. Because of the historically observed distribution of younger fish appearing first in western areas (BS, AI, WGOA) and older mature fish being more prevalent in eastern areas (CGOA, WY, EY), the location of catches in periods of high or low recruitment can clearly have an impact on different portions of the sablefish population-at-age. Thus, regional ABC apportionment to management areas can result in different impacts on the population depending on the apportionment. The SSC and Plan Teams and requested that new apportionment approaches be presented. However, the assessment authors currently do not have enough information on spatial processes (e.g., distribution of the population by age, movement rates by age among regions, or juvenile habitat preferences and distributions associated with large year classes) to adequately determine whether specific, reasonably distributed apportionment approaches create a conservation concern (e.g., localized depletion, age truncation, or year class reduction) for the Alaskan sablefish population. The results of simulation work (see Appendix 3D), though limited in scope of process and observation error, indicated that

apportionment of ABC to the six management regions can be conducted in numerous ways with little biological implications for the population. This is primarily due to the high movement rates exhibited by sablefish and the existing harvest control rule and management framework. The authors noted that the simulation model was conditioned on the general dynamics as estimated by the 2018 sablefish assessment and incorporates limited knowledge regarding the movement and distribution of juvenile sablefish.

The Teams concurred with the authors that an apportionment method that tracks regional biomass or a best proxy thereof is likely the best defense against localized depletion or other conservation concerns (e.g., disproportionately targeting spawners in only a handful of regions or population strongholds). While there are tradeoffs among all the methods examined, the rationale for moving away from the status quo fixed method is that it fails to reflect the increasing proportions of fish in the EBS. It is noted that the former apportionment method used before 2014 depends on fishery CPUE data. Given the issues related to boats converting to pot gear, whale depredation impacts in the biennial BS and AI longline surveys, and fishery coverage rates changing in different areas, the Team concurred with the authors to exclude the earlier apportionment method from consideration this year until these issues could be resolved. From a biological standpoint, the Teams agreed that a range of apportionment approaches be considered for Council specifications, including starting from the status quo (fixed apportionment) and the author recommended 5-year survey moving average (non-exponential). The Teams recommended, to the extent practical, moving away from the fixed apportionment to the true distribution of the stock would be preferred from a biological perspective. However, there was consensus that in the near term and at these reduced recommended exploitation rates, the impacts to the stock would likely be minimal under any apportionment range within these two options.

Apportionment values presented here include whale depredation adjustments for the two apportionment strategies:

Table of author-recommended the survey 5-year moving average apportionment (Non-exponential)

Region	OFL**	2020		2021		2022	
		ABC	TAC	OFL	ABC	OFL	ABC
W	--	2,278	1,942	--	2,671	--	3,521
C	--	7,560	6,445	--	5,738	--	7,563
*WYAK	--	2,521	2,343	--	2,050	--	2,702
*SEO	--	4,524	3,663	--	2,810	--	3,703
GOA	--	16,883	14,393	--	13,269	--	17,489
Alaska-wide	50,481			60,426	22,237	70,710	29,309

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

Fixed (Status Quo) apportionment

Region	OFL**	2020		2021		2022	
		ABC	TAC	OFL	ABC	OFL	ABC
W	--	2,278	1,942	--	2,339	--	3,083
C	--	7,560	6,445	--	7,629	--	10,056
*WYAK	--	2,521	2,343	--	2,773	--	3,656
*SEO	--	4,524	3,663	--	4,344	--	5,726
GOA	--	16,883	14,393	--	17,085	--	22,520
Alaska-wide	50,481			60,426	22,223	70,710	29,309

* 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 2021 and 2022. The shallow water flatfish (SWF) 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 12, 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	343,755	68,309	55,587	43,217	2,867
2020	339,593	68,010	55,463	44,864	4,234
2021	342,226	68,841	56,164		
2022		69,691	56,883		

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 the authors presented a partial assessment consisting of an executive summary including recent fishery catch, survey results, and recommend harvest levels for the next two years.

Spawning biomass and stock trends

The shallow-water flatfish complex 2021 biomass estimate was 342,226 t, which is a slight (0.07%) increase from the 2020 value of 339,593 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 OFL and ABC estimates were carried over from 2019 for the SWF species and added to the management advice from the 2020 projection model for northern rock sole and southern rock sole to provide a SWF complex OFL and ABC. The Plan Team agreed with author recommendations.

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
2021	24,151	28,082	2,808	1,123	56,164
2022	24,460	28,442	2,844	1,137	56,883

5. Deepwater flatfish complex

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2021 and 2022. 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 12 th , 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	145,926	11,434	9,501	9,501	109
2020	86,827	7,163	6,030	6,030	107
2021	84,771	7,040	5,926		
2022		7,040	5,926		

Changes from the previous assessment

The deepwater flatfish complex is comprised of Dover sole, Greenland turbot, and deepsea sole. A full assessment for the Gulf of Alaska deepwater flatfish complex was conducted in 2019. Projections were evaluated from that assessment and used for 2021 specifications. This stock is on a four-year cycle and a full assessment is scheduled for 2023. Given plans to do a partial assessment in 2021, values for OFL and ABC for 2022 were set to interim values equal to those for 2021. The Team noted that the projection model was not revisited this year as the difference in catch assumptions and actual 2020 catches were minor. Additionally, annual catch is consistently well below the ABC.

Spawning biomass and stock trends

The model estimate of 2021 spawning stock biomass for Dover sole is 27,011 t, which is well above B_{40%} (7,613 t). Spawning stock biomass and total biomass are expected to remain stable through 2022. 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 2021 and 2022 are as follows:

Area apportionments of deepwater flatfish ABCs for 2021 and 2022 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%
2021	225	1,914	2,068	1,719	5,926
2022	225	1,914	2,068	1,719	5,926

6. [Rex sole](#)

Status and catch specifications (t) of rex sole and projections for 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 12, 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	98,818	17,889	14,692	14,692	1,612
2020	99,383	18,127	14,878	14,878	1,239
2021	101,244	18,779	15,416		
2022		18,779	15,416		

Changes from the previous assessment

A partial assessment for Gulf of Alaska rex sole was conducted in 2019. Projections were evaluated from that assessment and used for 2021 specifications. This stock is on a four-year cycle and a full assessment is scheduled for 2021. Given plans to update the assessment in 2021, values for OFL and ABC for 2022 were set to interim values equal to those for 2021. The Team noted that the projection model was not revisited this year as the difference in catch assumptions and actual 2020 catches were minor.

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 was above $B_{40\%}$, therefore rex sole fall in Tier 3a. The Team noted that these ABC/OFL levels are considerably larger than likely catches in the next two years and hence these projection assumptions are appropriate.

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 2021 and 2022 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2021	3,013	8,912	1,206	2,285	15,416
2022	3,013	8,912	1,206	2,285	15,416

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2021 and 2022. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 12, 2020.					
Year	Age 1+ Biomass	OFL	ABC	TAC	Catch
2019	1,391,460	174,598	145,841	99,295	24,586
2020	1,327,620	153,017	128,060	96,696	21,177
2021	1,321,700	151,723	126,970		
2022		147,515	123,445		

Changes from the previous assessment

The last full assessment was done in 2019. In partial assessment years, parameter values from the previous year's assessment model and updated catch information are used to make projections. The final catch for 2020 was estimated by increasing the official catch as of October 21, 2020, by an expansion factor of 1.11, which represents the average fraction of catch taken after October 21 in the last five complete years (2015-2019). This resulted in an estimated catch for 2020 of 23,224 t. Future catches were estimated by updating the yield ratio to 0.23, which was the average of the ratio of catch to TAC for the last five complete catch years (2015-2019). This yield ratio was multiplied by the projected ABCs from the updated projection model to generate catches of 18,662 t in 2021.

Spawning biomass and stock trends

The estimates of arrowtooth flounder spawning biomass for 2021 and 2022 from the current year (2020) projection model are 752,703 t and 724,288 t, respectively. The projected spawning biomass for 2021 is 5% higher than the estimate from 2019. The projected estimate of total biomass for 2021 of 1,321,700 t was less than 1% higher than the estimate from the 2019 projection model.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The 2021 ABC of 126,970 t is 2% higher than the estimate from the 2019 projection model. Arrowtooth flounder is assessed in Tier 3a. The Team continued with this recommendation as this is a partial assessment.

Status determination

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

Area apportionment

Area apportionments of arrowtooth flounder ABCs for 2021 and 2022 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	EYAK/SE	Total
2021	32,377	69,072	8,380	17,141	126,970
2022	31,479	67,154	8,147	16,665	123,445

8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2021 and 2022. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 12 th , 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	283,285	44,865	36,782	26,489	2,667
2020	282,371	46,572	38,196	28,262	1,917
2021	280,980	47,982	39,377		
2022		48,534	39,851		

Changes from the previous assessment

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

Spawning biomass and stock trends

The 2021 spawning biomass estimate was above $B_{40\%}$ and projected to increase through 2022. Biomass (age 3+) for 2021 was estimated to be 280,980 t and projected to slightly decrease in 2022.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Flathead sole are determined to be in Tier 3a. For 2021, the Team concurred with the authors' recommendation to use the maximum permissible ABC of 39,377 t from the updated projection. The F_{OFL} is set at $F_{35\%}$ (0.36) which corresponds to an OFL of 47,982 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 2021 and 2022 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	SEO	Total
2021	14,209	20,826	2,427	1,915	39,377
2022	14,380	21,076	2,456	1,939	39,851

9. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2021 and 2022. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model; catch data are current through November 12, 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	496,922	33,951	28,555	28,855	25,470
2020	544,569	37,092	31,238	31,238	24,772
2021	613,522	42,977	36,177		
2022		41,110	34,602		

Changes from the previous assessment

A partial assessment was originally scheduled for GOA POP in 2020, but the assessment authors decided to conduct a full assessment in order to incorporate recent modeling changes. The mean of the prior

distribution for GOA bottom trawl catchability was increased from 1.0 to 1.15, based on recent field research on densities in untrawlable grounds. The mean of the prior distribution for the natural mortality rate was increased from 0.05 to 0.0614, based on updated life-history models. Data were updated to include survey age compositions for 2019, the final catch for 2019, and estimated catch for 2020-2022. Additionally, the data used for the ageing error matrix was updated, and the fishery age compositions were estimated using age-length keys.

Spawning biomass and stock trends

The 2021 spawning biomass of 207,096 t is 6% larger than the 2021 value projected from the 2019 assessment, and 63% larger than $B_{40\%}$.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA Pacific ocean perch stock was estimated to be in Tier 3a. The authors re-evaluated the risk table, and scored the risk categories identically as in the 2019 assessment (i.e., assessment considerations and population dynamics considerations were each scored as Level 2: “substantially increased concerns”, and environmental/ecosystem considerations and fishery performance considerations were each scored as Level 1: “no concern”). The authors recommended the maximum ABC, and 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 show the recommended apportionment for 2021 and 2022 ABCs from the random effects model.

Area apportionment	Western	Central	Eastern	Total
2021 Area ABC (t)	1,643	27,429	7,105	36,177
2022 Area ABC (t)	1,572	26,234	6,796	34,602

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, and therefore estimate the proportion of biomass in this sub-region for ABC considerations. The proportion of biomass

between the W. Yakutat and E. Yakutat/Southeast areas is unchanged from the 2019 assessment, and resulted in the following apportionment of the Eastern Gulf area:

Area apportionment	W.Yakutat	E.Yakutat/ Southeast	Total
2021 Area ABC (t)	1,705	5,400	7,105
2022 Area ABC (t)	1,631	5,165	6,796

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
2021 Area OFL (t)	36,563	6,414	42,977
2022 Area OFL (t)	34,974	6,136	41,110

10. Northern rockfish

Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Plan Team. Catch data are current through November 12 th , 2020. Note that for management purposes, the northern rockfish from the EGOA ABC is combined with other rockfish. The ABC for 2021 and 2022 listed below deducts 1 t.					
Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2019	87,409	5,402	4,528	4,528	2,748
2020	85,057	5,143	4,311	4,311	2,385
2021	102,715	6,396	5,357		
2022		6,088	5,099		

Changes from the previous assessment

Full assessments for GOA northern rockfish occur in even years, with partial assessments in odd years. The input data were updated to include survey biomass estimates for 2019, survey age compositions for 2019, final catch for 2018 and 2019, preliminary catch for 2020, fishery age compositions for 2018, and fishery size compositions for 2019. The survey biomass estimate is now based upon the Groundfish Assessment Program's Vector Autoregressive Spatio-temporal (VAST) model for the GOA. The aging error matrix was updated with data through 2017, the previous matrix had data through 2008. The assessment methodology is the same as the 2018 assessment with updated input data.

Spawning biomass and stock trends

The 2021 spawning biomass estimate (42,791 t) is above $B_{40\%}$ (33,933 t) and projected to decrease to 40,462 t in 2022. Total biomass (2+) for 2021 is 102,715 t and is projected to decrease to 99,597 in 2022.

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 2021 ABC and OFL values of 5,358 t and 6,396 t, respectively. This ABC is a 24% increase compared to the 2020 ABC of 4,312.

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 2021 and 2022 are based on the random effects model applied to GOA bottom trawl survey biomass for the Western, Central, and Eastern Gulf of Alaska resulting in the following percentage area apportionments: Western 37.76%, Central 62.22% 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 2021-2022:

Year	Western	Central	Eastern	Total
2021	2,023	3,334	1	5,358
2022	1,926	3,173	1	5,100

11. Shortraker rockfish

In accordance with the approved schedule, no assessment was conducted for shortraker rockfish this year. However, a full stock assessment will be conducted in 2021. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year's stock assessment for details regarding the rolled over estimates. Additional information listed below summarizes the 2019 assessment.

Status and catch specifications (t) of GOA shortraker rockfish 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 for 2020 are current through November 12 th , 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	38,361	1,151	863	863	702
2020	31,465	944	708	708	493
2021	31,465	944	708		
2022		944	708		

Changes from the previous assessment

A full stock assessment was conducted in 2019. 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 2021 and 2022. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Plan Team. Catch data for 2020 are current through November 12, 2020.					
Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2019	55,247	4,521	3,700	3,700	2,491
2020	54,626	4,492	3,676	3,676	2,195
2021	97,702	8,655	7,101		
2022		8,423	6,913		

Changes in assessment methods and data

This year a full assessment was completed for dusky rockfish with the main change in the treatment of bottom trawl survey data. Namely, since 2015 this stock had adopted an original VAST treatment of the survey data with specifications that assumed a lognormal distribution for the positive catch rate tows. The updated treatment uses somewhat fewer “knots” in the spatial map (500 compared to 1,000), and a gamma distribution (with bias corrections). This application has become standardized for the bottom trawl survey data and resulted in a noisier time series in this case (similar to the original design-based estimates of biomass). While there were no changes to the assessment model, the change in the data treatment, and the addition of age data and survey value for 2019, resulted in a sizeable increase in biomass and ABC value over the previous model.

Spawning biomass and stock status trends

The estimates of spawning biomass for 2021 and 2022 from the projection model were 38,362 t and 37,530 t; well above the $B_{40\%}$ estimate of 24,342 t. Catches have ranged from 2.5 to 4 thousand t over the last 10 years.

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 2021 and 2022.

Area Apportionment	Western	Central	Eastern	Total
2021 Area ABC (t)	355	5,993	753	7,101
2022 Area ABC (t)	346	5,834	733	6,913

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 0.82. This results in the following apportionment to the W. Yakutat area:

	W. Yakutat	E. Yakutat/Southeast
2021 Area ABC (t)	617	136
2022 Area ABC (t)	601	132

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2021 and 2022. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Plan Team. Total biomass estimates are age-3+ from the age-structured model; catch data are current as of November 12, 2020.

Year	Biomass	OFL	ABC	TAC	Catch
2019	45,363	1,715	1,428	1,428	748
2020	40,336	1,452	1,209	1,209	377
2021	40,432	1,456	1,212		
2022		1,467	1,221		

Changes from the previous assessment

Rockfish are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. For Gulf of Alaska rougheye and blackspotted rockfish in alternate (even) years, a partial assessment is provided to recommend harvest levels for the next two years. New data added to the projection model included updated catch through October 10, 2020.

Spawning biomass and stock status trends

Female spawning biomass (12,540 t) is above $B_{40\%}$ (8,263 t) and projected to remain stable.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The rougheye/blackspotted complex qualifies as a Tier 3a stock. For 2021 and 2022, the Plan Team accepted the authors' recommended maximum permissible ABCs and the OFLs as provided in the table above.

Status determination

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

Area apportionment

The recommended apportionments for 2021 and 2022 are calculated using the two-survey random effects model, which was approved for use in this assessment in 2019. This method equally weights the longline and trawl survey indices.

	WGOA	CGOA	EGOA	Total
2021 ABC (t)	168	456	588	1,212
2022 ABC (t)	170	459	592	1,221

14. Demersal shelf rockfish

Yelloweye rockfish comprise the largest component of the DSR complex and are managed using the Tier 4 harvest rule. The ABC and OFL for non-yelloweye DSR are calculated using the Tier 6 harvest rule. The Tier 6 ABC and OFL are added to the Tier 4 values for yelloweye rockfish to determine the ABC and OFL for the DSR complex. The Tier 6 values for non-yelloweye DSR utilizes catch data from 2010–2014, as this is the only time period with data available from the commercial, sport, and subsistence fisheries.

Status and catch specifications (t) of GOA demersal shelf rockfish and projections for 2021 and 2022 ¹ . Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Plan Team. Catch data are current through November 12, 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	12,029	411	261	261	140
2020	10,903	375	238	238	104
2021	11,852	405	257		
2022		405	257		

Changes from the previous assessment

The relative abundance estimate was updated for the EYKT management area using ROV survey data collected in August of 2019. Similar survey data from the SSEO was collected in 2020 and an updated density estimate for this region is expected in 2021. The authors chose not to use 2020 data to generate a biomass estimate because the directed commercial DSR fishery was closed and there was a lack of port sampling support due to COVID-19 measures in 2020.

Spawning biomass and stock trends

The regional estimate of yelloweye rockfish density increased due to the increase in density within the EYKT between 2017 and 2019. Consequently, yelloweye rockfish biomass estimates increased from 2020 to 2021 (10,903 to 11,852 and 15,085 to 16,693 depending on whether the lower 90% confidence interval or point estimate is used). While an increase, this species remains at low values within the time series.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

As in previous years, authors recommend a harvest rate lower than the maximum allowed under Tier 4; $F=M=0.02$. This results in an author's recommended ABC of 257 t (237 t yelloweye + 20 t non-yelloweye DSR Tier 6) for 2021 – up slightly from the estimate from last year for 2021 (238 t). The OFL is set using $F_{35\%}=0.032$; which is 405 t for 2021.

Status determination

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

Area apportionment

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

15. Thornyheads

Status and catch specifications (t) of thornyheads in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data for 2020 are current through November 12 th , 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	89,609	2,688	2,016	2,016	777
2020	89,609	2,688	2,016	2,016	459
2021	86,802	2,604	1,953		
2022		2,604	1,953		

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. The last full assessment for the thornyhead complex occurred in 2018. New information in this full assessment includes: 1) catch estimates (though October 6th 2020); 2) length compositions from the 2018 and 2019 longline and trawl fisheries; 3) length compositions from the 2019 GOA bottom trawl survey; 4) updated Relative Population Numbers (RPNs), Relative Population Weights (RPW), and length compositions from the 2018, 2019, and 2020 AFSC annual longline surveys; 5) updated RPWs from the 1992–2020 GOA longline survey for use in the random effects model; and 6) updated biomass values from the 1984–2019 GOA trawl surveys for use in the random effects model.

The methodology (Model 18.1) used to estimate exploitable biomass and calculate ABC and OFL values for the 2021 fishery is unchanged from the last full assessment.

Spawning biomass and stock trends

Estimates of spawning biomass are unavailable for thornyheads. The most recent 2019 trawl survey estimate was 4% lower than the 2017 estimate, whereas the longline survey RPW increased 15% between 2018 and 2019, and then decreased by 27% in 2020. 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 2010–2019 and a projected stable trend after 2020.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The Plan Team concurred with the authors' recommendations for ABC and OFL for 2021 and 2022. Gulf-wide catch of thornyheads in 2019 was 39% 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 1984–2019 trawl survey biomass estimates and the 1992–2020 longline survey RPW index. Subarea ABCs for 2021 and 2022 ABCs are:

2021 and 2022	Western	Central	Eastern	Total
ABC	352	910	691	1,953

16. Other rockfish

In accordance with the approved schedule, no assessment was conducted for other rockfish this year. However, a full stock assessment will be conducted in 2021. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year's stock assessment for details regarding the rolled over estimates. Additional information listed below summarizes the 2019 assessment.

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 12 th , 2020.					
Year	Survey biomass	OFL	ABC	TAC	Catch
2019	96,107	7,356	5,594	2,305	957
2020	70,687	5,320	4,053	4,053	843
2021	70,687	5,320	4,053		
2022		5,320	4,053		

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	2,744	4,053
2021	ABC (t)	940	369	2,744	4,053

17. [Atka mackerel](#)

In accordance with the approved schedule, no assessment was conducted for Atka mackerel this year. However, a full stock assessment will be conducted in 2021. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year's stock assessment for details regarding the rolled-over estimates. Additional information listed below summarizes the 2019 assessment.

Status and catch specifications (t) of Atka mackerel in recent years. Atka mackerel are managed under Tier 6 because reliable estimates of biomass are not available. The OFL and ABC for 2020 and 2021 are those recommended by the Plan Team. Catch data are current through November 12 th , 2020.						
Year	Biomass	OFL	ABC	TAC	Catch	
2019	-	6,200	4,700	3,000	1,254	
2020	-	6,200	4,700	3,000	608	
2021	-	6,200	4,700			
2022	-	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

In accordance with the approved schedule, no assessment was conducted for the skate complex this year. However, a full stock assessment will be conducted in 2021. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year's stock assessment for details regarding the rolled-over estimates. Additional information listed below summarizes the 2019 assessment.

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 12th, 2020.						
Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2019	37,975	3,797	2,848	2,848	1,351
	2020	42,779	4,278	3,208	3,208	1,035
	2021	42,779	4,278	3,208		
	2022		4,278	3,208		
Longnose Skate	2019	47,632	4,763	3,572	3,572	1,014
	2020	34,487	3,449	2,587	2,587	636
	2021	34,487	3,449	2,587		
	2022		3,449	2,587		
Other Skates	2019	18,454	1,845	1,384	1,384	902
	2020	11,662	1,166	875	875	494
	2021	11,662	1,166	875		
	2022		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	
2021 and 2022	Big skate	758	1,560	890	3,208
	Longnose skate	158	1,875	554	2,587
	other skates				875

19. [Sharks](#)

Status and catch specifications (t) of the GOA shark complex and projections for 2021 and 2022. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Plan Team. Catch data for 2020 are current through November 12, 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	54,301	10,913	8,184	4,514	1,998
2020	54,301	10,913	8,184	8,184	1,581
2021	23,289	5,006	3,755		
2022		5,006	3,755		

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. A full assessment was conducted for the shark complex this year. New information for this assessment includes GOA shark catch from 2003-2020 (through October 13, 2020), as well as the following updated survey indices:

- NMFS bottom trawl through 2019,
- NMFS longline through 2020,

- International Pacific Halibut Commission (IPHC) longline through 2019, and
- Alaska Department of Fish and Game (ADF&G) trawl through 2019 and longline through 2020

There were no changes to assessment methodology.

Spawning biomass and stock trends

There was a decline in spiny dogfish biomass in the 2019 trawl survey, this model is based on random effects to smooth the time series from the trawl survey biomass. Tier 6 shark recommendations are determined by average historical catches from 1997-2007, which did not change for this assessment.

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. The total OFL for the GOA shark complex is the sum of the Tier 5 and Tier 6 recommendations for each species.

The recommended ABC is 3,755 t and OFL is 5,006 t for the shark complex. This is a 54% decrease from the 2020 ABC of 8,184 t.

Status determination

Sharks are caught incidentally in other target fisheries. There are currently no directed commercial fisheries for shark species in federally or state managed waters of the GOA, and most incidental catch is discarded. 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. There is no evidence to suggest that overfishing is occurring for any shark species in the GOA because the OFL has not been exceeded.

Area apportionment

GOA sharks are managed Gulf-wide.

20. Octopus

In accordance with the approved schedule, no assessment was conducted for octopus this year. However, a full stock assessment will be conducted in 2021. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year's stock assessment for details regarding the rolled-over estimates. Additional information listed below summarizes the 2019 assessment.

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. 2020 catches current through November 12, 2020.					
Year	Biomass	OFL	ABC	TAC	Catch
2019	12,257	1,300	975	975	336
2020		1,307	980	980	78
2021		1,307	980		
2022		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.

Appendix 1. Grenadiers

An abbreviated grenadier assessment is provided in Appendix 1; while not required, it is provided to assist the Council in tracking abundance of the assemblage in the groundfish FMPs. The Secretary of Commerce approved Amendments 91/100 on August 6, 2014, which added the grenadier complex into both FMPs as Ecosystem Components. Under this rule, they are not allowed to be targeted but there is an 8% Maximum Retainable Allowance (MRA) (Federal Register, Proposed Rules, Vol. 79, No. 93). As an Ecosystem Component, a stock assessment is not required and there is no ABC or OFL.

In the summary table below, the 2019 and 2020 biomass estimates and ABCs are from the last SAFE, which was in 2016, so that 2019 and 2020 catches could be reported.

Complex	Year	GOA Biomass	GOA ABC	GOA Catch ¹	Total Catch ¹
grenadiers	2019	507,888	29,711	4,601	6,743
	2020	507,888	29,711	2,213	4,229
	2021	369,618	NA		
	2022		NA		

¹Current as of September 21, 2020. Source: NMFS Alaska Regional Office Catch Accounting System via the Alaska Fisheries Information Network (AKFIN) database (<http://www.akfin.org>).

Changes from previous assessment

The authors provided update estimates of catch and biomass calculated as relative population weight from the longline survey. New data inputs include from the last assessment include catch data, 2018 and 2020 Aleutian Island (AI) biomass using the estimation method presented in the 2012 SAFE, AFSC longline survey relative population weights (RPWs) in the Gulf of Alaska for 2017-2020, in the Eastern Bering Sea (EBS) for 2017 and 2019, and in the AI for 2018 and 2020, and updated GOA trawl survey biomass time series through 2019 using a random effects model. There were no changes to assessment methodology.

Spawning biomass and stock trends

The main grenadier species taken in the BSAI or GOA fisheries (mainly sablefish) are giant grenadiers. Grenadier are primarily caught in the greenland turbot and halibut fishery in the Bering Sea and in the sablefish fishery in the GOA. Catch in the Aleutian Islands is fairly stable. Biomass for the BSAI and GOA are both down and in the GOA is the lowest it has been since 1998. The AFSC longline survey index is down in all areas, possibly due to hook competition for sablefish since they are increasing. However, catch and biomass using other surveys are also down, and it is unknown how much sablefish are affecting grenadier on the longline survey. Recent catch levels have been well below ABC.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

A Tier 5 status is not determined, nor ABCs and OFLs set for Ecosystem Component species or complexes. However, Tier 5 methods are used for the grenadier complex to estimate ABC and OFL values to monitor the complex. The 2021 ABC for the GOA is 21,623 t with an OFL of 28,830 t.

Status determination

A status is not determined for Ecosystem Component species, however, using the Tier 5 criteria, the complex is not subject to overfishing. The Tier 5 methods do not provide a means to determine if the complex is overfished.

Appendix 2. Forage Species

A report on the status of forage species in the Gulf of Alaska is prepared on a biennial basis. While not a formal stock assessment, forage populations are analyzed if data are available. The forage fish category in the GOA Groundfish FMP includes the following species or groups of species: 1) more than 50 species in the “forage fish group” that are listed in an appendix of the assessment; 2) Pacific herring *Clupea pallasii*; 3) juvenile groundfishes and salmon; 4) shrimps; and 5) squids. Species in the forage fish category have been identified as having ecological importance as prey, and directed fishing is prohibited for the group. As of 2011, the forage fish category in the GOA Groundfish FMP is managed within the “ecosystem component” of the FMP. The report includes an analysis of temporal and spatial trends in capelin, eulachon, and squid, and a more detailed bycatch section particularly on Pacific herring.

Tables

Table 1. Gulf of Alaska groundfish 2020-2022 OFLs and ABCs, 2020 TACs, and 2020 catch (reported through 11/12/20). Note totals depend on sablefish apportionment methods.

Species	Area	2020				2021		2022	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pollock	State GHF	n/a	2,712	0	0	n/a	2,643	n/a	2,298
	W(61)	n/a	19,175	19,175	19,005	n/a	18,477	n/a	16,067
	C(62)	n/a	54,456	54,456	55,395	n/a	54,870	n/a	47,714
	C(63)	n/a	26,597	26,597	25,538	n/a	24,320	n/a	21,149
	WYAK	n/a	5,554	5,554	5,180	n/a	5,412	n/a	4,706
	Subtotal	140,674	108,494	105,782	105,118	123,455	105,722	106,767	91,934
	EYAK/SEO	13,531	10,148	10,148	0	13,531	10,148	13,531	10,148
	Total	154,205	118,642	115,930	105,118	136,986	115,870	120,298	102,082
Pacific Cod	W	n/a	4,942	2,076	235	n/a	7,986	n/a	12,892
	C	n/a	8,458	3,806	3,474	n/a	13,656	n/a	22,045
	E	n/a	1,221	549	271	n/a	1,985	n/a	3,204
	Total	17,794	14,621	6,431	3,980	28,977	23,627	46,587	38,141
Sablefish	W	n/a	2,278	1,942	1,424	n/a		n/a	
	C	n/a	7,560	6,445	5,846	n/a	see	n/a	see
	WYAK	n/a	2,521	2,343	1,789	n/a	options	n/a	options
	SEO	n/a	4,524	3,663	3,036	n/a	above	n/a	above
	Total	50,481	16,883	14,393	12,095	60,426		70,710	
Shallow Water Flatfish	W	n/a	23,849	13,250	22	n/a	24,151	n/a	24,460
	C	n/a	27,732	27,732	4,210	n/a	28,082	n/a	28,442
	WYAK	n/a	2,773	2,773	1	n/a	2,808	n/a	2,844
	EYAK/SEO	n/a	1,109	1,109	1	n/a	1,123	n/a	1,137
	Total	68,010	55,463	44,864	4,234	68,841	56,164	69,691	56,883
Deep water flatfish	W	n/a	226	226	1	n/a	225	n/a	225
	C	n/a	1,948	1,948	99	n/a	1,914	n/a	1,914
	WYAK	n/a	2,105	2,105	3	n/a	2,068	n/a	2,068
	EYAK/SEO	n/a	1,751	1,751	4	n/a	1,719	n/a	1,719
	Total	7,163	6,030	6,030	107	7,040	5,926	7,040	5,926
Rex Sole	W	n/a	2,901	2,901	36	n/a	3,013	n/a	3,013
	C	n/a	8,579	8,579	1,202	n/a	8,912	n/a	8,912
	WYAK	n/a	1,174	1,174	1	n/a	1,206	n/a	1,206
	EYAK/SEO	n/a	2,224	2,224	0	n/a	2,285	n/a	2,285
	Total	18,127	14,878	14,878	1,239	18,779	15,416	18,779	15,416
Arrowtooth flounder	W	n/a	31,455	14,500	288	n/a	32,377	n/a	31,479
	C	n/a	68,669	68,669	20,811	n/a	69,072	n/a	67,154
	WYAK	n/a	10,242	6,900	46	n/a	8,380	n/a	8,147
	EYAK/SEO	n/a	17,694	6,900	32	n/a	17,141	n/a	16,665
	Total	153,017	128,060	96,969	21,177	151,723	126,970	147,515	123,445
Flathead sole	W	n/a	13,783	8,650	100	n/a	14,209	n/a	14,380
	C	n/a	20,201	15,400	1,817	n/a	20,826	n/a	21,076
	WYAK	n/a	2,354	2,354	0	n/a	2,427	n/a	2,456
	EYAK/SEO	n/a	1858	1858	0	n/a	1,915	n/a	1,939
	Total	46,572	38,196	28,262	1,917	47,982	39,377	48,534	39,851

Table 1. (continued) Gulf of Alaska groundfish 2020 – 2022 OFLs and ABCs, 2020 TACs and catch (reported through 11/12/20). Note totals depend on sablefish apportionment methods.

Species	Area	2020				2021		2022	
		OFL	ABC	TAC	Catch	OFL	ABC	OFL	ABC
Pacific Ocean Perch	W	n/a	1,437	1,437	1,335	n/a	1,643	n/a	1,572
	C	n/a	23,678	23,678	21,971	n/a	27,429	n/a	26,234
	WYAK	n/a	1,470	1,470	1,466	n/a	1,705	n/a	1,631
	W/C/WYAK	31,567	26,585	26,585	24,772	36,563	30,777	34,974	29,437
	SEO	5,525	4,653	4,653	0	6,414	5,400	6,136	5,165
	Total	37,092	31,238	31,238	24,772	42,977	36,177	41,110	34,602
Northern Rockfish	W	n/a	1,133	1,133	769	n/a	2,023	n/a	1,926
	C	n/a	3,178	3,178	1,616	n/a	3,334	n/a	3,173
	E	n/a	1	0	0	n/a	1	n/a	1
	Total	5,143	4,312	4,311	2,385	6,396	5,358	6,088	5,100
Shortraker rockfish	W	n/a	52	52	6	n/a	52	n/a	52
	C	n/a	284	284	186	n/a	284	n/a	284
	E	n/a	372	372	301	n/a	372	n/a	372
	Total	944	708	708	493	944	708	944	708
Dusky Rockfish	W	n/a	776	776	231	n/a	355	n/a	346
	C	n/a	2,746	2,746	1,879	n/a	5,993	n/a	5,834
	WYAK	n/a	115	115	83	n/a	617	n/a	601
	EYAK/SEO	n/a	39	39	2	n/a	136	n/a	132
	Total	4,492	3,676	3,676	2,195	8,655	7,101	8,423	6,913
Rougheye and Blacspotted rockfish	W	n/a	168	168	4	n/a	168	n/a	170
	C	n/a	455	455	183	n/a	456	n/a	459
	E	n/a	586	586	190	n/a	588	n/a	592
	Total	1,452	1,209	1,209	377	1,456	1,212	1,467	1,221
DSR	GOA-wide	375	238	238	104	405	257	405	257
Thornyhead rockfish	W	n/a	326	326	50	n/a	352	n/a	352
	C	n/a	911	911	208	n/a	910	n/a	910
	E	n/a	779	779	201	n/a	691	n/a	691
	Total	2,688	2,016	2,016	459	2,604	1,953	2,604	1,953
Other rockfish	WC	n/a	940	940	647	n/a	940	n/a	940
	WYAK	n/a	369	369	101	n/a	369	n/a	369
	EYAK/SEO	n/a	2,744	2,744	95	n/a	2,744	n/a	2,744
	Total	5,320	4,053	4,053	843	5,320	4,053	5,320	4,053
Atka mack.	GOA-wide	6,200	4,700	3,000	608	6,200	4,700	6,200	4,700
Big Skate	W	n/a	758	758	32	n/a	758	n/a	758
	C	n/a	1,560	1,560	815	n/a	1,560	n/a	1,560
	E	n/a	890	890	188	n/a	890	n/a	890
	Total	4,278	3,208	3,208	1,035	4,278	3,208	4,278	3,208
Longnose Skate	W	n/a	158	158	21	n/a	158	n/a	158
	C	n/a	1,875	1,875	360	n/a	1,875	n/a	1,875
	E	n/a	554	554	255	n/a	554	n/a	554
	Total	3,449	2,587	2,587	636	3,449	2,587	3,449	2,587
Other Skates	GOA-wide	1,166	875	875	494	1,166	875	1,166	875
Sculpins	GOA-wide	6,932	5199	5199	570	Moved to ecosystem component			
Sharks	GOA-wide	10,913	8,184	8,184	1,581	5,006	3,755	5,006	3,755
Octopuses	GOA-wide	1,307	980	980	78	1,307	980	1,307	980
Total	SQ sablefish	607,120	465,956	399,239	186,497	610,917	469,543	616,921	470,145
Total	5-yr avg					610,917	473,360	616,921	475,176

Table 2a. Gulf of Alaska 2021 and 2022 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 2021 abundance for the age+ range reported in the summary.

Stock or Assemblage	Tier	Area	Biomass	2021				2022			
				OFL	F_{OFL}	ABC	F_{ABC}	OFL	F_{OFL}	ABC	F_{ABC}
		State GHL		n/a		2,643		n/a		2,298	
Pollock ^a	3a	W(61)			0.33	18,477	0.28		0.30	16,067	0.26
		C(62)				54,870				47,714	
		C(63)				24,320				21,149	
		WYAK				5,412				4,706	
		Subtotal	1,097,340	123,455		105,722		106,767		91,934	
	5	EYAK/SEO	45,103	13,531	0.30	10,148	0.23	13,531	0.30	10,148	0.23
		Total	1,142,443	136,986		115,870		120,298		102,082	
Pacific Cod	3b	W			0.41	7,986	0.33		0.54	12,892	0.43
		C				13,656				22,045	
		E				1,985				3,204	
		Total	265,661	28,977		23,627		46,587		38,141	
Sablefish	3b	W			0.117	See Options Below***	0.042		0.117	See Options Below***	0.048
		C									
		WYAK									
		EYAK/SEO									
		Total	390,000	60,426				70,710			
Shallow Water* Flatfish	3a, 5	W			0.462, 0.326 ^b	24,151	0.382, 0.271 ^b		0.462, 0.326 ^b	24,460	0.382- 0.271 ^b
		C				28,082				28,442	
		WYAK				2,808				2,844	
		EYAK/SEO				1,123				1,137	
		Total	342,226	68,841		56,164		69,691		56,883	
Deepwater** Flatfish	3a, 6	W			0.11 ^c	225	0.09 ^c		0.11 ^c	225	0.09 ^c
		C				1,914				1,914	
		WYAK				2,068				2,068	
		EYAK/SEO				1,719				1,719	
		Total	84,771	7,040		5,926		7,040		5,926	
Rex Sole**	3a	W			0.29 ^d 0.31	3,013	0.23 ^d 0.25		0.29 ^d 0.31	3,013	0.23 ^d 0.25
		C				8,912				8,912	
		WYAK				1,206				1,206	
		EYAK/SEO				2,285				2,285	
		Total	101,244	18,779		15,416		18,779		15,416	
Arrowtooth* Flounder	3a	W			0.234	32,377	0.192		0.234	31,479	0.192
		C				69,072				67,154	
		WYAK				8,380				8,147	
		EYAK/SEO				17,141				16,665	
		Total	1,321,700	151,723		126,970		147,515		123,445	
Flathead Sole*	3a	W			0.36	14,209	0.28		0.36	14,380	0.28
		C				20,826				21,076	
		WYAK				2,427				2,456	
		EYAK/SEO				1,915				1,939	
		Total	280,980	47,982		39,377		48,534		39,851	

*Partial assessment

** The Team evaluated whether adjustments to assumed catches from previous partial assessments were needed (the updated projection model result was unavailable) and determined the projections from last year's partial assessment were appropriate for 2021 and 2022.

*** See Table 2b.

^a The Prince William Sound GHL (2.5% of ABC; 2,643 t in 2021, 2,298 t in 2022) is deducted from the pollock 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 F_{OFL} and F_{ABC} values for deep water flatfish are for Tier 3 Dover sole.

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

Table 2a. Continued... Gulf of Alaska 2021 and 2022 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	2021				2022			
				OFL	F _{OFL}	ABC	F _{ABC}	OFL	F _{OFL}	ABC	F _{ABC}
Pacific Ocean Perch	3a	W			0.120	1,643	0.100		0.120	1,572	0.100
		C				27,429				26,234	
		WYAK				1,705				1,631	
		W/C/WYAK		36,563		30,777		34,974		29,437	
		EYAK/SEO		6,414		5,400		6,136		5,165	
		Total	613,522	42,977		36,177		41,110		34,602	
Northern Rockfish	3a	W			0.073	2,023	0.061		0.073	1,926	0.061
		C				3,334				3,173	
		E				1				1	
		Total	102,715	6,396		5,358		6,088		5,100	
<i>Shortraker</i> ⁱ (No assessment this year)	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			0.114	355	0.093		0.114	346	0.093
		C				5,993				5,834	
		WYAK				617				601	
		EYAK/SEO				136				132	
		Total	97,702	8,655		7,101		8,423		6,913	
Rougheye / Blackspotted Rockfish*	3a	W			0.048	168	0.040		0.048	170	0.040
		C				456				459	
		E				588				592	
		Total	40,432	1,456		1,212		1,467		1,221	
DSR*	4, 6	Total	11,852 ^g	405	0.032 ^g	257	0.02 ^g	405	0.032 ^g	257	0.02 ^g
Thornyhead rockfish	5	W			0.03	352	0.0225		0.03	326	0.0225
		C				910				911	
		E				691				779	
		Total	86,802	2,604		1,953		2,604		1,953	
Other Rockfish ⁱ (No assessment this year)	4, 5, 6	W/C			0.079 ^e 0.070 ^e	940	0.065 ^f 0.053 ^f		0.07 ^e 0.073 ^e	940	0.065 ^f 0.053 ^f
		WYAK				369				369	
		EYAK/SEO				2,744				2,745	
		Total	70,687	5,320		4,053		5,320		4,054	
<i>Atka Mackerel</i> ^f	6		--	6,200	--	4,700	--	6,200	--	4,700	--
<i>Big Skates</i> ⁱ (No assessment this year)	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	
<i>Longnose Skates</i> ⁱ (No assessment this year)	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	
<i>Other Skates</i> ⁱ (no assessment this year)	5		11,662	1,166	0.1	875	0.075	1,166	0.1	875	0.075
Sharks	6		23,289 ^h	5,006	0.04 ^g	3,755	0.03 ^g	5,006	0.04 ^g	3,755	0.03 ^g
<i>Octopus</i> ⁱ (no assessment this year)	6		12,257	1,307	--	980	--	1,307	--	980	--
Total		Total	5,005,961	595,362		460,754		624,684		477,927	

^e F_{OFL} equal to 0.079 for Tier 4 sharpchin and 0.070 for 17 Tier 5 other rockfish species.

^f F_{ABC} equal to 0.065 for Tier 4 sharpchin rockfish and 0.053 for 17 Tier 5 other rockfish species.

^g Values listed are for Tier 4 yelloweye rockfish.

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

ⁱ No assessments were provided for shortraker rockfish, other rockfish, Atka mackerel, big skates, longnose skates, other skates, and octopus. Values in the table are from the 2019 assessment and the 2020 harvest specifications (for 2021 and 2022).

Table 2b. Gulf of Alaska Plan Team recommended options for sablefish apportionments

Option: Author recommended, survey 5-year moving average apportionment:

2021			2022	
OFL			ABC	ABC
Sablefish	W	n/a	2,671	n/a
	C	n/a	5,738	n/a
	WYAK	n/a	2,050	n/a
	SEO	n/a	2,810	n/a
Total		n/a	13,269	n/a
Alaska-wide			60,426	70,710
Option: Fixed (Status Quo) apportionment				
2021			2022	
OFL			ABC	ABC
Sablefish	W	n/a	2,339	n/a
	C	n/a	7,629	n/a
	WYAK	n/a	2,773	n/a
	SEO	n/a	4,345	n/a
Total		n/a	17,086	n/a
Alaska-wide			60,426	70,710

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 2021 and 2022 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum permissible.

2021					
Species	Tier	$Max F_{ABC}$	$Max ABC$	F_{ABC}	ABC
Sablefish	3a	0.100		0.042	
Demersal shelf rockfish	4, 6	0.026	328	0.02	257
2022					
Species	Tier	$Max F_{ABC}$	$Max ABC$	F_{ABC}	ABC
Sablefish	3a	0.100		0.042	
Demersal shelf rockfish	4, 6	0.026	328	0.02	257

Table 4. Groundfish landings (metric tons) in the Gulf of Alaska, 1956-2020.

Year	Pollock	Pacific cod	sablefish	Flatfish	Arrowtooth Flounder	Slope rockfish ^a
1956			1,391		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.	
1957			2,759			
1958			797			
1959			1,101			
1960			2,142			
1961			897			16,000
1962			731			65,000
1963			2,809		b Catch from Southeast Outside District.	136,300
1964	1,126	196	2,457	1,028		243,385
1965	2,749	599	3,458	4,727	c Thornyheads were included in the other species category, and are foreign catches only.	348,598
1966	8,932	1,376	5,178	4,937		200,749
1967	6,276	2,225	6,143	4,552		120,010
1968	6,164	1,046	15,049	3,393	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. Various FMP amendments have reduced the number of species in this category: in 2020, it only included sculpins, sharks, and octopuses.	100,170
1969	17,553	1,335	19,376	2,630		72,439
1970	9,343	1,805	25,145	3,772		44,918
1971	9,458	523	25,630	2,370		77,777
1972	34,081	3,513	37,502	8,954		74,718
1973	36,836	5,963	28,693	20,013		52,973
1974	61,880	5,182	28,335	9,766		47,980
1975	59,512	6,745	26,095	5,532		44,131
1976	86,527	6,764	27,733	6,089		46,968
1977	112,089	2,267	17,140	16,722		23,453
1978	90,822	12,190	8,866	15,198		8,176
1979	98,508	14,904	10,350	13,928	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	h Catch data reported through November 12, 2020.	21,114
1991	107,500	76,997	19,580	20,068		13,994
1992	93,904	80,100	20,451	28,009	i Includes all species except arrowtooth.	16,910
1993	108,591	55,994	22,671	37,853		14,240
1994	110,891	47,985	21,338	29,958	j Does not include state fisheries	11,266
1995	73,248	69,053	18,631	32,273	k Includes all managed skate species	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 ⁱ		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		29,864
2019	43,771	10,909	12,219	7,976		28,547
2020	105,118	3,980	12,095	7,497		28,870

Table 4. (cont'd) Groundfish landings (t) in the Gulf of Alaska, 1956-2020. 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	246,642
2019	2,365	140	764	1,254	3,042	2,618	137,237
2020	2,195	104	459	608	2,165	2,229	186,497

