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

GOA Introduction Contents

Summary 3
Overview of Stock Assessments 9
Economic Summary of the GOA commercial groundfish fisheries in 2020 12
Ecosystem Considerations summary 16
GOA Regional Action Plan (RAP) 17
GOA Climate Integrated Modeling Project (CLIM) 17
Stock summaries 18
1. Walleye pollock 18
2. Pacific cod 19
3. Sablefish 21
4. Shallow water flatfish 22
5. Deepwater flatfish complex (partial) 23
6. Rex sole 24
7. Arrowtooth flounder 25
8. Flathead sole (partial) 26
9. Pacific ocean perch 27
10. Northern rockfish (partial) 28
11. Shortraker rockfish 29
12. Dusky rockfish (partial) 30
13. Rougheye and blackspotted rockfish 31
14. Demersal shelf rockfish 32
15. Thornyheads (from the 2020 assessment) 32
16. Other rockfish 34
17. Atka mackerel 35
18. Skates 36
19. Sharks (from the 2020 assessment) 37
20. Octopus 38
Tables 39

NOTE: full chapters are available through links within each summary and via website HERE.

Summary

The *National Standard Guidelines for Fishery Management Plans* published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). The SAFE reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks and fisheries under federal management. The FMPs for the groundfish fisheries managed by the 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 15-19, 2021 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, Pete Hulson, Janet Rumble, Nat Nichols, Marysia Szymkowiak, Paul Spencer, Andrew Olson, 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 2011 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.

Amendments 91/100 added grenadiers to the GOA and BSAI FMPs (respectively) 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 110/121 moved sculpins to the Ecosystem Component category of the FMPs in 2020.

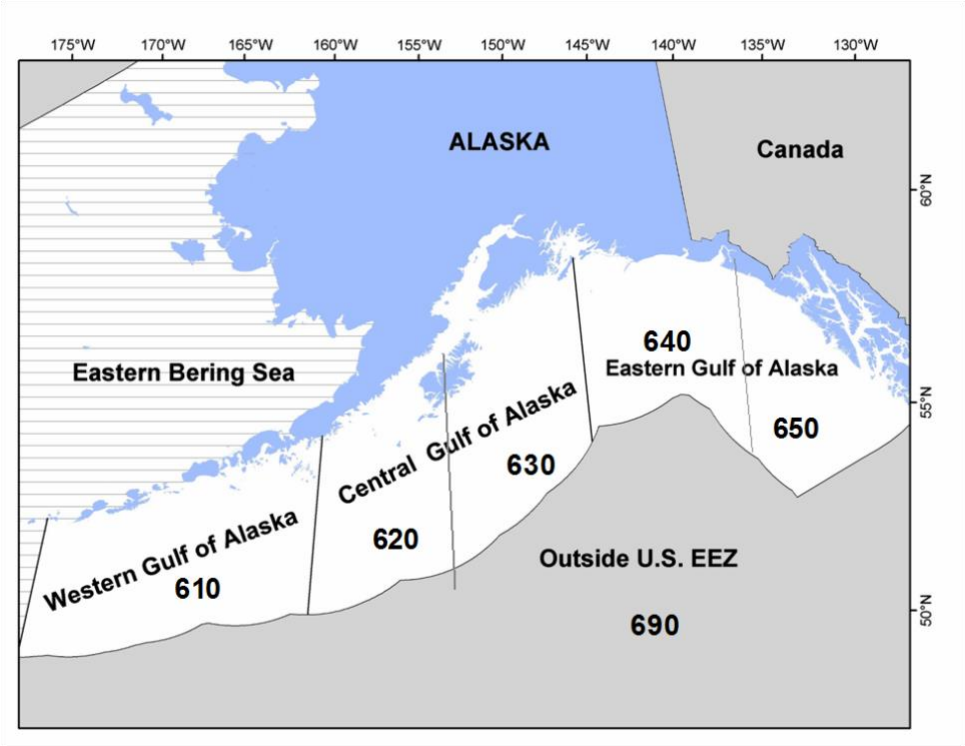


Figure 1. Gulf of Alaska statistical and reporting areas.

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, deepwater flatfish, shallow water flatfish, rex sole, flathead sole, arrowtooth flounder, Pacific ocean perch, shortraker rockfish, rougheye/blackspotted rockfish, northern rockfish, "other" rockfish, dusky rockfish, demersal shelf rockfish, thornyhead rockfish, Atka mackerel, 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, deepwater flatfish, rex sole, flathead sole, arrowtooth flounder), Rockfish (Pacific ocean perch, northern rockfish, shortraker rockfish, rougheye/blackspotted rockfish, other rockfish, dusky rockfish, demersal shelf rockfish[3], thornyhead rockfish), Atka mackerel, skates (big skates, longnose skates, and other skates), 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[7]	Families: Cottidae, Hemitripteridae, 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. 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, deepwater 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 2022 and 2023 PWS GHL (equal to 2.5% of the recommended 2022 and 2023 W/C/WY pollock ABCs) from the recommended 2022 and 2023 W/C/WY pollock ABCs (listed in the summary table), before area apportionments were 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 2022 and 2023 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	Deepwater 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 for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under "overfishing" below.

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

Tier

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

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

Overfished (listed in each assessment as projection 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 2021 or 2) above ½ of its MSY level in 2021 and above its MSY level in 2031 under this scenario, then the stock is not overfished.)

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

In 2022, 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 2023 or 2) above 1/2 of its MSY level in 2023 and expected to be above its MSY level in 2033 under this scenario, then the stock is not approaching an overfished condition.)

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

Overview of Stock Assessments

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

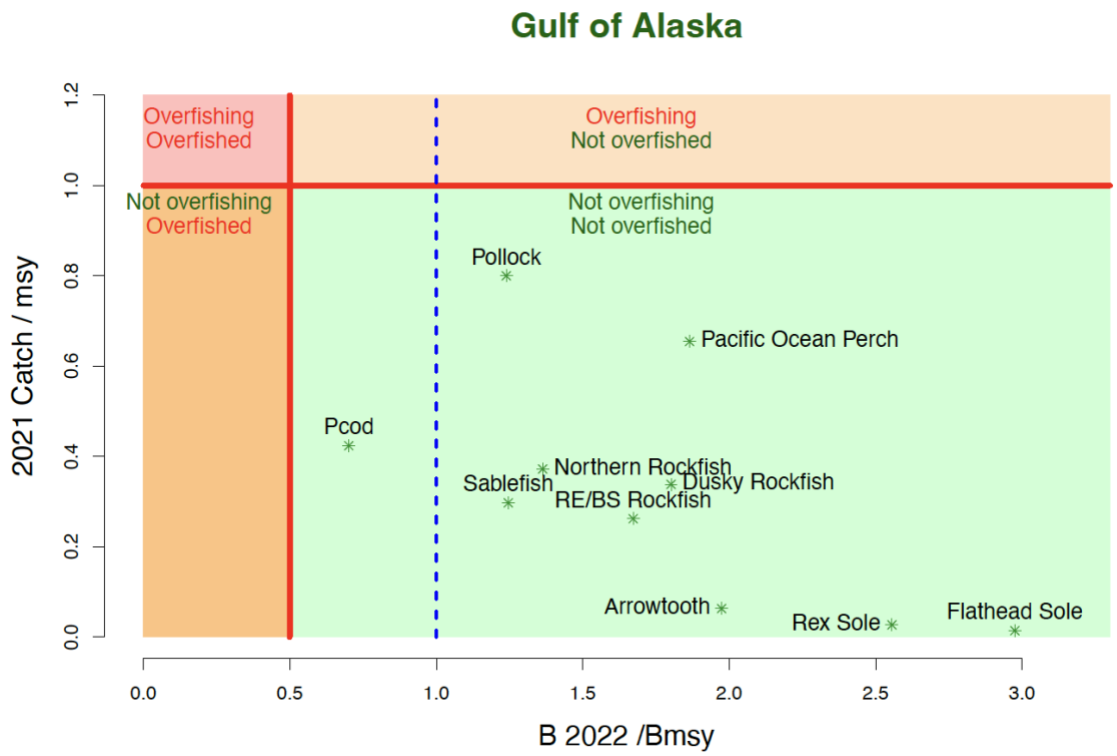


Figure 2. Summary of Gulf of Alaska stock status next year (spawning biomass relative to B_{MSY}; horizontal axis) and current year catch relative to fishing at F_{MSY} (vertical axis). Note that sablefish is for Alaska-wide values including the BSAI catches.

Summary and Use of Terms

Table 1 provides a summary of the status of the groundfish stocks, including catch statistics, ABCs, and TACs for 2021, and recommendations for ABCs and overfishing levels (OFLs) for 2022 and 2023. 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, 1956-2021.

The sum of the Plan Team's recommended 2022 ABCs for target species in the GOA is 499,446 t (497,269 t for 2023). This sum includes only the GOA sablefish ABCs. The Alaska-wide sablefish ABCs are shown in Table 1. Note that for management of annual catch limits, the Alaska-wide ABC for sablefish is the ACL. 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 2022 and 2023 OFLs (with Alaska-wide sablefish

OFLs) are 616,157 and 615,816 t, respectively. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2022 will be considerably under this upper limit. For perspective, the sum of the 2021 TACs was 407,976 t and the sum of the ABCs (with GOA-wide sablefish ABC) was 476,037 t (and catch through November 6th, 2021 was 178,511 t). The Team recommended maximum permissible ABCs for all stocks, except for sablefish, demersal shelf rockfish, and dusky rockfish.

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 2020 and 2021 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 2022 and 2023 correspond to the Plan Team recommendations.

(4) The exploitable biomass for 2020 and 2021 that are reported in the following summaries were estimated by the assessments in *those* years. Comparisons of the projected 2022 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 (https://www.fisheries.noaa.gov/alaska/sustainable-fisheries/alaska-catch-accounting-system) unless otherwise noted.

(6) The values used for 2022 and 2023 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 2022 harvest specifications (from Council recommendations in December 2020) are in place to start the fishery on January 1, 2022, but these will be replaced by final harvest specifications that will be recommended by the Council in December 2021. The final 2022 and 2023 harvest specifications will become effective when final rulemaking occurs in February or March 2022. 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 2023 ABC and OFL values recommended in next year's SAFE report are likely to differ from this year's projections for 2023 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. For stocks in Tiers 1-3, in years without a full assessment, a "partial assessment" is produced by updating recent catch data and re-running the projection model using the parameters and results from the previous full assessment as a starting point. In general, partial assessments should not update apportionment percentages by area based on new survey information. Stocks in Tiers 4-6 do not need assessments in off years. 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	**2021 Assessment status**	**Tier**	**Schedule (years)**	**Year of next Full Assessment**
Pollock	Full	3	1	2022
Pacific cod	Full	3	1	2022
Sablefish	Full	3	1	2022
Northern and southern rock sole	Full	3	4	2025
Shallow water flatfish (excluding northern and southern rock sole)	Full	5	4	2025
Deepwater flatfish (Dover)	Partial	3/6	4	2023
Rex sole	Full	3	4	2025
Arrowtooth flounder	Full	3	2	2023
Flathead sole	Partial	3	4	2022[1]
Pacific ocean perch	Full	3	2	2023
Northern rockfish	Partial	3	2	2022
Shortraker rockfish	Full	5	2	2023
Other rockfish	Full	4/5/6	2	2023
Rougheye & blackspotted rockfish	Full	3	2	2023
Dusky rockfish	Partial	3	2	2022
Demersal shelf rockfish	Full	4/6	2	2022[2]
Thornyhead rockfish	None	5	2	2022
Atka mackerel	Full	6	2	2023
Octopus	Full	6	2	2023
Sharks	None	5/6	2	2022
Skates	Full	5	2	2023
Sculpins	None	eco	4	2023
Forage species (including Squid)	None	eco	2	2022
Grenadiers (BSAI/GOA)	None	eco	4	2024

Economic Summary of the GOA commercial groundfish fisheries in 2020

The ex-vessel value of all Alaska domestic fish and shellfish catch, which includes the amount paid to harvesters for fish caught, and the estimated value of pre-processed fish species that are caught by catcher/processors, decreased from $2,003 million dollars in 2019 to $1,504 million in 2020 in real 2020 dollars.

The first wholesale value of 2020 groundfish catch after primary processing was $2,102 million in real 2020 dollars. The 2020 total groundfish catch decreased by 4.6%, and the total first-wholesale value of groundfish catch decreased by 17%, relative to 2019. Much of the decline in values was associated with COVID-19 impacts on supply chains and demand changes, especially those products with significant exports to China for reprocessing and those where food service constitutes a significant portion of the end market.

The groundfish fisheries accounted for the largest share (54%) of the ex-vessel value of all commercial fisheries off Alaska, while the Pacific salmon fishery was second with $377.3 million or 25% of the total

[1] A full flathead sole assessment was scheduled for this year but was postponed until 2022. After next year's full assessment, the next full assessment will be conducted in 2025 and then will resume the 4-year cycle.

[2] Despite a full assessment this year, another full DSR assessment is planned in 2022, after which DSR will be on a two-year cycle in even years.

Alaska ex-vessel value. The value of the shellfish fishery amounted to $234.8 million or 16% of the total for Alaska and exceeded the value of Pacific halibut with $70.4 million or 5% of the total for Alaska.

The Economic SAFE report (appendix bound separately) contains detailed information about economic aspects of the groundfish fisheries, including figures and tables, economic performance indices, current year product price and ex-vessel price projections, groundfish in-season ex-vessel revenue estimates, groundfish price projections, and wholesale market profiles. 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 2016-2020, 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. Economic SAFE data is publicly available in a user-friendly format on: https://reports.psmfc.org/akfin/f?p=501:2001

Decomposition of the change in first-wholesale revenues from 2019-20 in the GOA

The following brief analysis summarizes the overall changes that occurred between 2019-20 in the quantity produced and revenue generated from GOA groundfish. According to data reported in the 2021 Economic SAFE report, the ex-vessel value of GOA groundfish continued to decreased from $144 million in 2019 to $94 million in 2020 (values adjusted to 2020 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 2019 ($254 million) and 2020 ($191 million) (Figure 4). At the same time, the total quantity of groundfish products from the GOA decreased from 100 thousand metric tons to 82 thousand metric tons, a 18% decrease. Similarly in the BSAI, first-wholesale revenues from processing saw a 16% decrease for groundfish from 2019 to 2020 and a 9% year-to-year decrease in groundfish products.

Landings decreased for all groundfish species in the GOA with concurrent declines in price effects for most species driving precipitous declines in net values across the board. The largest decline was for Pacific cod with a $20 million wholesale revenue decline (Figure 5). For GOA pollock, a minor positive price effect was insufficient to offset the decline in landings driving wholesale values down by $16 million. For sablefish, despite an increase in harvests, wholesale values declined by $14 million due to continued substantial declines in ex-vessel prices from 2017, as well as supply chain and demand issues associated with COVID-19. In the GOA, retained catch for all flatfish species decreased by 13%. For rockfish, a negative price effect led to a 4% decrease in wholesale values.

Similarly to impacts across the groundfish species, there were declines in wholesale revenues across all product groups. These were driven by both negative quantity and price effects nearly across the board of product types (surimi, fillet, head&gut, roe). Although the category of “other” had a minor positive price effect that did not offset the negative quantity effect. The whole and head and gut (whole-H&G) category had the most substantial negative wholesale revenue declines, of $37 million.

In summary, first-wholesale revenues from the GOA groundfish fisheries decreased by about $17.5 million from 2019-20, continuing a decline in values that began in 2016 and amounts to a $197 million (or 51%) decrease from 2016 to 2020. The impacts of COVID-19 exacerbated previous revenue declines associated with the decline of the GOA Pacific cod stocks, small sablefish and associated decreases in average prices, and negative impacts on prices associated with tariff issues for other groundfish.

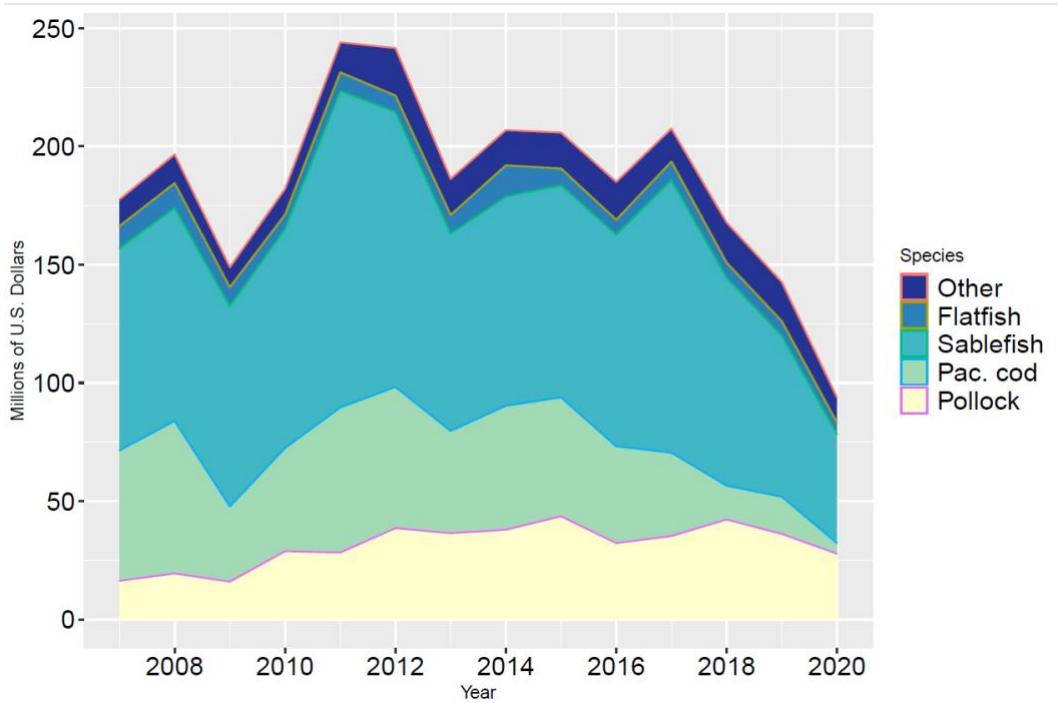


Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the GOA area by species, 2007-2020 (base year = 2020)

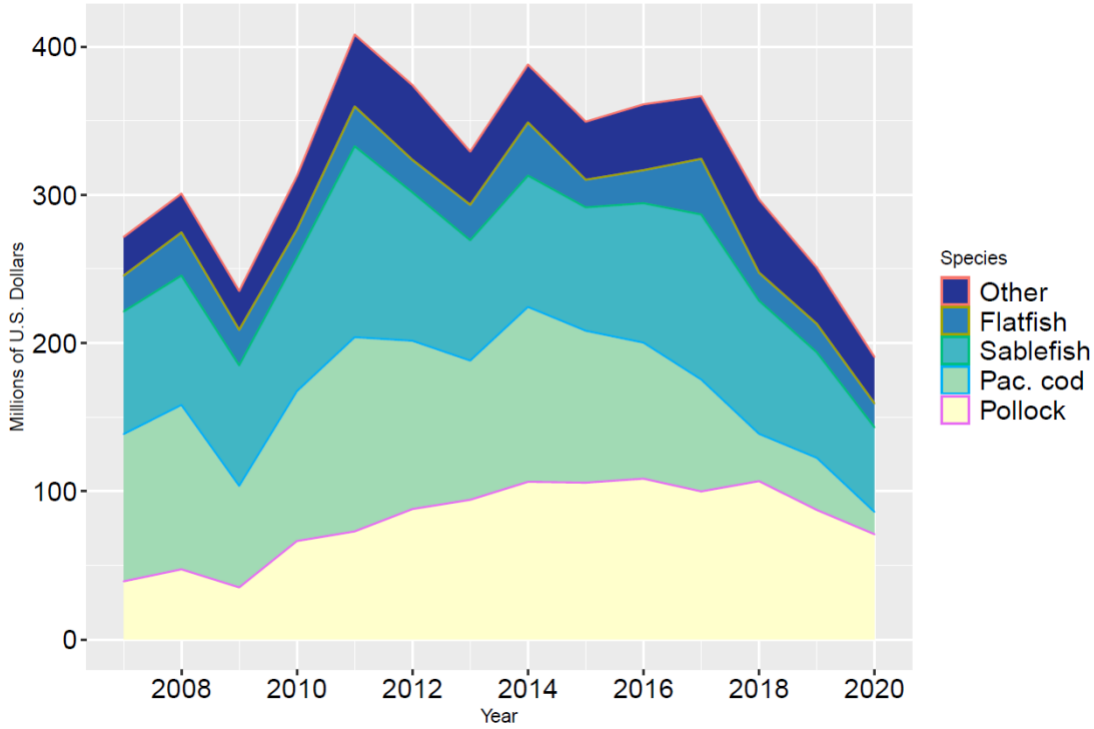
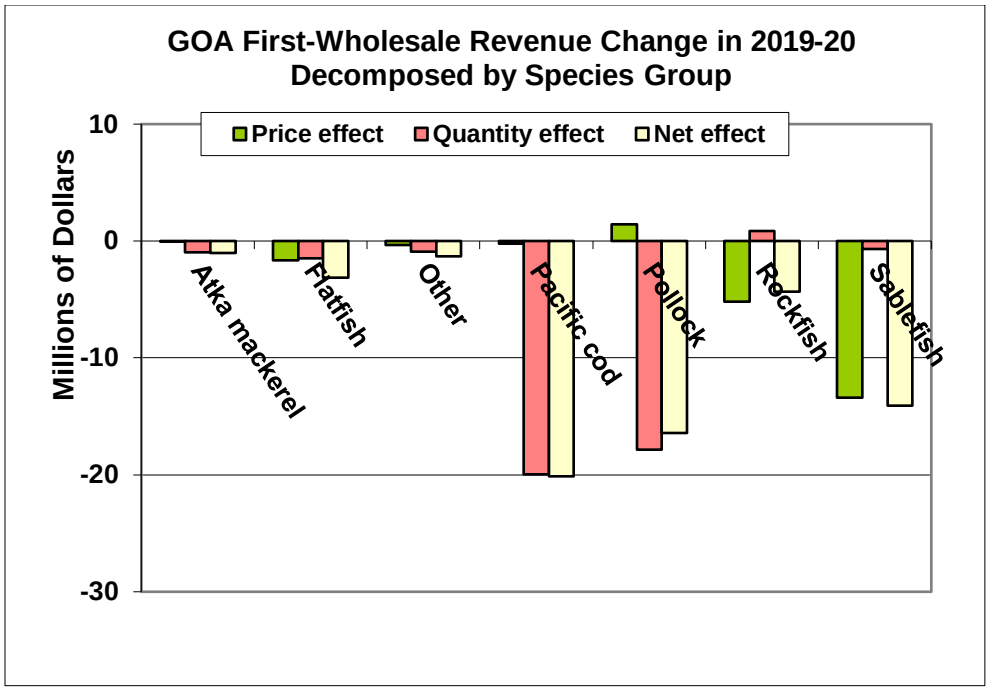


Figure 4. Real gross product value of the groundfish catch in the GOA area by species, 2007-2020 (base year = 2020).



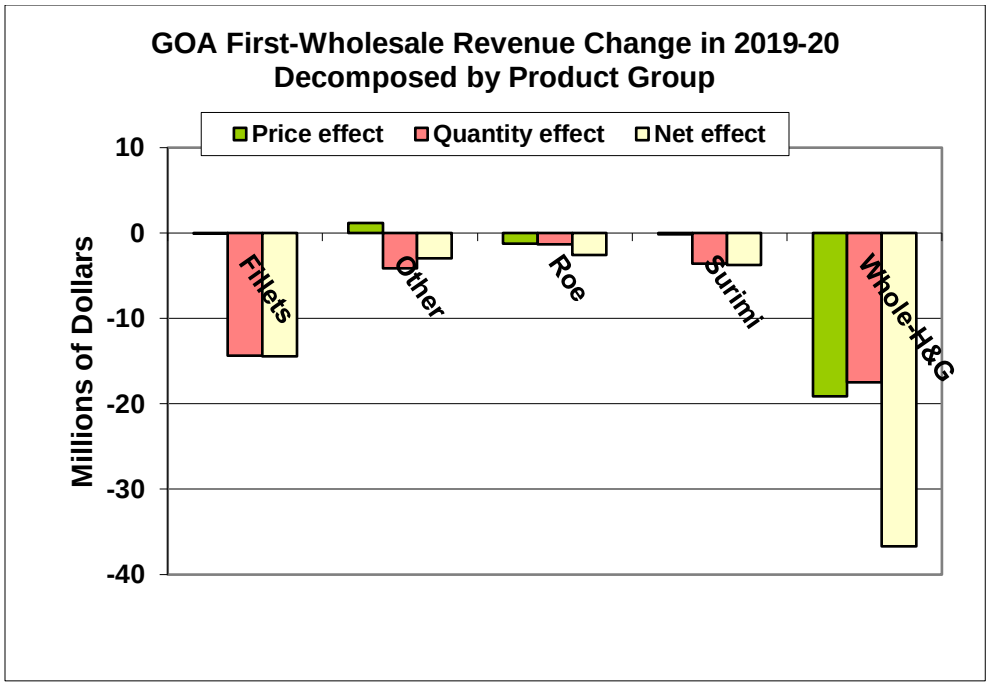


Figure 5. Decomposition of the change in first-wholesale revenues from 2019-20 in the GOA area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in the 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 2021 Report Card

- The PDO continued its negative trend in 2021, reflecting cooling sea surface temperatures in the GOA.
- Summer (June-August) 2021 sea surface temperatures in the western GOA were generally lower than 2020, although spring surface temperatures were elevated.
- Mesozooplankton biomass (sampled April-Sept) decreased in 2020, indicating average foraging conditions for planktivorous predators.
- Copepod community size slightly increased in 2020 (sampled April-Sept) indicating there were slightly more large species available (often considered of higher nutritional quality).
- Motile epifauna biomass, observed during 2021 AFSC bottom trawl survey (May-Aug), decreased from 2019 to 2021.
- Trends in capelin, as sampled by rhinoceros auklets at Middleton Island (April-Aug.), continue to be minimal in seabird chick diets in recent years.
- Fish apex predator biomass, observed during 2021 AFSC bottom trawl survey (May-Aug), increased from 2019 to 2021 to within just above 1SD below the long-term mean.
- Black-legged kittiwakes reproductive success in 2021 (June-July) increased from 2020.
- Modelled estimates of western Gulf of Alaska Steller sea lion non-pup counts continued a slightly increasing trend from previous years; however realized counts for non-pups show the lowest values in this area since 2011.

Eastern Gulf of Alaska 2021 Report Card

- La Nina conditions prevailed in winter 2020/2021 and are predicted for winter 2021/2022.
- Summer (June-Aug.) 2021 sea surface temperatures in the eastern GOA remain within 1SD of the long-term mean.
- Total zooplankton density in in SEAK inside waters (May-Aug) increased from 2020, suggesting improved foraging conditions for planktivorous fish, seabirds, and mammals.
- The overall copepod community size (ratio of large calanoid copepods to total calanoid copepods) decreased due to decreased densities of large copepods and increased densities of small copepods.
- Motile epifauna biomass, observed during 2021 AFSC bottom trawl survey (May-Aug), decreased from 2019 to 2021. Hermit crabs, brittle stars, and other echinoderms are all below their long-term means. Eelpouts have also decreased from 2019 to 2021.
- Estimated total mature herring biomass (age 3+) of Sitka herring in spring 2020 continued to increase to the largest value in the time series (since 1980). The two populations with ocean influence (Sitka Sound and Craig) were elevated while populations in SEAK inner waters and Prince William Sound increased but remained low.
- Fish apex predator biomass, observed during 2021 AFSC bottom trawl survey, trended downward from a high in 2015 to their second lowest value over the time series in 2021. The decrease over this time period has largely been driven by Arrowtooth flounder which are at their lowest value over the time series. Pacific halibut, sablefish, and Pacific cod, have all increased from 2019.
- Growth rates of piscivorous rhinoceros auklet chicks remain below the long-term mean in 2021 (June-July), a pattern since 2015, suggesting that the adults were unable to find sufficient prey to support optimal chick growth.
- Modelled estimates of eastern Gulf of Alaska Steller sea lion non-pup counts continue an increasing trend. However, counts suggest that non-pup have been lower than predicted in 2019 and 2017.

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

- In mid-July 2021, a large number of sick and dying seabirds were observed on Middleton Island, south of Prince William Sound (PWS) in the Gulf of Alaska. Testing revealed a positive bioassay test

for (avian) botulinum toxin type C in one of the birds, presenting the first verified case of botulinum toxin type C in Alaska which can cause large die-offs of waterbirds. If the cause of this event is determined to be botulism, this event and subsequent mortality could be a harbinger of more such events as the distribution of naturally occurring toxins expands northward alongside warming oceans and changing weather patterns.

- Four unique North Pacific right whales (Eubalaena japonica), two during each of two sightings, were sighted during a large whale survey (PacMAPPS) near Kodiak Island. This endangered population is estimated to consist of approximately 30 whales, and this is more sightings of these North Pacific right whales than occurred on any other cetacean survey in the GOA.

GOA Regional Action Plan (RAP)

The RAPs for the GOA, Bering Sea, and Arctic take a regional approach to the NOAA Fisheries Climate Science Strategy, which specifies goals and objectives for producing, delivering, and using climate-related information needed to reduce impacts and increase resilience with changing climate and ocean conditions. The RAPs focus on building regional capacity, partners, products, and services tailored to each specific region, and identify current and new climate research activities over the time period of the RAPs, as well as evaluating remaining key scientific gaps for each region. The RAPs are meant to guide climate-oriented research on a regional scale, and are to be updated for an additional three years. Original work on the GOA RAP began in 2017 and was published in 2018. The presentation to the GOA Plan Team in September 2021 included the seven climate science objectives, a review of what was included in RAP 1.0, and the goals of the RAP 2.0 updates, which include addressing regional priorities for climate-related information and tools.

GOA Climate Integrated Modeling Project (CLIM)

The GOA CLIM project is just beginning its work, and will examine how individuals, families, and communities may adapt to climate variability and associated changes in fisheries and marine ecosystems. It will also identify the factors underlying adaptation choices, and tradeoffs associated with those adaptations. Predicted fleet responses and adaptations will be coupled with regional economic models to understand potential economic impacts on fishing communities. In turn, fleet behavior will feed into biological models to understand changes in harvest patterns and species composition of catch.

The project includes a wide range of institutional partners, and the project is closely aligned with ongoing research at AFSC, is closely aligned with the EBS ACLIM Project, and a major component of the GOA RAP. More practically, the GOA CLIM uses the Regional Ocean Modeling System (ROMS) framework to model ocean circulation in the GOA marine ecosystem. It will allow projections of future conditions and how they relate to physical conditions in the ocean, system-level productivity, and ways that fisheries management can promote resilient fisheries and communities. Three current research pathways include:

- Development and application of an Atlantis model as a component of a multi-model ensemble to evaluate fisheries management strategies with respect to a changing climate.
- Evaluate and predict the impacts of environmental anomalies to the endangered Western DPS of Steller sea lions.
- Develop tools and a knowledge base to couple the ecosystem models to regional economic models to evaluate the impacts of climate change on fisheries and resource-dependent communities.

Stock summaries

1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2022 and 2023. 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 2022 and 2023 are those recommended by the Plan Team. Catch data were through November 6th, 2021. 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	2020	1,007,850	140,674	108,494	105,782	105,159
	2021	1,097,340	123,455	105,722	103,079	98,768
	2022	848,878	154,983	133,081		
	2023		153,097	131,912		
SEO	2020	45,103	13,531	10,148	10,148	0
	2021	45,103	13,531	10,148	10,148	1
	2022	50,500	15,150	11,363		
	2023		15,150	11,363		
GOA-wide	2020	1,052,953	154,205	118,642	115,930	105,159
	2021	1,142,443	136,986	115,870	113,227	98,769
	2022	899,378	170,133	144,444		
	2023		168,247	143,275		

Changes from the previous assessment

This year's pollock assessment features the following new data: 1) 2020 total catch and catch-at-age from the fishery, 2) 2021 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2021 NMFS Bottom Trawl survey biomass and length composition, 4) 2021 Summer GOA-wide acoustic survey biomass and length composition, and 5) 2021 biomass and 2020 age composition from the ADF&G crab/groundfish trawl survey.

The age-structured assessment model used for GOA W/C/WYAK pollock assessment was identical to the 2019 and 2020 assessments (Model 19.1).

Spawning biomass and stock trends

The spawning stock is projected to continue to decline slightly in 2022 and 2023 as the 2012 year class is further reduced in abundance, however with new fish recruited into the fishery, spawning biomass is projected to start increasing in 2025. The presence of several incoming year classes should result in a stabilization in biomass. However, the 2021 Shelikof Strait survey showed an unexpected reduction in the estimated abundance of the 2018 year class (aged 3) relative to their abundance in the 2019 survey. The 2017 year-class (aged 4) is still present in high numbers, and a strong new 2020 class was detected in all surveys. Overall, the Shelikof Strait survey data in 2021 showed a similar biomass to 2020. Overall, survey indices seem to be providing similar trends with closer agreement with the ADF&G survey, as well as the 2021 NMFS bottom trawl survey results. An exception to this was the acoustic summer survey, which was 25% percent lower than the 2019 estimate.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The model projection of female spawning biomass in 2022 is 186,481, which is above $B_{40\%}$ (172,000), which places the W/C/WYAK Gulf of Alaska pollock stock in Tier 3a. The model estimated 2022 age-3+ biomass is 1,097,340 t (for the W/C/WYAK areas) which was similar to the 2020 estimate (1,007,850 t) 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.

The Team supported the authors' recommendation using the assessment-derived maximum permissible ABC for 2022. The resulting 2022 ABC for pollock in the Gulf of Alaska west of 140° W longitude (W/C/WYAK) is 133,081 t which is a 26 % increase from the 2021 ABC. The OFL is 154,983 t for 2022. The 2021 Prince William Sound (PWS) GHL is 3,327t (2.5% of the W/C/WYAK ABC).

Pollock in southeast Alaska (East Yakutat and Southeastern areas) are in Tier 5. The recommended ABC is 11,363 t for 2022 and 2023, which is an increase of 12% from the 2020 ABC. These recommendations are based on natural mortality (0.3) and the random effects model fit to the 1990-2021 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 1D.3 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 for the State of Alaska managed pollock fishery in Prince William Sound, are as follows:

Area apportionments for 2022 and 2023 pollock ABC's for the Gulf of Alaska (including the Prince William Sound GHL)

Year	610 Western	620 Central	630 Central	640 WYAK	650 SEO	PWS GHL	Total
2022	23,720	69,259	30,053	6,722	11,363	3,327	144,444
2023	23,511	68,651	29,789	6,663	11,363	3,298	143,275

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 2022 and 2023 are those recommended by the Plan Team. Catch data are current through November 6th, 2021.

Year	Age 0+ biomass	OFL	ABC	TAC	Catch
2020	203,373	17,794	14,621	6,431	3,944
2021	265,661	28,977	23,627	17,321	12,272
2022	159,837	29,131	24,043		
2023		27,715	22,882		

Changes from the previous assessment

Data updated from the 2021 assessment included federal and state fishery catch for 2020 and 2021 (preliminary catch projected through the end of 2021), federal and state fishery size composition for 2020 and preliminary size compositions for 2021, 2021 AFSC longline survey abundance index (Relative

Population Numbers, RPN) and size composition, 2021 AFSC bottom trawl survey conditional length-at-age, and all length composition samples with less than 30 fish were excluded. The increasing trend observed in 2020 continues in 2021 with a 58% increase, however the index remains rather low at 43% of the 1990-2021 average. The author presented the base (19.1) model and two alternatives:

Model 21.1 as 19.1 but with a mortality block for the 2015-2017 period (2014-2016 was used in 19.1).
Model 21.2 as 21.1 but with a temperature dependent growth and heatwave dependent recruitment. In addition, 21.2 includes an age-0 beach seine survey index.

In addition, the author presented two projection scenarios: one which used recruitment from the full period (1977-2019), and one which just used recruitment from 2010-2019. The Team concurred with the author's recommended model 21.2 and recommended the standard post-1977 projection period (Projection A).

Spawning biomass and stock trends

The $B_{40\%}$ estimate was 64,970 t, with projected 2022 spawning biomass of 39,873 t. Spawning biomass is projected to slightly decrease from 2022 to 2023.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Based on previous classification of this stock being in Tier 3, the 2022 spawning biomass was projected to be below $B_{40\%}$ and would therefore be classified as Tier 3b. The F_{OFL} and F_{ABC} values are 0.54 and 0.44, respectively. The maximum permissible ABC is 24,043 t. The recommended ABC is a 1.76% increase from the 2021 ABC of 23,627 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 2021, the author and the Team recommended area-apportioned ABCs are:

Year	Western	Central	Eastern	Total
2022	7,285	14,474	2,284	24,043
2023	6,933	13,775	2,174	22,882

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 2022 and 2023 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 6, 2021.

Area	Year	Age 4+ Biomass	OFL	ABC	TAC	Catch
Alaska (all areas)	2020	657,000	50,726			19,005
	2021	707,000	60,426			17,945
	2022	529,800	40,432			
	2023		42,520			
Gulf of Alaska	2020	387,000		16,883	14,393	12,495
	2021	390,000		21,475	17,992	14,115
	2022	240,600		22,794	n/a	n/a
	2023			22,003	n/a	n/a

Changes from the previous assessment

New data in the assessment model included relative abundance and length data from the 2021 longline survey, length data from the fixed gear fishery for 2020, length data from the trawl fisheries for 2020, age data from the longline survey and fixed gear fishery for 2020, updated catch for 2020, and projected 2021–2023 catches. Estimates of killer and sperm whale depredation in the fishery were updated and projected for 2021–2023. The 2021 NMFS Gulf of Alaska trawl survey extended the relative abundance index and length data for waters less than 500m and these were also used in the assessment. Due to funding issues and timing constraints, 2020 fixed gear fishery catch-per-unit effort (CPUE) data were unavailable (from logbooks). Additionally, the proposed 2021 SAFE model (model *21.12*) included revised estimates of growth-, weight-, and maturity-at-age as reviewed during the September 2021 Plan Team meeting.

In addition to updating biological information, the model removed the prior constraint of survey catchability. Also, due to changes in the availability of smaller sablefish at depth, the model allowed for catchability and selectivity changes (in 2016) for the fixed gear fishery and selectivity in the longline survey. These changes improved model fits to the index data and the retrospective patterns. Finally, the composition data was reweighted so that the implied variances were more consistent with the model specification and other data components.

Spawning biomass and stock trends

Survey abundance and biomass indices continued to increase in 2021. The longline survey abundance index increased by 9% in 2021 following a 32% increase in 2020. The biennial trawl survey biomass index has increased nearly five-fold since 2013, with a 40% increase from 2019 to 2021. The data and model indicate strong year classes from 2014, 2016, 2017, and 2018. Based on the strength of these recent year classes, biomass estimates have more than doubled from a time series low of 215,000 t in 2015 to 553,000 t in 2021, exceeding the highs of the mid-1980s. Spawning biomass is also increasing but more gradually since many of these year classes are immature. The 2021 SSB was estimated to be 36% of the $B_{100\%}$ value. Spawning biomass is projected to increase to $B_{44\%}$ in 2022 and $B_{51\%}$ in 2023 (contingent on the estimates of young-fish abundance remains strong).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Sablefish have been classified for management under Tier 3 of FMP. Reference points were estimated based on average recruitment from 1977 – 2017, and age-specific schedules of selectivity, weight-at-age, natural mortality, and maturity. The $B_{40\%}$ estimate was 118,140 t and the projected 2022 spawning biomass of 128,789 t places sablefish in sub-tier “a” of Tier 3. The updated point estimates of $F_{40\%}$ and

$F_{35\%}$ from this assessment were 0.080 and 0.094, respectively. Thus, the maximum permissible value of F_{ABC} under Tier 3a is 0.080, which translates into a 2022 maximum permissible (and author recommended) ABC (combined areas) is 34,863 t. The OFL fishing mortality rate is 0.094, which translates into a 2022 OFL (combined areas) of 40,432 t. Adjusting for estimated whale-depredation, the 2022 combined areas ABC is 34,521 t and 22,794 t for the Gulf of Alaska. The Teams agreed with these recommendations.

Status determination

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

Area apportionment

In 2013, the Team and SSC agreed that a fixed apportionment scheme was acceptable. In 2020, results of a simulation analysis resulted in recommending a five-year average survey apportionment method be adopted. The authors continued to recommend this approach and the Plan Teams agreed. The SSC recommended a transition to this method and the authors noted that would mean a "50% stair step" from the 2019 fixed apportionment values towards the 2021 five-year average survey apportionment. This gives the following area-specific ABCs (including deductions for estimated whale depredation):

	2022			2023	
Region	**OFL****	**ABC**	**TAC**	**OFL**	**ABC**
W	--	3,727		--	3,951
C	--	9,965		--	9,495
*WYAK	--	3,437		--	3,159
*SEO	--	5,665		--	5,398
GOA	--	**22,794**		--	**22,003**
Alaska-wide	**40,432**	**34,521**		**42,520**	**36,318**

* 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 2022 and 2023. The shallow water flatfish (SWF) complex comprises 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 6, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	339,593	68,010	55,463	44,864	4,360
2021	342,226	68,841	56,164	45,263	1,682
2022	442,424	62,273	50,610		
2023		65,676	53,486		

Changes from the previous assessment

Northern and southern rock sole are Tier 3a species and assessed separately from the other shallow water flatfish, which are Tier 5. The shallow water flatfish stock complex has been moved to a 4-year assessment cycle; the last full assessment was completed in 2017. Separate assessment models were developed for northern and southern rock sole, and two-area models were developed for each species due to growth differences between the central and western Gulf of Alaska. The rock sole models included recent fishery catch and survey results.

Spawning biomass and stock trends

The shallow-water flatfish complex 2022 biomass estimate was 360,322 t, which is an (5%) increase from the 2021 value of 342,226 t. Overall, biomass for shallow water flatfish is stable. The northern rock sole biomass and spawning biomass estimates show an increasing trend, and the southern rock sole results show the start of an increasing trend.

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 estimated for SWF species other than the rock soles were added to the management advice from the 2021 projection model for northern rock sole and southern rock sole to provide a SWF complex OFL and ABC. The Team agreed with author recommendations.

Status determination

Information was insufficient to determine stock status relative to overfished criteria for the complex. 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 area-specific survey biomass estimates (including the 2021 GOA survey) for ABC are:

Year	Western	Central	WYAK	SEO	Total
2022	21,256	25,305	2,531	1,518	50,610
2023	22,464	26,743	2,674	1,605	53,486

5. Deepwater flatfish complex (partial)

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2022 and 2023. 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 6th, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	86,827	7,163	6,030	6,030	105
2021	84,771	7,040	5,926	5,926	89
2022	83,131	7,026	5,908		
2023		6,920	5,818		

Changes from the previous assessment

The deepwater flatfish complex is comprised of Dover sole, Greenland turbot, Kamchatka flounder, and deepsea sole. A full assessment for the Gulf of Alaska deepwater flatfish complex was conducted in 2019. Projections were run and updated numbers were used for 2022 specifications.

One notable change from the previous assessment is the inclusion of Kamchatka flounder in ABC and OFL calculations. Previously, catch of Kamchatka flounder catch was accounted for under the Deepwater flatfish complex TAC, but the species was not accounted for during OFL and ABC determination. The Team appreciates efforts made by the author to correct this disconnect.

Spawning biomass and stock trends

The model estimate of 2022 spawning stock biomass for Dover sole is 26,349 t, which is well above $B_{40\%}$ (7,613 t). Spawning stock biomass and total biomass are expected to remain stable through 2023. Stock trends for Greenland turbot, Kamchatka flounder, and deepsea sole 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, Kamchatka flounder, 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, Kamchatka flounder, and deepsea sole. Since Dover sole comprises approximately 96% 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 2001–2021. The ABC by area for the deepwater flatfish complex is the sum of the species-specific portions of the ABC. The area apportionment for 2022 and 2023 are as follows:

Area apportionments of deepwater flatfish ABCs for 2022 and 2023 based on the fraction of the survey biomass in each area for Greenland turbot, and deepsea sole (2001–2021) and from random effects model by area for Dover sole.

Year	Western	Central	WYAK	SEO	Total
	0.8%	37.3%	25.2%	36.7%	100.0%
2022	256	2,139	1,431	2,082	5,908
2023	256	2,105	1,408	2,049	5,818

6. Rex sole

Status and catch specifications (t) of rex sole and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 6th, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	99,383	18,127	14,878	14,878	1,238
2021	101,244	18,779	15,416	15,416	285
2022	124,543	23,302	19,141		
2023		25,049	20,594		

Changes from the previous assessment

This stock is on a four-year cycle and a full assessment was conducted in 2021. Data were updated to include catch estimates through 2021, 2018-2021 fishery length compositions, 2017-2020 fishery age compositions, 2019 and 2021 NMFS bottom trawl survey biomass estimates, 2019 and 2021 survey length compositions, and 2019 survey age compositions. In addition, the 1984 and 1987 bottom trawl survey information were excluded, iterative data weighting was conducted using the Francis

methodology, and catchability was estimated using a normal prior with a mean of 1.2 based on survey efficiency studies.

Spawning biomass and stock trends

The model estimates of female spawning biomass and total biomass (3+) for the Eastern and Western/Central areas are above $B_{40\%}$. This year's model indicates an increase in survey biomass since 2019, likely influenced by a recent large year class from 2015 that is present in both the survey and fishery age compositions. The author noted a very low catch estimate in 2021. This was attributed to closures of certain fisheries and marketing challenges.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

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

Status determination

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

Area apportionment

Area apportionments of rex sole ABCs for 2022 and 2023 are based on the random effects model applied to GOA bottom trawl survey biomass in each area. The ABCs calculated for the Western/Central area (based on model estimates) are apportioned based on random effects model predictions of the proportion of survey biomass in Western/Central and the Eastern area ABCs (based on model estimates) are apportioned based on random effects model predictions of the proportion of survey biomass in the West Yakutat and Southeast areas, respectively.

Year	Western	Central	WYAK	SEO	Total
2022	2,981	12,076	1,361	2,723	19,141
2023	3,222	13,054	1,439	2,879	20,594

7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 6, 2021.

Year	Age 1+ Biomass	OFL	ABC	TAC	Catch
2020	1,325,867	153,017	128,060	96,969	21,122
2021	1,321,700	151,723	126,970	97,372	9,517
2022	1,268,140	143,100	119,779		
2023		141,231	118,201		

Changes from the previous assessment

A full assessment for arrowtooth flounder was conducted in 2021; the last full assessment was in 2019. Data were updated to include the 2021 NMFS bottom trawl survey biomass estimates, the 2019 trawl survey age compositions, 2019-2020 fishery length compositions, and updated fishery catch data. The recommended model removes the GOA trawl survey size compositions from 1985, 1986, and 1989. The 2021 survey size composition data are not fit in anticipation age 2021 survey ages in the next full assessment.

Spawning biomass and stock trends

Arrowtooth flounder biomass estimates have been decreasing since 2008. The trend in spawning biomass increased from about 725,000 t in 1977 to over 1.1 t by 2008. Since then, the spawning biomass estimate decreased to about 731,000 t in 2021. The largest estimated age-1 recruitment occurred in 2000 (1.7 billion) but has been below average since 2007. However, the 2017 year class appears to be above the longer term mean. The projected spawning biomass for 2022 was 703,853 t, down 3% from last year's projection for 2022.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Arrowtooth flounder is estimated to be in Tier 3a, and the Team accepted the recommended ABC and OFL. Consistent with decreasing spawning biomass and updated reference fishing mortality rates, the 2022 ABC was 6% lower than the estimate from the 2021 projected value.

Status determination

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

Area apportionment

Area apportionments of arrowtooth flounder ABCs for 2022 and 2023 are based on the random effects model applied to GOA bottom trawl survey biomass in each area.

Year	Western	Central	WYAK	EYAK/SE	Total
2022	33,658	68,394	6,707	11,020	119,779
2023	33,214	67,493	6,619	10,875	118,201

8. Flathead sole (partial)

Status and catch specifications (t) of flathead sole and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 6, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	282,371	46,572	38,196	28,262	1,911
2021	280,980	47,982	39,377	28,392	661
2022	279,975	48,928	40,175		
2023		48,757	40,046		

Changes from the previous assessment

The flathead sole stock is assessed on a four-year schedule. A full stock assessment was scheduled for 2021, but due to limited staff resources, the full stock assessment will be postponed. This year a partial assessment was presented. The projection model was run using updated catches.

Spawning biomass and stock trends

The 2022 spawning biomass estimate increased slightly from 2021 and projected to increase through 2023. Biomass (age 3+) for 2022 decreased slightly, and is estimated to be 279,975 t.

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 40,175 t from the updated projection. The F_{OFL} is set at $F_{35\%}$ (0.36) which corresponds to an OFL of 48,928 t.

Status determination

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

Area apportionment

Area apportionment for ABC of flathead sole is currently based on the proportion of survey biomass projected for each area in 2021 and 2022 using the survey averaging random effects model developed by the survey averaging working group.

Year	Western	Central	WYAK	SEO	Total
2022	14,755	22,033	1,511	1,876	40,175
2023	14,708	21,962	1,506	1,870	40,046

9. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model; catch data are current through November 6th, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	544,569	37,092	31,238	31,238	25,191
2021	613,522	42,977	36,177	36,177	28,126
2022	650,832	45,580	38,268		
2023		44,196	37,104		

Changes from the previous assessment

This was a full assessment (biennial to coincide with the NMFS bottom trawl survey). The model was unchanged from the last assessment. Data were updated to include survey biomass estimates for 2021, survey age compositions for 2019, fishery age compositions for 2020, and final catch for 2019 and 2020 and projected catch for 2021-2023.

Spawning biomass and stock trends

Spawning biomass is projected to decrease over the next several years, however, the stock remains well above $B_{40\%}$.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA Pacific ocean perch stock was estimated to be in Tier 3a. The authors re-evaluated the risk table, and scored the risk categories identically as in the 2020 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 shows the recommended apportionment for 2022 and 2023 ABCs from the random effects model.

Area apportionment	Western	Central	Eastern	Total
2022 Area ABC (t)	2,602	30,806	4,860	38,268
2023 Area ABC (t)	2,523	29,869	4,712	37,104

Amendment 41 prohibited trawling in the Eastern area east of 140° W longitude. The Team and authors consider the biomass in the W. Yakutat area (between 147° W and 140° W) to be fishable hence estimate the proportion of biomass in this sub-region for ABC considerations. The proportion of biomass for the EGOA sub-area based on 2021 survey data update is lower—13% compared to the 2019 estimate of 24%. This results in the following apportionment of the Eastern Gulf area:

Area apportionment	W.Yakutat	E.Yakutat/Southeast	Total
2022 Area ABC (t)	1,409	3,451	4,860
2023 Area ABC (t)	1,366	3,346	4,712

10. Northern rockfish (partial)

Status and catch specifications (t) of northern rockfish and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 6th, 2021. *Note that for management purposes, the northern rockfish ABC from the EGOA is combined with the other rockfish complex. To reflect this, the ABCs for 2022 and 2023 listed below deduct 1 t from Plan Team recommended ABC for northern rockfish.

Year	Age 2+ biomass	OFL	ABC	TAC	Catch
2020	85,057	5,143	4,312	4,311	2,385
2021	102,715	6,396	5,358	5,357	2,378
2022	100,371	6,143	*5,146		
2023		5,874	*4,920		

Changes from the previous assessment

As this is a partial assessment, no changes were made to the assessment methodology. New data added to the projection model included updated catch data from 2020 and new estimated catches for 2021-2023.

Spawning biomass and stock trends

The 2022 spawning biomass estimate (40,474 t) is above $B_{40\%}$ but projected to decrease to 37,408 t in 2023. Total biomass (ages 2+) for 2022 is 100,371 t and is projected to decrease to 96,045 in 2023.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Northern rockfish are estimated to be in Tier 3a. The Team agreed with the authors' recommendation to use the maximum permissible 2022 ABC and OFL values of 5,147 t and 6,143 t, respectively. This ABC is a 4% decrease from last year.

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 2022 and 2023 are based on the random effects model applied to GOA bottom trawl survey biomass estimates through 2019 determined in the last full assessment (2020). Northern rockfish area apportionments for ABCs in 2022 and 2023 are shown below:

Year	Western	Central	Eastern	Total
2022	1,944	3,202	*0	5,146
2023	1,859	3,061	*0	4,920

* Note that the small northern rockfish ABC apportionments from the Eastern Gulf are combined with the other rockfish complex ABC in the West Yakutat management area for management purposes and are removed here from the Team recommended apportionments and ABC totals for northern rockfish.

11. Shortraker rockfish

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 2022 and 2023 are those recommended by the Plan Team. Catch data for 2021 are current through November 6th, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	31,465	944	708	708	491
2021	31,465	944	708	708	475
2022	31,331	940	705		
2023		940	705		

Changes from the previous assessment

A full stock assessment was conducted this year. Data were updated to include: 1) 2021 bottom trawl survey biomass and length compositions; 2) 1992-1999 longline survey length compositions; 3) 2020 and 2021 longline survey Relative Population Numbers (RPNs), Relative Population Weights (RPWs), and length compositions; 4) 2020 and 2021 longline and trawl fishery length composition; and 5) updated catch from trawl and longline fisheries.

Spawning biomass and stock trends

Applying the random effects model to trawl survey data from 1984–2021 and the longline survey RPW indices resulted in a 2022 biomass estimate of 31,331 t for shortraker rockfish, almost equivalent to the previous estimate (31,465 t).

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Shortraker rockfish are Tier 5 species for specifications where $F_{\mathrm{ABC}} = 0.75M = 0.0225$, and $F_{OFL} = 0.03$; applying this definition to the biomass results in an OFL 940 t and an ABC of 705 t for 2022.

Status determination

Available data are insufficient to determine stock status relative to overfished criteria. This stock was not being subjected to overfishing in 2021.

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 2022 and 2023.

Year	Western	Central	Eastern	Total
2022 and 2023	51 (7.3%)	280 (39.7%)	374 (53.0%)	705 (100.0%)

12. Dusky rockfish (partial)

Status and catch specifications (t) of dusky rockfish and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. Catch data for 2021 are current through November 6, 2021.

Year	Age 4+ biomass	OFL	ABC	TAC	Catch
2020	54,626	4,492	3,676	3,676	2,198
2021	97,702	8,655	5,389	5,389	2,924
2022	95,682	8,614	5,372		
2023		8,146	5,181		

Changes in assessment methods and data

This year was a partial assessment so there was no change to the assessment model methodology. New data added to the projection model included updated catch data from 2020 and new estimated catches for 2021-2023. To estimate future catches, authors updated the yield ratio (the average ratio of catch to ABC for the last three complete catch years) and multiplied this value by the projected ABCs from the updated projection model to generate 2022 and 2023 catches.

Spawning biomass and stock status trends

The estimates of spawning biomass for 2022 and 2023 from the current year projection model are 38,371 t and 36,853 t which are above the B35% estimate of 21,299 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The GOA dusky rockfish is classified as a Tier 3 stock and is assessed using a statistical age structure model. A maximum allowable ABC of 7,069 t was recommended for the 2022 fishery from the updated projection model. An adjusted ABC of 5,372 t resulted from the “stair step” methodology that was requested by the SSC. The newly estimated OFL for 2022 was 8,614 t. These ABC and OFL values for the 2022 fishery are only slightly changed from the specifications made last year.

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 2022 and 2023.

Area Apportionment	Western	Central	Eastern	Total
2022 Area ABC (t)	269	4,534	569	5,372
2023 Area ABC (t)	259	4,373	549	5,181

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

	W. Yakutat	E. Yakutat/Southeast
2022 Area ABC (t)	427	142
2023 Area ABC (t)	412	137

13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2022 and 2023. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2022 and 2023 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 6, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	40,336	1,452	1,209	1,209	383
2021	40,432	1,456	1,212	1,212	381
2022	26,060	947	788		
2023		937	781		

Changes from the previous assessment

This year was a full assessment and the authors used updated catch data, trawl and longline survey biomass, and fishery and longline ages. There have been no model changes for this assessment since 2015.

Spawning biomass and stock status trends

Estimated female spawning biomass for 2022 is 8,648 t. This is above the $B_{40\%}$ value of 5,911 t.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

The rougheye/blackspotted complex qualifies as a Tier 3 stock. For 2022 and 2023, the Plan Team accepted the authors' recommended maximum permissible ABCs and the OFLs as provided in the table above.

Status determination

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

Area apportionment

The recommended apportionments for 2022 and 2023 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
2022 ABC (t)	184	235	369	788
2023 ABC (t)	182	234	365	781

14. Demersal shelf rockfish

Status and catch specifications (t) of GOA demersal shelf rockfish and projections for 2022 and 2023. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. Catch data are current through November 6, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	10,620	375	250	231	105
2021	10,648	405	257	250	105
2022	12,388	422	268		
2023		422	268		

[1] For 2020–2023, the non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology. Non-yelloweye Tier 6 ABCs and OFLs are added to the Tier 4 yelloweye ABCs and OFLs for total DSR values.

Changes from the previous assessment

This year was a full assessment and the authors updated catch information and the average weight of yelloweye rockfish caught in the commercial fishery were updated for 2021, relative abundance estimates from the ROV survey were updated for the SSEO region, and density estimates were reduced due to corrections to density estimate coding. No updates were made to the assessment methodology.

Spawning biomass and stock trends

The estimated yelloweye rockfish biomass increased from 10,648 metric tons (t) to 12,388 t from 2021 to 2022. The increase in abundance is driven by an increase in the estimated density of yelloweye rockfish sampled from the ROV survey in the SSEO management area in 2020.

Tier determination/Plan Team discussion and resulting ABCs and OFLs

Under Tier 4 for yelloweye rockfish, the overfishing level (OFL) was set using $F_{35\%}$=0.032; which equates to 422 t for 2022. As in the past, F_{ABC} is based on F=M=0.02 rather than the maximum permissible F_{ABC}. This resulted in an ABC for 2022 (and 2023) of 268 t, a slight increase from the recommended 2021 ABC.

Status determination

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

Area apportionment

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

15. Thornyheads (from the 2020 assessment)

In accordance with the approved schedule, no assessment was conducted for thornyhead rockfish this year. However, a full stock assessment will be conducted in 2022. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2022 specifications. Please refer to last year's stock assessment for details regarding the rolled-over estimates. Additional information listed below summarizes the 2020 assessment.

Status and catch specifications (t) of thornyheads in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data for 2021 are current through November 6th, 2021.					
Year	**Biomass**	**OFL**	**ABC**	**TAC**	**Catch**
2020	89,609	2,688	2,016	2,016	462
2021	86,802	2,604	1,953	1,953	274
2022	86,802	2,604	1,953		
2023		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

Status and catch specifications (t) of other rockfish. Biomass estimates for 2022 and 2023 are based on the random effects model for Tier 4 and 5 species. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. *Note that 1 t of northern rockfish has been added for management purposes to "other rockfish" in WYAK of the EGOA. Catch data are current through November 6th, 2021.

Year	Survey biomass	OFL	ABC	TAC	Catch
2020	70,687	5,320	4,053	4,053	882
2021	70,687	5,320	4,053	1,609	1,219
2022	67,325	5,320	4,054		
2023		5,320	4,054		

Changes from the previous assessment

Other rockfish (OR) are assessed on a biennial stock assessment schedule to coincide with the availability of new survey data. New data included in the assessment are 2021 Gulf of Alaska survey biomass estimates and updated total catch for 2003–2021. The random effects models for the Tiers 4 and 5 species were updated to include the 2021 GOA trawl survey data. The trawl survey fractional biomass for separating EGOA biomass between WY and EY/SE subareas were updated to reflect assessment methods and catch data from unidentified rockfish have been added to this assessment.

Spawning biomass and stock trends

The estimated biomass declined 22% from 2020 and there is no evidence to suggest that overfishing is occurring. 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. Higher discard rates were observed despite the full retention mandate going into effect in 2020 for HAL and CVs and is being further investigated by AKRO and OLE.

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

The Plan Team recommended rolling-over ABC (4,053 t) and OFL (5,320 t) recommendations from 2021 due to declines in estimated survey biomass for harlequin (-94%), redstripe (-85%), and sharpchin rockfish (-26%) from the previous survey. These dramatic changes in biomass are likely due to the patchiness distribution of these species and affect the application of weighted M for Tier 5 (17 species) when recommending ABC and OFLs. The Team discussed the Tier 5 weighted M approach encompassing a large species complex with varying life histories and this approach was intended to minimize influence of individual species may have on M, therefore due to these uncertainties the Team recommended rolling-over ABC and OFL recommendations from 2021.

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.

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 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.

As the Team recommended rolling over ABCs/OFLs from 2021 due to uncertainties in survey biomass, the apportionment percentages are also rolled-over to reflect the 2021 percentages as shown here:

Year	Other Rockfish	W/C GOA	WYAK	EYAK/SE	Total
2022	ABC (t)	940	*370	2,744	4,054
2023	ABC (t)	940	*370	2,744	4,054

*Note that the small northern rockfish ABC apportionments from EGOA are combined with OR in the WYAK management area and added for management purposes here from the Plan Team recommended apportionments for OR.

17. Atka mackerel

Status and catch specifications (t) of Atka mackerel in recent years. Atka mackerel are managed under Tier 6 because reliable estimates of biomass are not available. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. Catch data are current through November 6, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	-	6,200	4,700	3,000	608
2021	-	6,200	4,700	3,000	940
2022	-	6,200	4,700		
2023	-	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 2019. New information in this year's full assessment includes updated catch data, age data from the 2019 and 2020 GOA fisheries, age data from the 2019 GOA bottom trawl survey, biomass estimates from the 2021 GOA bottom trawl survey, and length frequency data from the 2021 GOA bottom 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 2021 survey biomass estimates are essentially based on 1,459 fish caught in one haul off Unalaska Island in the Western Gulf of Alaska. A total of 1,507 Atka mackerel were caught in the 2021 survey, with a single haul capturing 98% of the Atka mackerel catch. 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 2022 ABC for GOA Atka mackerel equal to the maximum permissible value of 4,700 t. The 2022 OFL is 6,200 t under Tier 6.

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

Status determination

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

18. Skates

Status and catch specifications (t) of skates in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. Catch data are current through November 6, 2021.

Species	Year	Biomass	OFL	ABC	TAC	Catch
Big Skate	2020	42,779	4,278	3,208	3,208	961
	2021	42,779	4,278	3,208	3,208	1,087
	2022	38,220	3,822	2,867		
	2023		3,822	2,867		
Longnose Skate	2020	34,487	3,449	2,587	2,587	616
	2021	34,487	3,449	2,587	2,587	890
	2022	36,162	3,616	2,712		
	2023		3,616	2,712		
Other Skates	2020	11,662	1,166	875	875	461
	2021	11,662	1,166	875	875	632
	2022	13,114	1,311	984		
	2023		1,311	984		

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 2021, there were no changes in methodology.

New inputs this year include updated fishery catch (thru 2021) and length composition data (through 2019), biomass estimates and length composition data from the 2021 GOA bottom trawl survey and noncommercial catch data through 2020. Also, the assessment includes information from four additional surveys: the AFSC longline survey, the IPHC longline survey, and two bottom trawl surveys conducted by the Alaska Department of Fish and Game (Kodiak and Prince William Sound).

Spawning biomass and stock trends

Big skate survey biomass from the AFSC BTS decreased relative to 2019 based on new survey estimates while the longnose skate survey biomass increased. The biomass of the other skates increased but there is still a continued decline from a peak in 2013. The additional survey information supports a conclusion of a substantial decline in *Bathyraga* skate biomass since 2009, the current biomass level is similar to the 1990s. Smaller big skates seem to inhabit the EGOA and larger big skates in WGOA indicating movement through their life stages.

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 Western	Central	Eastern	Total
2022 and 2023	Big skate	591	1,482	794	2,867
	Longnose skate	151	2,044	517	2,712
	other skates				984

19. Sharks (from the 2020 assessment)

In accordance with the approved schedule, no assessment was conducted for GOA sharks this year. However, a full stock assessment will be conducted in 2022. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2022 specifications. Please refer to last year's stock assessment for details regarding the rolled-over estimates. Additional information listed below summarizes the 2020 assessment.

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 6, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	54,301	10,913	8,184	8,184	1,481
2021	23,289	5,006	3,755	3,755	1,639
2022	23,289	5,006	3,755		
2023		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

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 2022 and 2023 are those recommended by the Plan Team. 2021 catches current through November 6th, 2021.

Year	Biomass	OFL	ABC	TAC	Catch
2020	12,257	1,307	980	980	79
2021	1,199	1,307	980	980	51
2022		1,307	980		
2023		1,307	980		

Changes from the previous assessment

For 2021, the author followed the 2017 SSC recommendation to use maximum historical catch to recommend OFL. New information includes updated catch data through October 2021 and biomass estimates from the 2021 bottom trawl survey.

Spawning biomass and stock trends

The most recent data from the 2021 GOA trawl survey suggested a decrease in octopus biomass that was an order of magnitude smaller than the 2019 survey biomass. The 2019 survey encountered octopus at a rate that was the second largest (after 2015) in the time-series. The random effects (RE) model estimate of 2021 biomass is 1,199 t compared to the 2019 RE model estimate of 12,257t. The contrast between these values is typical for the complex and underscores the problematic nature of using the trawl survey to generate reliable biomass estimates.

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 2003-2018 and the Team concurs. For 2022 (and 2023), the OFL is 1,307 t equal to the maximum historical catch in 2014, and ABC is 980 t equal to 0.75 * OFL.

Status determination

Biomass estimates for octopuses are unreliable, therefore, 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 2020 catch was below the 2020 OFL, the stock is not being subjected to overfishing.

Area apportionment

GOA octopus are managed Gulf-wide.

Tables

Table 1. Gulf of Alaska groundfish 2022 – 2023 OFLs and ABCs, 2021 TACs and catch (reported through 11/6/21).

		2021				Plan Team Rec 2022		Plan Team Rec 2023	
Species	**Area**	**OFL**	**ABC**	**TAC**	**Catch**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	State GHL	n/a	2,643	n/a		n/a	3,327	n/a	3,298
	W (610)	n/a	18,477	18,477	18,112	n/a	23,720	n/a	23,511
	C (620)	n/a	54,870	54,870	52,432	n/a	69,259	n/a	68,651
	C (630)	n/a	24,320	24,320	23,079	n/a	30,053	n/a	29,789
	WYAK	n/a	5,412	5,412	5,145	n/a	6,722	n/a	6,663
	Subtotal	123,455	105,722	103,079	98,768	154,983	133,081	153,097	131,912
	EYAK/SEO	13,531	10,148	10,148	1	15,150	11,363	15,150	11,363
	Total	136,986	115,870	113,227	98,769	170,133	144,444	168,247	143,275
Pacific Cod	W	n/a	7,986	5,590	3,792	n/a	7,285	n/a	6,933
	C	n/a	13,656	10,242	8,258	n/a	14,474	n/a	13,775
	E	n/a	1,985	1,489	222	n/a	2,284	n/a	2,174
	Total	28,977	23,627	17,321	12,272	29,131	24,043	27,715	22,882
Sablefish	W	n/a	3,224	2,428	1,763	n/a	3,727	n/a	3,951
	C	n/a	9,527	8,056	6,551	n/a	9,965	n/a	9,495
	WYAK	n/a	3,451	2,929	2,188	n/a	3,437	n/a	3,159
	SEO	n/a	5,273	4,579	3,613	n/a	5,665	n/a	5,398
	GOA Total[1]	n/a	21,475	17,992	14,115	n/a	22,794	n/a	22,003
Alaska-wide OFL and ABC[2]	AK Total	60,426	29,588	n/a		40,432	34,521	42,520	36,318
Shallow-Water Flatfish	W	n/a	24,151	13,250	26	n/a	21,256	n/a	22,464
	C	n/a	28,082	28,082	1,654	n/a	25,305	n/a	26,743
	WYAK	n/a	2,808	2,808	1	n/a	2,531	n/a	2,674
	EYAK/SEO	n/a	1,123	1,123	1	n/a	1,518	n/a	1,605
	Total	68,841	56,164	45,263	1,682	62,273	50,610	65,676	53,486
Deepwater Flatfish	W	n/a	225	225	1	n/a	256	n/a	256
	C	n/a	1,914	1,914	79	n/a	2,139	n/a	2,105
	WYAK	n/a	2,068	2,068	5	n/a	1,431	n/a	1,408
	EYAK/SEO	n/a	1,719	1,719	4	n/a	2,082	n/a	2,049
	Total	7,040	5,926	5,926	89	7,026	5,908	6,920	5,818
Rex Sole	W	n/a	3,013	3,013	14	n/a	2,981	n/a	3,222
	C	n/a	8,912	8,912	269	n/a	12,076	n/a	13,054
	WYAK	n/a	1,206	1,206	2	n/a	1,361	n/a	1,439
	EYAK/SEO	n/a	2,285	2,285	-	n/a	2,723	n/a	2,879
	Total	18,779	15,416	15,416	285	23,302	19,141	25,049	20,594
Arrowtooth Flounder	W	n/a	32,377	14,500	332	n/a	33,658	n/a	33,214
	C	n/a	69,072	69,072	9,114	n/a	68,394	n/a	67,493
	WYAK	n/a	8,380	6,900	47	n/a	6,707	n/a	6,619
	EYAK/SEO	n/a	17,141	6,900	24	n/a	11,020	n/a	10,875
	Total	151,723	126,970	97,372	9,517	143,100	119,779	141,231	118,201
Flathead Sole	W	n/a	14,209	8,650	106	n/a	14,755	n/a	14,708
	C	n/a	20,826	15,400	555	n/a	22,033	n/a	21,962
	WYAK	n/a	2,427	2,427	-	n/a	1,511	n/a	1,506
	EYAK/SEO	n/a	1,915	1,915	-	n/a	1,876	n/a	1,870
	Total	47,982	39,377	28,392	661	48,928	40,175	48,757	40,046
Pacific ocean perch	W	n/a	1,643	1,643	1,654	n/a	2,602	n/a	2,523
	C	n/a	27,429	27,429	24,809	n/a	30,806	n/a	29,869
	WYAK	n/a	1,705	1,705	1,663	n/a	1,409	n/a	1,366
	W/C/WYAK	36,563	30,777	30,777	28,126	41,470	34,817	40,211	33,758
	SEO	6,414	5,400	5,400	-	4,110	3,451	3,985	3,346
	Total	42,977	36,177	36,177	28,126	45,580	38,268	44,196	37,104
Northern Rockfish	W	n/a	2,023	2,023	708	n/a	1,944	n/a	1,859
	C	n/a	3,334	3,334	1,670	n/a	3,202	n/a	3,061
	E	n/a	1	-	-	n/a	-	n/a	-
	Total	6,396	5,358	5,357	2,378	6,143	5,146	5,874	4,920

Species	Area	2021 OFL	2021 ABC	2021 TAC	2021 Catch	Plan Team Rec 2022 OFL	Plan Team Rec 2022 ABC	Plan Team Rec 2023 OFL	Plan Team Rec 2023 ABC
Shortraker Rockfish	W	n/a	52	52	5	n/a	51	n/a	51
	C	n/a	284	284	197	n/a	280	n/a	280
	E	n/a	372	372	273	n/a	374	n/a	374
	Total	944	708	708	475	940	705	940	705
Dusky Rockfish	W	n/a	270	270	146	n/a	269	n/a	259
	C	n/a	4,548	4,548	2,748	n/a	4,534	n/a	4,373
	WYAK	n/a	468	468	30	n/a	427	n/a	412
	EYAK/SEO	n/a	103	103	-	n/a	142	n/a	137
	Total	8,655	5,389	5,389	2,924	8,614	5,372	8,146	5,181
Rougheye and Blackspotted Rockfish	W	n/a	168	168	21	n/a	184	n/a	182
	C	n/a	456	456	175	n/a	235	n/a	234
	E	n/a	588	588	185	n/a	369	n/a	365
	Total	1,456	1,212	1,212	381	947	788	937	781
Demersal shelf rockfish	Total	405	257	257	105	422	268	422	268
Thornyhead Rockfish	W	n/a	352	352	42	n/a	352	n/a	352
	C	n/a	910	910	99	n/a	910	n/a	910
	E	n/a	691	691	133	n/a	691	n/a	691
	Total	2,604	1,953	1,953	274	2,604	1,953	2,604	1,953
Other Rockfish	W/C	n/a	940	940	1,060	n/a	940	n/a	940
	WYAK	n/a	369	369	119	n/a	370	n/a	370
	EYAK/SEO	n/a	2,744	300	40	n/a	2,744	n/a	2,744
	Total	5,320	4,053	1,609	1,219	5,320	4,054	5,320	4,054
Atka mackerel	Total	6,200	4,700	3,000	940	6,200	4,700	6,200	4,700
Big Skate	W	n/a	758	758	142	n/a	591	n/a	591
	C	n/a	1,560	1,560	752	n/a	1,482	n/a	1,482
	E	n/a	890	890	193	n/a	794	n/a	794
	Total	4,278	3,208	3,208	1,087	3,822	2,867	3,822	2,867
Longnose Skate	W	n/a	158	158	26	n/a	151	n/a	151
	C	n/a	1,875	1,875	447	n/a	2,044	n/a	2,044
	E	n/a	554	554	417	n/a	517	n/a	517
	Total	3,449	2,587	2,587	890	3,616	2,712	3,616	2,712
Other Skates	GOA-wide	1,166	875	875	632	1,311	984	1,311	984
Sharks	GOA-wide	5,006	3,755	3,755	1,639	5,006	3,755	5,006	3,755
Octopuses	GOA-wide	1,307	980	980	51	1,307	980	1,307	980
TOTAL		610,917	484,150	407,976	178,511	616,157	511,173	615,816	511,584

Sources: 2021 OFLs, ABCs, and TACs, as well as 2022 OFLs and ABCs, are from harvest specifications adopted by the Council in December 2020. 2021 catches through November 6, 2021 from AKR Catch Accounting.

[1] The sablefish ABC total for the GOA is **not** included in the grand total.

[2] The Alaska-wide sablefish OFL and ABC **are** included in the grand total.

Table 2. Gulf of Alaska 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 2022 abundance for the age+ range reported in the summary. * indicates a partial assessment.

Stock or Assemblage	Tier	Area	Biomass	2022				2023			
				OFL	FOFL	ABC	FABC	OFL	FOFL	ABC	FABC
Pollock[a]	3a	State GHL		n/a		3,327		n/a		3,298	
		W(61)				23,720				23,511	
		C(62)				69,259				68,651	
		C(63)			0.31	30,053	0.26		0.29	29,789	0.26
		WYAK				6,722				6,663	
		Subtotal	848,878	154,983		133,081		153,097		131,912	
	5	EYAK/SEO	50,500	15,150	0.3	11,363	0.23	15,150	0.3	11,363	0.23
		Total	899,378	170,133		144,444		168,247		143,275	
Pacific Cod	3b	W				7,285				6,933	
		C			0.54	14,474	0.44		0.52	13,775	0.42
		E				2,284				2,174	
		Total	159,837	29,131		24,043		27,715		22,882	
Sablefish	3a	W				3,727				3,951	
		C				9,965				9,495	
		WYAK			0.094	3,437	0.08		0.094	3,159	0.08
		EYAK/SEO				5,665				5,398	
		GOA Total	240,600	n/a		22,794		n/a		22,003	
Alaska-wide biomass & OFL			529,800	40,432				42,520			
Shallow Water Flatfish	3a, 5	W			0.27,0.34[b1]	21,256	0.23,0.28[b1]		0.27,0.34[b1]	22,464	0.23,0.28[b1]
		C			0.19,0.27[b2]	25,305	0.16,0.22[b2]		0.19,0.27[b2]	26,743	0.16,0.22[b2]
		WYAK			0.2[b3]	2,531	0.15[b3]		0.2[b3]	2,674	0.15[b3]
		EYAK/SEO				1,518				1,605	
		Total	442,424	62,273		50,610		66,964		53,486	
Deepwater* Flatfish	3a, 6	W				256				256	
		C				2,139				2,105	
		WYAK			0.11[c]	1,431	0.09[c]		0.11[c]	1,408	0.09[c]
		EYAK/SEO				2,082				2,049	
		Total	83,131	7,026		5,908		6,920		5,818	
Rex Sole	3a	W			0.28[d1]	2,981	0.23[d1]		0.28[d1]	3,222	0.23[d1]
		C				12,076				13,054	
		WYAK			0.31[d2]	1,361	0.25[d2]		0.31[d2]	1,439	0.25[d2]
		EYAK/SEO				2,723				2,879	
		Total	124,543	23,302		19,141		25,049		20,594	
Arrowtooth Flounder	3a	W				33,658				33,214	
		C				68,394				67,493	
		WYAK			0.225	6,707	0.185		0.225	6,619	0.185
		EYAK/SEO				11,020				10,875	
		Total	1,268,140	143,100		119,779		141,231		118,201	
Flathead Sole*	3a	W				14,755				14,708	
		C				22,033				21,962	
		WYAK			0.36	1,511	0.28		0.36	1,506	0.28
		EYAK/SEO				1,876				1,870	
		Total	279,975	48,928		40,175		48,757		40,046	

Table 2. Continued.

Stock or Assemblage				2022				2023			
	Tier	Area	Biomass	OFL	FOFL	ABC	FABC	OFL	FOFL	ABC	FABC
Pacific Ocean Perch	3a	W				2,602				2,523	
		C				30,806				29,869	
		WYAK			0.12	1,409	0.1		0.12	1,366	0.1
		W/C/WYAK		41,470		34,817		40,211		33,758	
		EYAK/SEO		4,110		3,451		3,985		3,346	
		Total	650,832	45,580		38,268		44,196		37,104	
Northern Rockfish*	3a	W				1,944				1,859	
		C			0.073	3,202	0.061		0.073	3,061	0.061
		E				--				--	
		Total	100,371	6,143		5,146		5,874		4,920	
Shortraker	5	W				51				51	
		C			0.03	280	0.0225		0.03	280	0.0225
		E				374				374	
		Total	31,331	940		705		940		705	
Dusky Rockfish*	3a	W				269				259	
		C				4,534				4,373	
		WYAK			0.114	427	0.093		0.114	412	0.093
		EYAK/SEO				142				137	
		Total	95,682	8,614		5,372		8,146		5,181	
Rougheye / Blackspotted Rockfish*	3a	W				184				182	
		C			0.046	235	0.038		0.046	234	0.038
		E				369				365	
		Total	26,060	947		788		937		781	
DSR	4, 6	Total	12,388[e]	422	0.032[e]	268	0.02[e]	422	0.032[e]	268	0.02[e]
Thornyhead rockfish[i] (No assessment this year)	*5*	*W*				*352*				*352*	
		C			*0.03*	*910*	*0.0225*		*0.03*	*910*	*0.0225*
		E				*691*				*691*	
		Total	*86,802*	*2,604*		*1,953*		*2,604*		*1,953*	
Other Rockfish	4, 5, 6	W/C				940				940	
		WYAK			0.079[f]	370	0.065[g]		0.079[f]	370	0.065[g]
		EYAK/SEO			0.070[f]	2,744	0.053[g]		0.070[f]	2,744	0.053[g]
		Total	67,325	5,320		4,054		5,320		4,054	
Atka Mackerel	6		--	6,200	--	4,700	--	6,200	--	4,700	--
Big Skates	5	W				591				591	
		C			0.1	1,482	0.075		0.1	1,482	0.075
		E				794				794	
		Total	38,220	3,882		2,867		3,822		2,867	
Longnose Skates	5	W				151				151	
		C			0.1	2,044	0.075		0.1	2,044	0.075
		E				517				517	
		Total	36,162	3,616		2,712		3,616		2,712	
Other Skates	5		13,114	1,311	0.1	984	0.075	1,311	0.1	984	0.075
Sharks[i] (No assessment this year)	*5, 6*		*23,289[h]*	*5,006*	*0.04[h]*	*3,755*	*0.03[h]*	*5,006*	*0.04[h]*	*3,755*	*0.03[h]*
Octopus	6		--	1,307	--	980	--	1,307	--	980	--
Total		Total	4,851,025	617,839		501,002		617,104		498,504	

[a] The Prince William Sound GHL (2.5% of ABC; 3,327 t in 2022, 3,298 t in 2023) is deducted from the pollock ABC prior to apportionment.
[b1] FOFL and FABC values for shallow water flatfish are for Tier 3 northern and southern rock sole in the WGOA
[b2] FOFL and FABC values for shallow water flatfish are for Tier 3 northern and southern rock sole in the CGOA
[b3] FOFL and FABC values for shallow water flatfish are for Tier 5 shallow water species in the GOA
[c] FOFL and FABC values for deep water flatfish are for Tier 3 Dover sole.
[d1] FOFL and FABC values are for rex sole in the Western-Central GOA
[d2] FOFL and FABC values are for rex sole in the EGOA
[e] Values listed are for Tier 4 yelloweye rockfish.
[f] FOFL equal to 0.079 for Tier 4 sharpchin and 0.070 for 17 Tier 5 other rockfish species.
[g] FABC equal to 0.065 for Tier 4 sharpchin rockfish and 0.053 for 17 Tier 5 other rockfish species.
[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 thornyhead rockfish and sharks this year. Values in the table are from the 2020 assessment and the 2021 harvest specifications (for 2022 and 2023).

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 2022 and 2023 recommended fishing mortality rates and ABCs, for those species whose recommendations were below the maximum permissible.

			2022		
Species	Tier	*Max* F_{ABC}	*Max* ABC	F_{ABC}	ABC
Sablefish	3a	0.080	34,863	0.080	34,521
Dusky rockfish	3	0.093	7,069	0.093	5,372
Demersal shelf rockfish	4, 6	0.026	342	0.02	268
			2023		
Species	Tier	*Max* F_{ABC}	*Max* ABC	F_{ABC}	ABC
Sablefish	3a	0.080	36,670	0.080	36,318
Dusky rockfish	3	0.093	6,686	0.093	5,181
Demersal shelf rockfish	4, 6	0.026	342	0.02	268

Note: Shows Alaska-wide ABCs for sablefish

Table 4. Groundfish landings (metric tons) in the Gulf of Alaska,1956-2021.

Year	Pollock	Pacific cod	sablefish	Flatfish	Arrowtooth Flounder	Slope rockfish[a]
1956			1,391			
1957			2,759			
1958			797			
1959			1,101			
1960			2,142			
1961			897			16,000
1962			731			65,000
1963			2,809			136,300
1964	1,126	196	2,457	1,028		243,385
1965	2,749	599	3,458	4,727		348,598
1966	8,932	1,376	5,178	4,937		200,749
1967	6,276	2,225	6,143	4,552		120,010
1968	6,164	1,046	15,049	3,393		100,170
1969	17,553	1,335	19,376	2,630		72,439
1970	9,343	1,805	25,145	3,772		44,918
1971	9,458	523	25,630	2,370		77,777
1972	34,081	3,513	37,502	8,954		74,718
1973	36,836	5,963	28,693	20,013		52,973
1974	61,880	5,182	28,335	9,766		47,980
1975	59,512	6,745	26,095	5,532		44,131
1976	86,527	6,764	27,733	6,089		46,968
1977	112,089	2,267	17,140	16,722		23,453
1978	90,822	12,190	8,866	15,198		8,176
1979	98,508	14,904	10,350	13,928		9,921
1980	110,100	35,345	8,543	15,846		12,471
1981	139,168	36,131	9,917	14,864		12,184
1982	168,693	29,465	8,556	9,278		7,991
1983	215,567	36,540	9,002	12,662		7,405
1984	307,400	23,896	10,230	6,914		4,452
1985	284,823	14,428	12,479	3,078		1,087
1986	93,567	25,012	21,614	2,551		2,981
1987	69,536	32,939	26,325	9,925		4,981
1988	65,625	33,802	29,903	10,275		13,779
1989	78,220	43,293	29,842	11,111		19,002
1990	90,490	72,517	25,701	15,411		21,114
1991	107,500	76,997	19,580	20,068		13,994
1992	93,904	80,100	20,451	28,009		16,910
1993	108,591	55,994	22,671	37,853		14,240
1994	110,891	47,985	21,338	29,958		11,266
1995	73,248	69,053	18,631	32,273		15,023
1996	50,206	67,966	15,826	19,838	22,183	14,288
1997	89,892	68,474	14,129	17,179	16,319	15,304
1998	123,751	62,101	12,758	11,263 [i]	12,974	14,402
1999	95,637	68,613	13,918	8,821	16,209	18,057
2000	71,876	54,492	13,779	13,052	24,252	15,683
2001	70,485	41,614	12,127	11,817	19,964	16,479
2002	49,300 [j]	52,270	12,246	12,520	21,230	17,128
2003	49,300	52,500	14,345	10,750	23,320	18,678
2004	62,826	43,104	15,630	7,634	15,304	18,194
2005	80,086	35,205	13,997	9,890	19,770	17,306
2006	70,522	37,792	13,367	14,474	27,653	20,492
2007	51,842	39,473	12,265	15,077	25,364	18,718
2008	51,721	43,481	12,326	16,393	29,293	18,459
2009	42,389	39,397	10,910	17,360	24,937	18,621
2010	75,167	58,003	10,086	13,556	24,334	21,368
2011	79,789	62,475	11,148	10,043	30,890	19,612
2012	101,356	56,520	11,914	8,909	20,714	22,334
2013	93,733	51,792	11,945	12,283	21,620	19,367
2014	140,260	62,223	10,422	11,236	36,290	23,360
2015	163,065	55,260	10,313	7,572	19,054	24,915
2016	173,226	42,517	9,354	8,214	19,830	29,265
2017	184,167	35,204	10,500	6,363	26,863	26,268
2018	155,142	10,899	12,037	7,135	18,930	29,864
2019	43,771	10,909	12,219	7,976	23,632	28,547
2020	105,159	3,944	12,495	7,614	21,122	29,332
2021[h]	98,769	12,272	14,115	2,717	9,517	32,579

a Catch defined as follows: (1) 1961-78, Pacific ocean perch (*S.alutus*) only;(2)1979-1987, the 5 species of the Pacific ocean perch complex; 1988-90, the 18 species of the slope rock assemblage;1991-1995, the 20 species of the slope rockfish assemblage. In 2021, comprised of POP, Northern rockfish, shortraker, rougheye and blackspotted rockfish, and other rockfish complex.

b Catch from Southeast Outside District.

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

d Other species category stabilized in 1981 to include sharks, skates, sculpins, eulachon, capelin (and other smelts in the family Osmeridae and octopus. Atka mackerel and squid were added in 1989. Catch of Atka Mackerel is reported separately for 1990-1992; thereafter Atka mackerel was assigned a separate target species. Various FMP amendments have reduced the number of species in this category: in 2020, it only included sculpins, sharks, and octopuses. In 2021, only included sharks and octopuses.

e Atka mackerel was added to the Other Species category in 1988 and separated out in 1994

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

g Does not include at-sea discards.

h Catch data reported through November 6, 2021.

i Includes all species except arrowtooth.

j Does not include state fisheries

k Includes all managed skate species

Table 4. (cont'd) Groundfish landings (t) in the Gulf of Alaska,1956-2020. 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	2,198	105	462	608	2,038	1,560	186,637
2021	2,924	105	274	940	2,609	1,690	178,511

Table 5. Proposed 2022 and 2023 Pacific halibut discard mortality rates for vessels fishing in the Gulf of Alaska (percent of Pacific halibut assumed to be dead).

Gear	Sector	Groundfish fishery	Halibut discard mortality rate
Pelagic trawl	Catcher vessel	All	100%
	Catcher/processor	All	100%
Non-pelagic trawl	Catcher vessel	Rockfish Program	66%
	Catcher vessel	All others	69%
	Mothership and catcher/processor	All	83%
Hook-and-line	Catcher/processor	All	15%
	Catcher vessel	All	12%
Pot	Catcher vessel and catcher/processor	All	29%