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

Compiled by The Plan Team for the Groudfish Fisheries of the Gulf of Alaska  with contributions by: November 22 North Pacific Fishery Management Council 1007 West Third, Suite 400 Anchorage, AK 99501

Table of Contents

# 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 14-18, 2022 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 Chris Lunsford (co-chair), Jim Ianelli (co-chair), Andrew Olson, Ben Williams, Cecilia O’Leary, Craig Faunce, Janet Rumble, Marysia Szymkowiak, Nat Nichols, Obren Davis, Paul Spencer, Pete Hulson, Sandra Lowe and Sara Cleaver.

*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.

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 Fishery** |  |
| --- | --- |
| Target species | Walleye pollock, Pacific cod,   Sablefish, Flatfish (shallow-water flatfish,   deepwater flatfish, rex sole, flathead sole,   and arrowtooth flounder),   Rockfish (Pacific ocean perch,   northern rockfish, shortraker rockfish,   rougheye/blackspotted rockfish, other rockfish,   dusky rockfish, demersal shelf rockfish, and thornyhead rockfish),   Atka mackerel, skates (big skates, longnose skates, and other skates) |
| **Ecosystem Component** | |
| Prohibited Species | Pacific halibut,   Pacific herring,   Pacific salmon,   Steelhead trout,   King crab,   Tanner crab |
| Forage Fish Species | 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 | Macrouridae family |
| Squids | Chiroteuthidae family,   Cranchiidae family,   Gonatidae family,   Onychoteuthidae family,   Sepiolidae family |
| Sculpins | Families: Cottidae, Hemitripteridae,   Psychrolutidae, and Rhamphocottidae |

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 | walleye 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 ( and , respectively). Fishing mortality rates reduce the level of spawning biomass per recruit to some percentage *P* of the pristine level (). The fishing mortality rate used to compute ABC is designated FABC, and the fishing mortality rate used to compute the overfishing level (OFL) is designated .

*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 and 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 BMSY is available, the preferred point estimate of 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 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 “” 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 refers to the long-term average biomass that would be expected under average recruitment and .

**Tier**

 1) Information available: *Reliable point estimates of B and and reliable pdf of* .  
     1a) Stock status:   
           , *the arithmetic mean of the pdf*  
           , *the harmonic mean of the pdf*  
     1b) Stock status:   
             
             
     1c) Stock status:   
             
             
 2) Information available: *Reliable point estimates of B, , , , and* .  
     2a) Stock status: .  
             
             
     2b) Stock status:   
             
             
     2c) Stock status:   
             
             
 3) Information available: *Reliable point estimates of B, , , and* .  
     3a) Stock status: .  
             
             
     3b) Stock status:   
             
             
     3c) Stock status:   
             
             
 4) Information available: *Reliable point estimates of B, , and* .  
             
             
 5) Information available: *Reliable point estimates of B, and natural mortality rate M*.  
             
             
 6) Information available: *Reliable catch history from 1978 through 1995*.  
            *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*

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

Overfished (listed in each assessment as projection scenario 6):

In all future years, is set equal to . (Rationale: This scenario determines whether a stock is overfished. If the stock is expected to be 1) above its MSY level in 2022 or 2) above ½ of its MSY level in 2022 and above its MSY level in 2032 under this scenario, then the stock is not overfished.)

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

In 2023, is set equal to , 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 2024 or 2) above 1/2 of its MSY level in 2024 and expected to be above its MSY level in 2034 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.proaching 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 BMSY. 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.

# Economic Summary of the GOA commercial groundfish fisheries in 2022

## Ecosystem Considerations summary

## GOA Regional Action Plan (RAP)

## GOA Climate Integrated Modeling Project (CLIM)

## Stock status

## 1. Walleye pollock

Status and catch specifications (t) of pollock and projections for 2023 and 2024. 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 2023 and 2024 are those recommended by the Plan Team. Catch data were through November 5th.

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 | age-3+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- | --- |
| W/C/WYAK | 2021 | 1,097,340 | 123,455 | 35,241 | 41,232 | 39,608 |
| 2022 | 848,878 | 154,983 | 44,360 | 51,902 | 51,950 |
| 2023 | 666,666 | 173,470 | 49,646 |  |  |
| 2024 | 4 | 186,101 | 53,693 |  |  |
| SEO | 2021 | 1,097,340 | 13,531 | 10,148 | 10,148 | 0 |
| 2022 | 848,878 | 15,150 | 11,363 | 11,363 | 0 |
| 2023 | 666,666 | 15,150 | 11,363 |  |  |
| 2024 | 4 | 15,150 | 11,363 |  |  |
| Goa-wide | 2021 | 1,097,340 | 136,986 | 115,870 | 113,227 | 99,019 |
| 2022 | 848,878 | 170,133 | 144,444 | 141,117 | 129,876 |
| 2023 | 666,666 | 188,620 | 160,301 |  |  |
| 2024 | 4 | 201,251 | 172,443 |  |  |

*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 B40% (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. pportionments 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:

| Year | W (610) | C (620) | C (630) | WYAK | EYAK/SEO | PWS GHL | Total |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2023 | 26,958 | 77,005 | 33,729 | 7,523 | 11,363 | 3,723 | 160,301 |
| 2024 | 29,156 | 83,283 | 36,478 | 8,136 | 11,363 | 4,027 | 172,443 |

## 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 `2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th.

| Year | age-0+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 28,977 | 23,627 | 17,320.75 | 13,281 |
| 2022 | 1,007,850 | 39,555 | 32,811 | 24,110.75 | 18,275 |
| 2023 | 4 | 29,737 | 24,634 |  |  |
| 2024 |  | 27,507 | 22,683 |  |  |

*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 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 and would therefore be classified as Tier 3b. The and 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 |
| --- | --- | --- | --- | --- |
| 2023 | 7,464 | 14,830 | 2,340 | 47,317 |
| 2024 | 6,873 | 13,655 | 2,155 | 47,317 |

## 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. Beginning in 2020, the OFL was specified Alaska-wide (for both BSAI and GOA). The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th.

| Area | Year | age-4+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- | --- |
| GOA Total | 2021 | 1,007,850 |  | 21,475 | 17,992 | 15,508 |
| 2022 | 1,007,850 |  |  | 22,794 | 17,531 |
| 2023 | 4 |  |  |  |  |
| 2024 |  |  |  |  |  |
| AK Total | 2021 | 1,007,850 | 60,426 | 29,588 |  |  |
| 2022 | 1,007,850 | 40,432 | 34,521 |  |  |
| 2023 | 4 | 47,390 | 40,502 |  |  |
| 2024 |  | 48,561 | 41,539 |  |  |

*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 B100% value. Spawning biomass is projected to increase to in 2022 and 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 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 and from this assessment were 0.080 and 0.094, respectively. Thus, the maximum permissible value of 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):

| Year | Western | Central | WYAK\* | SEO\* | GOA Total | AK Total |
| --- | --- | --- | --- | --- | --- | --- |
| \*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 2023 and 2024. 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 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 68,841 | 56,164 | 45,263 | 1,857 |
| 2022 | 1,007,850 | 62,273 | 50,610 | 42,604 | 1,294 |
| 2023 | 4 | 65,736 | 53,537 |  |  |
| 2024 |  | 68,015 | 55,474 |  |  |

*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 | EYAK/SEO | Total |
| --- | --- | --- | --- | --- | --- |
| 2023 | 22,486 | 26,768 | 2,677 | 1,606 | 53,537 |
| 2024 | 23,299 | 27,737 | 2,774 | 1,664 | 55,474 |

## 5. Deep water flatfish

Status and catch specifications (t) of deepwater flatfish (Dover sole and others) and projections for 2023 and 2024. 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 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 7,040 | 5,926 | 5,926 | 95 |
| 2022 | 1,007,850 | 7,026 | 5,908 | 5,908 | 122 |
| 2023 | 4 | 6,918 | 5,816 |  |  |
| 2024 |  | 6,802 | 5,719 |  |  |

*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 B40% (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. 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. The area apportionment for 2022 and 2023 are as follows:

| Year | Western | Central | WYAK | SEO | Total |
| --- | --- | --- | --- | --- | --- |
|  | XX% | XX% | XX% | XX% | 100% |
| 2,023 | 256 | 2,105 | 1,407 | 2,048 | 5,816 |
| 2,024 | 255 | 2,068 | 1,383 | 2,013 | 5,719 |

## 6. Rex sole

Status and catch specifications (t) of rex sole and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th.

| Year | age-3+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 18,779 | 15,416 | 15,416 | 301 |
| 2022 | 1,007,850 | 23,302 | 19,141 | 19,141 | 694 |
| 2023 | 4 | 25,135 | 20,664 |  |  |
| 2024 |  | 25,652 | 21,097 |  |  |

*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 B40%. 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 B40%, 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 |
| --- | --- | --- | --- | --- | --- |
| 2023 | 3,236 | 13,110 | 1,439 | 2,879 | 20,664 |
| 2024 | 3,314 | 13,425 | 1,453 | 2,905 | 21,097 |

## 7. Arrowtooth flounder

Status and catch specifications (t) of arrowtooth flounder and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 5th.

| Year | age-1+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 151,723 | 126,970 | 97,372 | 9,984 |
| 2022 | 1,007,850 | 143,100 | 119,779 | 96,501 | 11,456 |
| 2023 | 4 | 142,749 | 119,485 |  |  |
| 2024 |  | 141,008 | 118,015 |  |  |

*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 | SEO | Total |
| --- | --- | --- | --- | --- | --- |
| 2023 | 30,469 | 65,000 | 7,886 | 16,130 | 119,485 |
| 2024 | 30,094 | 64,200 | 7,789 | 15,932 | 118,015 |

## 8. Flathead sole

Status and catch specifications (t) of flathead sole and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data current through November 5th.

| Year | age-1+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 47,982 | 39,377 | 28,392 | 707 |
| 2022 | 1,007,850 | 48,928 | 40,175 | 27,437 | 563 |
| 2023 | 4 | 48,161 | 39,480 |  |  |
| 2024 |  | 49,073 | 40,222 |  |  |

*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 is set at (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 |
| --- | --- | --- | --- | --- | --- |
| 2023 | 12,793 | 21,487 | 2,320 | 2,880 | 39,480 |
| 2024 | 13,033 | 21,892 | 2,363 | 2,934 | 40,222 |

## 9. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Total biomass estimates are age-2+ from the age-structured model. Catch data are current through November 5th.

| Year | age-2+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 42,977 | 36,177 | 36,177 | 28,900 |
| 2022 | 1,007,850 | 45,580 | 38,268 | 38,268 | 28,943 |
| 2023 | 4 | 44,302 | 37,193 |  |  |
| 2024 |  | 43,117 | 36,196 |  |  |

*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 .

*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 apportionments:

| Year | Western | Central | Eastern | Total |
| --- | --- | --- | --- | --- |
| 2023 | 2,529 | 29,940 | 4,724 | 37,193 |
| 2024 | 2,461 | 29,138 | 4,597 | 36,196 |

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:

| Year | WYAK | SEO | Total |
| --- | --- | --- | --- |
| 2023 | 1,370 | 3,354 | 4,724 |
| 2024 | 1,333 | 3,264 | 4,597 |

## 10. Northern rockfish

Status and catch specifications (t) of northern rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th.

\*Note that for management purposes, the northern rockfish ABC from the eastern GOA is combined with the other rockfish complex. > To reflect this, the ABCs for 2023 and 2024 listed below deduct 1 t from Plan Team recommended ABC for northern rockfish.

| Year | age-2+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 6,396 | 5,358 | 5,357 | 2,377 |
| 2022 | 1,007,850 | 6,143 | 5,146 | 5,146 | 1,879 |
| 2023 | 4 | 5,927 | 4,965 |  |  |
| 2024 |  | 5,661 | 4,742 |  |  |

*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 B40% 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 2023 and 2024 are based on the random effects model applied to GOA bottom trawl survey biomass estimates through 2021. Northern rockfish area apportionment for ABCs are shown below:

| Year | Western | Central | Eastern\* | Total |
| --- | --- | --- | --- | --- |
| 2023 | 2,614 | 2,350 | 1 | 4,965 |
| 2024 | 2,497 | 2,244 | 1 | 4,742 |
| \*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 shortraker rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 944 | 708 | 708 | 528 |
| 2022 | 1,007,850 | 940 | 705 | 705 | 443 |
| 2023 | 4 | 940 | 705 |  |  |
| 2024 |  | 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 = 0.75M = 0.0225, and = 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. Shortraker rockfish area apportionment for ABCs are shown below:

| Year | Western | Central | Eastern | Total |
| --- | --- | --- | --- | --- |
| 2023 | 51 | 280 | 374 | 1,410 |
| 2024 | 51 | 280 | 374 | 1,410 |

## 12. Dusky rockfish

Status and catch specifications (t) of dusky rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. Catch data are current through November 5th.

| Year | age-4+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 8,655 | 5,389 | 5,389 | 2,928 |
| 2022 | 1,007,850 | 8,614 | 5,372 | 5,372 | 2,568 |
| 2023 | 4 | 9,638 | 7,917 |  |  |
| 2024 |  | 9,154 | 7,520 |  |  |

*Changes from the previous assessment* 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 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 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. Northern rockfish area apportionment for ABCs are shown below:

| Year | Western | Central | Eastern | Total |
| --- | --- | --- | --- | --- |
| 2023 | 149 | 7,647 | 121 | 7,917 |
| 2024 | 141 | 7,264 | 115 | 7,520 |

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:

| Year | WYAK | EYAK/SEO | Total |
| --- | --- | --- | --- |
| 2023 | 90 | 31 | 121 |
| 2024 | 85 | 30 | 115 |

## 13. Rougheye and blackspotted rockfish

Status and catch specifications (t) of rougheye and blackspotted rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current as of November 5th.

| Year | age-3+ Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 1,456 | 1,212 | 1,212 | 407 |
| 2022 | 1,007,850 | 947 | 788 | 788 | 438 |
| 2023 | 4 | 930 | 775 |  |  |
| 2024 |  | 927 | 772 |  |  |

*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 trends* Estimated female spawning biomass for 2022 is 8,648 t. This is above the 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. Rougheye and blackspotted rockfish area apportionment for ABCs are shown below:

| Year | Western | Central | Eastern | Total |
| --- | --- | --- | --- | --- |
| 2023 | 180 | 232 | 363 | 1,547 |
| 2024 | 180 | 231 | 361 | 1,547 |

## 14. Demersal shelf rockfish

Status and catch specifications (t) of demersal shelf rockfish and projections for 2023 and 2024. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current as of November 5th.

| Year | Biomass | OFL\* | ABC\* | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 405 | 257 | 257 | 109 |
| 2022 | 1,007,850 | 579 | 365 | 365 | 163 |
| 2023 | 4 | 376 | 244 |  |  |
| 2024 |  | 376 | 244 |  |  |
| \*Non-yelloweye DSR ABCs and OFLs are calculated using Tier 6 methodology and 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 =0.032; which equates to 422 t for 2022. As in the past, is based on F=M=0.02 rather than the maximum permissible FABC. 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. Thornyhead rockfish

Status and catch specifications (t) of thornyhead rockfish and projections for year+1 and year+2. Biomass for each year corresponds to the projections given in the SAFE report issued in the preceding year. The OFL and ABC for year+1 and year+2 are those recommended by the Plan Team. Catch data are current as of November 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 2,604 | 1,953 | 1,953 | 273 |
| 2022 | 1,007,850 | 2,604 | 1,953 | 1,953 | 355 |
| 2023 | 4 | 2,170 | 1,628 |  |  |
| 2024 |  | 2,170 | 1,628 |  |  |

*Changes from the previous assessment* 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* For area apportionment of ABC, the random effects model was fit to area-specific biomass and proportions of survey biomass by area were calculated. Thoryhead rockfish area apportionment for ABCs are shown below:

| Year | Western | Central | Eastern | Total |
| --- | --- | --- | --- | --- |
| 2023 | 314 | 693 | 621 | 1,628 |
| 2024 | 314 | 693 | 621 | 1,628 |

## 16. Other rockfish

Status and catch specifications (t) of other rockfish. Biomass estimates for 2023 and 2024 are based on the random effects model for Tier 4 and 5 species. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. \*Note that 1 t of northern rockfish has been added for management purposes to Other rockfish complex in WYAK of the EGOA. Catch data are current through November 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 5,320 | 4,053 | 1,609 | 1,216 |
| 2022 | 1,007,850 | 5,320 | 4,054 | 1,610 | 1,266 |
| 2023 | 4 | 5,320 | 4,054 |  |  |
| 2024 |  | 5,320 | 4,054 |  |  |

*Changes from the previous assessment* 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 ABCs and OFLs* 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 Plan Team 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 | W/C GOA | WYAK\* | EYAK/SEO | Total |
| --- | --- | --- | --- | --- |
| 2023 | 940 | 370 | 2,744 | 4,054 |
| 2024 | 940 | 370 | 2,744 | 4,054 |
| \*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 added here from the Team recommended apportionments for Other rockfish. | | | | |

## 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 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 6,200 | 4,700 | 3,000 | 939 |
| 2022 | 1,007,850 | 6,200 | 4,700 | 3,000 | 880 |
| 2023 | 4 | 6,200 | 4,700 |  |  |
| 2024 |  | 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. 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 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th.

| Species | Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- | --- |
| Big Skate | 2021 | 1,007,850 | 4,278 | 3,208 | 3,208 | 765 |
| 2022 | 1,007,850 | 3,822 | 2,867 | 2,867 | 944 |
| 2023 | 4 | 3,822 | 2,867 |  |  |
| 2024 |  | 3,822 | 2,867 |  |  |
| Longnose Skate | 2021 | 1,007,850 | 3,449 | 2,587 | 2,587 | 1,035 |
| 2022 | 1,007,850 | 3,616 | 2,712 | 2,712 | 940 |
| 2023 | 4 | 3,616 | 2,712 |  |  |
| 2024 |  | 3,616 | 2,712 |  |  |
| Other Skates | 2021 | 1,007,850 | 1,166 | 875 | 875 | 732 |
| 2022 | 1,007,850 | 1,311 | 984 | 984 | 822 |
| 2023 | 4 | 1,311 | 984 |  |  |
| 2024 |  | 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.

| Year | Species | Western | Central | Eastern | Total |
| --- | --- | --- | --- | --- | --- |
| 2023 | big skate | 591 | 1,482 | 794 | 2,867 |
| 2024 | 591 | 1,482 | 794 | 2,867 |
| 2023 | longnose skate | 151 | 2,044 | 517 | 2,712 |
| 2024 | 151 | 2,044 | 517 | 2,712 |
| 2023 | other skates |  |  |  | 984 |
| 2024 |  |  |  | 984 |

## 19. Sharks

Status and catch specifications (t) of the GOA shark complex and projections for 2023 and 2024. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 5,006 | 3,755 | 3,755 | 1,933 |
| 2022 | 1,007,850 | 5,006 | 3,755 | 3,755 | 2,112 |
| 2023 | 4 | 6,341 | 4,756 |  |  |
| 2024 |  | 6,341 | 4,756 |  |  |

*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. 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.

*Tier determination/Plan Team discussion and resulting ABCs and OFLs* 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.

*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 2023 and 2024 are those recommended by the Plan Team. Catch data are current through November 5th.

| Year | Biomass | OFL | ABC | TAC | Catch |
| --- | --- | --- | --- | --- | --- |
| 2021 | 1,007,850 | 1,307 | 980 | 980 | 55 |
| 2022 | 1,007,850 | 1,307 | 980 | 980 | 111 |
| 2023 | 4 | 1,307 | 980 |  |  |
| 2024 |  | 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