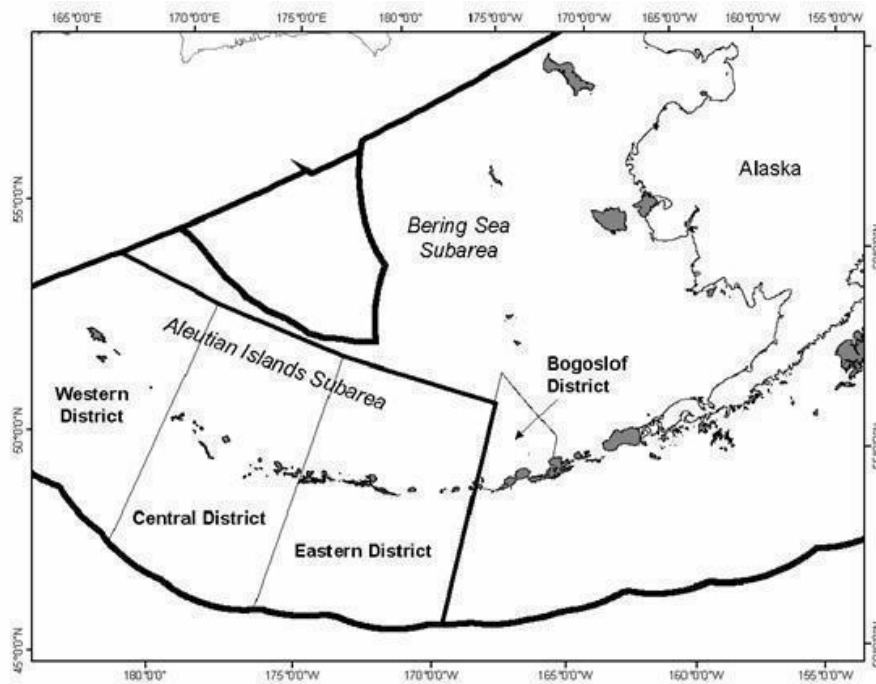


# STOCK ASSESSMENT AND FISHERY EVALUATION REPORT FOR THE GROUND FISH RESOURCES OF THE BERING SEA/ALEUTIAN ISLANDS REGIONS

Compiled by:

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of the Bering Sea and Aleutian Islands**



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## **Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Region**

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## Summary

By

The Plan Team for the Groundfish Fisheries  
of the Bering Sea and Aleutian Islands

## Introduction

The Stock Assessment and Fishery Evaluation (SAFE) report summarizes the best available scientific information concerning the past, present, and possible future condition of the stocks, marine ecosystems, and fisheries that are managed under Federal regulation. It provides information to the Councils for determining annual harvest levels from each stock, documenting significant trends or changes in the resource, marine ecosystems, and fishery over time, and assessing the relative success of existing state and Federal fishery management programs. For the FMP for the Groundfish Fishery of the Bering Sea and Aleutian Islands (BSAI) Area, the SAFE report is published in three reports: a “Stock Assessment” report, the “Economic Status of Groundfish Fisheries off Alaska” (i.e., the “Economic SAFE report”) and the “Ecosystem Status Report” (by Area between the Eastern Bering Sea (EBS) and Aleutian Islands (AI)).

The BSAI Groundfish FMP requires that a draft of the SAFE report be produced each year in time for the December meeting of the North Pacific Fishery Management Council. Each stock or stock complex is represented in the SAFE report by a chapter containing the latest stock assessment. New or revised stock assessment models are usually previewed at the September Plan Team meeting and considered again by the Team at its November meeting for recommending final specifications for the following two fishing years. This process is repeated annually.

This Stock Assessment section of the SAFE report for the BSAI groundfish fisheries is compiled by the BSAI Groundfish Plan Team from chapters contributed by scientists at NMFS Alaska Fisheries Science Center (AFSC). These chapters include a recommendation by the author(s) for the overfishing level (OFL) and acceptable biological catch (ABC) for each stock and stock complex managed under the FMP for the next two fishing years. This introductory section includes the recommendations of the Team (Table 1), along with a summary of each chapter, including the Ecosystem Status Report and the Economic SAFE report.

The OFL and ABC recommendations by the Plan Team are reviewed by the Scientific and Statistical Committee (SSC), which may confirm the Team recommendations or develop its own. The Team and SSC recommendations, together with social and economic factors, are considered by the Council in determining total allowable catches (TACs) and other measures used to manage the fisheries. Neither the author(s), Team, nor SSC typically recommends TACs.

The BSAI Groundfish Plan Team met remotely via the internet on November 15-19, 2021 to review the status of stocks of twenty-three 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 BSAI Groundfish Plan Team who compiled this SAFE report were: Grant Thompson (Co-chair), Steve Barbeaux (Co-chair), Diana Stram (BSAI Groundfish PT coordinator), Mary Furuness, Alan Haynie, Allan Hicks, Lisa Hillier, Kirstin Holsman, Andy Kingham, Kalei Shotwell, Phillip Joy, and Cindy Tribuzio.

## Background Information

The BSAI management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the US (Figure 1). International North Pacific Fisheries Commission (INPFC) statistical areas 1 and 2 comprise the EBS. The Aleutian Islands (AI) region is INPFC Area 5.

Amendment 95 to the BSAI Groundfish FMP, which was implemented in 2010 for the start of the 2011 fishing year, defined three categories of species or species groups that are likely to be taken in the groundfish fishery. 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 under two management classifications are listed below.

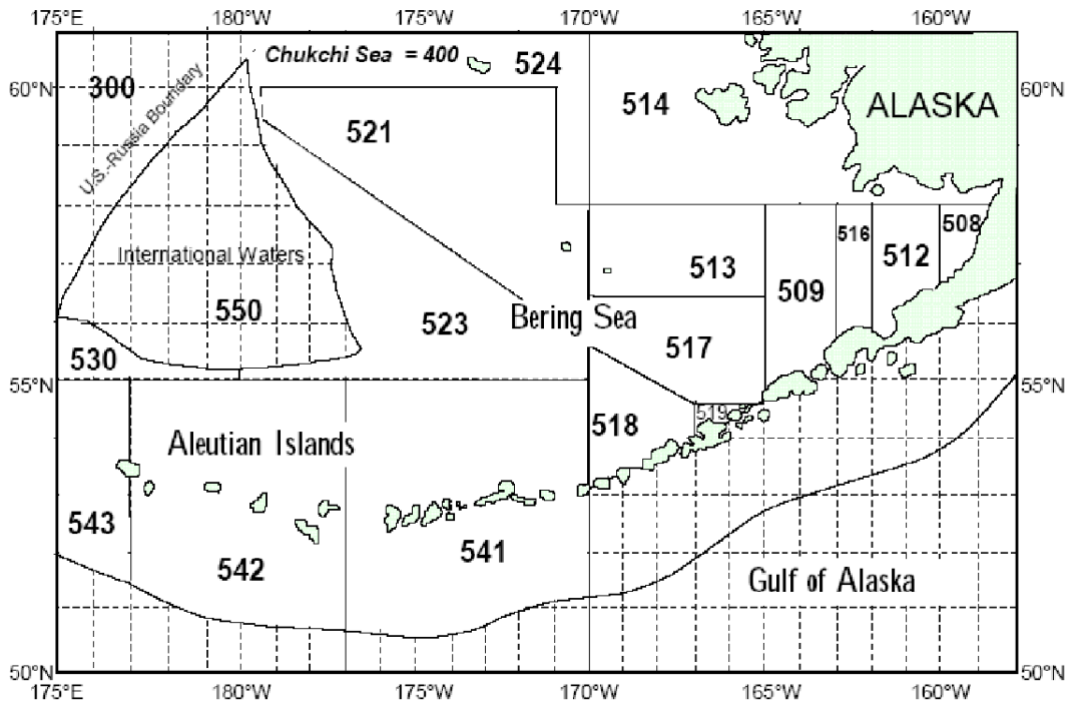


Figure 1. Bering Sea/Aleutian Islands statistical and reporting areas.

*In the Fishery:*

**Target species**—are those species that support either 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 TAC is established annually for each target species or species assemblage. Catch of each species must be recorded and reported. Stocks/assemblages in the target category are listed below.

*Ecosystem Component:*

**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 ABCs have been achieved shall be treated in the same manner as prohibited species.

**Forage fish species**—are those species listed 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 and may include such measures as prohibitions on directed fishing, limitations on allowable bycatch retention amounts, or limitations on the sale, barter, trade or any other commercial exchange, as well as the processing of forage fish in a commercial processing facility.

In the fishery	Ecosystem component	
<b>Target species<sup>1</sup></b>	<b>Prohibited species<sup>2</sup></b>	<b>Forage fish species<sup>3</sup></b>
Walleye Pollock	Pacific halibut	Osmeridae family (eulachon, capelin, and other smelts)
Pacific cod	Pacific herring	Myctophidae family (lanternfishes)
Sablefish	Pacific salmon	Bathylagidae (deep-sea smelts)
Yellowfin sole	Steelhead trout	Ammodytidae family (Pacific sand lance)
Greenland turbot	King crab	Trichodontidae family (Pacific sand fish)
Arrowtooth flounder	Tanner crab	Pholidae family (gunnells)
Kamchatka flounder		Stichaeidae family (pricklebacks warbonnets, eelblennys, cockscombs, shannys)
Northern rock sole		Gonostomatidae family (bristlemouths, lightfishes and anglemouths)
Flathead sole		Other euphausiacea (krill)
Alaska plaice		Squid
Other flatfish		Sculpins
Pacific Ocean perch		
Northern rockfish		
Blackspotted/Rougheye		
Shortraker rockfish		
Other rockfish		
Atka mackerel		
Skates		
Sharks		
Octopus		

<sup>1</sup> TAC for each listing. Species and species groups may or may not be targets of directed fisheries.

<sup>2</sup> Must be immediately returned to the sea, except when retention is required or authorized.

<sup>3</sup> Management measures for forage fish are established in regulations implementing the FMP.

In 2019, the NPFMC took final action to amend the FMPs for the BSAI (Amendment 121) and GOA (Amendment 110) and moved the sculpin stock complex into the ecosystem component category and establish an MRA of 20% for sculpins for all basis species in both the BSAI and GOA. Amendments 121/110 and their implementing regulations were approved by the Secretary of Commerce in August 2020 (85 FR 133,41427). Sculpins are, therefore, categorized as an ecosystem component species and information on sculpins will be contained in a report produced every four years.

### Historical Catch Statistics

Catch statistics since 1954 are shown for the Eastern Bering Sea (EBS) subarea in Table 4. The initial target species in the BSAI commercial fisheries was yellowfin sole. During this period, total catches of groundfish peaked at 674,000 t in 1961. Following a decline in abundance of yellowfin sole, other species (principally walleye pollock) were targeted, and total catches peaked at 2.2 million t in 1972. Pollock is now the principal fishery, with catches peaking at approximately 1.4-1.5 million t due to years of high recruitment. After the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) was adopted in 1976, catch restrictions and other management measures were placed on the fishery and total groundfish catches have since varied from one to two million t. In 2005, Congress implemented a statutory cap on TACs for BSAI groundfish of 2 million t, which had previously been a policy adopted by the Council. Total groundfish catches in the EBS in 2020 totaled 1,770,739t, Catches through November 6, 2021 totaled 1,682,106t. Pollock catches in the EBS totaled 1,367,232t in 2020; catches through November 6, 2021 totaled 1,374,009 t.

Catches in the Aleutian Islands (AI) subarea always are much less than in the EBS (Table 5). Total AI catches peaked at 190,750 t in 1996. Total AI catches were 144,446 t in 2010, and dropped to 103,804 t in 2012. Total catch decreased again in 2015 to 99,916 t but rose to 101,375 t in 2016 and 110,824 t in 2017, 123,896 t in 2018, 114,926 t in 2019 and 124,081 t in 2020. Total catch as of November 6, 2021 was 114,225 t. Recent increases are largely due to increased catch of Atka mackerel and cod.

The predominance of target species in the AI has changed over the years. Pacific ocean perch (POP) was the initial target species. As POP abundance declined, the fishery diversified to target different species. Atka mackerel was the largest fishery in the AI at 50,600 t in 2011 and 46,859 t in 2012 (down from 68,496 t in 2010); catch was 30,815 t in 2014 and increased to 53,003 in 2015, to 54,125 t in 2016, 63,401 t in 2017, 69,248 t in 2018, and 56,081 t in 2019 and 57,820 in 2020. Through November 6, 2021 Atka mackerel catch in the AI was 58,952 t. Catches since 2015 have been higher due to modifications in the Steller sea lion protection measures. POP was the second largest fishery at 26,311 t in 2013; 26,944 t in 2014, 23,507 in 2015, 23,097 t in 2016, 23,240 t in 2017, 29,097 in 2019 and 28,473 t in 2020. Through November 6, 2021, POP catch in the AI was 23,629t. Pacific ocean perch displaced Pacific cod as the second largest fishery beginning in 2011, as Pacific cod catch dropped from 29,001 t in 2010 to 9,064 in 2015 as a result of Steller sea lion protection measures; catch has increased since to 12,359 t in 2016, 12,286 in 2017, 14,719 t in 2018, 12,941 t in 2019 and 14,250 t in 2020. Through November 6, 2021, Pacific cod catch was 13,733 t.

Total catches since 1954 for the BSAI, combined, are shown in Table 6. Total BSAI catches were 1,354,662 t in 2010 (81 percent of the total TAC and 67 percent of the OY) and rose to 1,817,774 t in 2011 (92 percent of total TACs (which equaled the OY)), 1,914,585 t (96 percent of OY) in 2013 and 1,928,379 t in 2014 (96 percent of OY), 1,914,061 in 2015 (96 percent of OY), 1,952,492 t in 2016 (98 percent of OY), 1,909,033 t in 2017 (95% of OY) 1,947,840 t in 2018 (97% of OY), 1,936,278 t in 2019 (97% of OY) and 1,895,427 t in 2020 (95% of OY). BSAI catches through November 6, 2021 were 1,796,3321 t, which is 90% of OY.

### **Recent Total Allowable Catches**

Amendment 1 to the BSAI Groundfish FMP provided the framework to manage the groundfish resources as a complex. Maximum sustainable yield (MSY) for the BSAI groundfish complex was estimated at 1.8 to 2.4 million t. The OY range was set at 85% of the MSY range, or 1.4 to 2.0 million t. The sum of the TACs equals OY for the groundfish complex, which is constrained by the 2.0 million t cap on OY. Recent total TACs have been set equal to the OY cap.

Establishment of the Western Alaska Community Development Quota (CDQ) Program annual groundfish reserves is concurrent with the annual BSAI groundfish harvest specifications. Once annual BSAI groundfish TACs are established, the CDQ Program is allocated set portions of the TACs for certain species and species assemblages. This includes 10% of the BS and AI pollock TACs, 20% of the fixed gear sablefish TAC, and 7.5% of the sablefish trawl gear allocation. It also receives 10.7% of the TACs for Pacific cod, yellowfin sole, rock sole, flathead sole, Atka mackerel, AI Pacific ocean perch, arrowtooth flounder, and BS Greenland turbot. The program also receives allocations of PSC limits.

The TAC specifications for the primary allocated species, and PSC limit specifications, are recommended by the Council at its December meetings. The State of Alaska (State) manages separate Pacific cod guideline harvest level (GHL) fisheries in the Bering Sea subarea (starting in 2006) and Aleutian Islands subarea (starting in 2014). The State's Pacific cod GHL fisheries are conducted independently of the Federal groundfish fisheries under direct regulation of the State. The GHL amounts for 2020 for each subarea are derived as 9% of the Bering Sea ABC (and an additional 45 t to the State jig fishery) and 39% of the Aleutian Islands subarea ABC to a maximum of 15 million pounds (6804 t). The Council is expected to set the TAC for each subarea to account for the two State GHL fisheries. This is necessary to prevent harvest levels, GHL plus TAC, from exceeding the ABCs.

For the BSAI reserves, 15% of the TAC for each target species, except for pollock, the hook-and-line and pot gear allocation of sablefish, and the Amendment 80 species (Pacific cod, Atka mackerel, flathead sole, rock sole, yellowfin sole, and Aleutian Islands Pacific ocean perch), are automatically apportioned to a non-specified reserve. Apportionments to the non-specified reserve range from 4.3% to 15% of the TAC for each species or species group. The non-specified reserve is used to (1) correct operational problems in the fishing fleets, (2) promote full and efficient use of groundfish resources, (3) adjust species TACs according to changing conditions of stocks during the fishing year, and (4) make apportionments and

Community Development Quota allocations. The initial TAC (ITAC) for each species is the remainder of the TAC after the subtraction of the reserve.

### **Definition of Acceptable Biological Catch and the Overfishing Level**

Amendment 56 to the BSAI Groundfish FMP, which was implemented in 1999, defines ABC and OFL for the BSAI groundfish fisheries. The definitions are shown below, where the fishing mortality rate is denoted  $F$ , stock biomass (or spawning stock biomass, as appropriate) is denoted  $B$ , and the  $F$  and  $B$  levels corresponding to MSY are denoted  $F_{MSY}$  and  $B_{MSY}$  respectively.

Acceptable Biological Catch is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or 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 as shown in the text box below.

Overfishing is defined as any amount of fishing in excess of 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 the purpose of this definition and may use either objective or subjective criteria in making such determinations. For determination, 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 ‘ $\alpha$ ’ 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 percent of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For Tier (3), the term  $B_{40\%}$  refers to the long-term average biomass that would be expected under average recruitment and  $F=F_{40\%}$ .

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

Overfished or approaching an overfished condition is determined for all age-structured stock assessments by comparison of the stock level in relation to its MSY level according to harvest scenarios 6 and 7 described in the next section (for Tier 3 stocks, the MSY level is defined as  $B_{35\%}$ ). 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.

### Standard Harvest and Recruitment Scenarios and Projection Methodology

A standard set of projections is required for each stock managed under Tiers 1, 2, or 3 of Amendment 56. This set of projections encompasses seven harvest scenarios designed to satisfy the requirements of Amendment 56, the National Environmental Policy Act, and the MSFCMA.

For each scenario, authors have the option of making projections using either Stock Synthesis or the standard AFSC projection model. For the AFSC projection model the projections begin with an estimated vector of 2019 numbers at age. In each subsequent year, the fishing mortality rate is prescribed on the basis of the spawning biomass in that year and the respective harvest scenario.

For assessments using the standard AFSC projection model, recruitment in each year is drawn from an inverse Gaussian distribution whose parameters consist of maximum likelihood estimates determined from recruitments estimated in the assessment. Spawning biomass is computed in each year based on the time of peak spawning and the maturity and weight schedules described in the assessment. Total catch is assumed



to equal the catch associated with the respective harvest scenario in all years, except that in the first two years of the projection, a lower catch may be specified for stocks where catch is typically below ABC. This projection scheme is run 1000 times to obtain distributions of possible future stock sizes, fishing mortality rates, and catches.

Five of the seven standard scenarios are designed to provide a range of harvest alternatives that are likely to bracket the final TACs for 2021 and 2022, are as follow (“ $max F_{ABC}$ ” refers to the maximum permissible value of  $F_{ABC}$  under Amendment 56):

*Scenario 1:* In all future years,  $F$  is set equal to  $max F_{ABC}$ . (Rationale: Historically, TAC has been constrained by ABC, so this scenario provides a likely upper limit on future TACs.)

*Scenario 2:* In all future years,  $F$  is set equal to a constant fraction of  $max F_{ABC}$ , where this fraction is equal to the ratio of the  $F_{ABC}$  value for 2021 recommended in the assessment to the  $max F_{ABC}$  for 2021, and where catches for 2021 and 2022 are estimated at their most likely values given the 2021 and 2022 maximum permissible ABCs under this scenario. (Rationale: When  $F_{ABC}$  is set at a value below  $max F_{ABC}$ , it is often set at the value recommended in the stock assessment.)

*Scenario 3:* In all future years,  $F$  is set equal to the average of the five most recent years. (Rationale: For some stocks, TAC can be well below ABC, and recent average  $F$  may provide a better indicator of  $F_{TAC}$  than  $F_{ABC}$ .)

*Scenario 4:* In all future years, the upper bound on  $F_{ABC}$  is set at  $F_{60\%}$ . (Rationale: This scenario provides a likely lower bound on  $F_{ABC}$  that still allows future harvest rates to be adjusted downward when stocks fall below reference levels.)

*Scenario 5:* In all future years,  $F$  is set equal to zero. (Rationale: In extreme cases, TAC may be set at a level close to zero.)

Two other scenarios are needed to satisfy the MSFCMA’s requirement to determine whether a stock is currently in an overfished condition or is approaching an overfished condition. These two scenarios are as follow (for Tier 3 stocks, the MSY level is defined as  $B_{35\%}$ ):

*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 1) above its MSY level in 2020 or 2) above 1/2 of its MSY level in 2020 and expected to be above its MSY level in 2030 under this scenario, then the stock is not overfished.)

*Scenario 7:* In 2021,  $F$  is set equal to  $max F_{ABC}$ , and in all subsequent years,  $F$  is set equal to  $F_{OFL}$ . (Rationale: This scenario determines whether a stock is approaching an overfished condition. If the stock is 1) above its MSY level in 2022 or 2) above 1/2 of its MSY level in 2022 and expected to be above its MSY level in 2032 under this scenario, then the stock is not approaching an overfished condition.)

## Overview of “Stock Assessment” Section

The current status of individual groundfish stocks managed under the FMP is summarized in this section. Plan Team recommendations for 2021 and 2022 ABCs and OFLs are summarized in Tables 1, 2, and 3.

The sum of the Plan Team’s recommended ABCs for target species for 2022 and 2023 are 2,322,082 t and 2,564,366 t, respectively. These compare with the 2,747,727 in 2021 and 3,272,581 t in 2020. The primary decrease from previous years is due to declines in EBS pollock, and Yellowfin sole. The Team recommended maximum permissible ABCs for all stocks, except for EBS pollock and Yellowfin sole (Table 2).

Overall, the status of the stocks continues to appear favorable. All stocks but EBS pollock are above  $B_{MSY}$  or the  $B_{MSY}$  proxy of  $B_{35\%}$  (Figure 2).

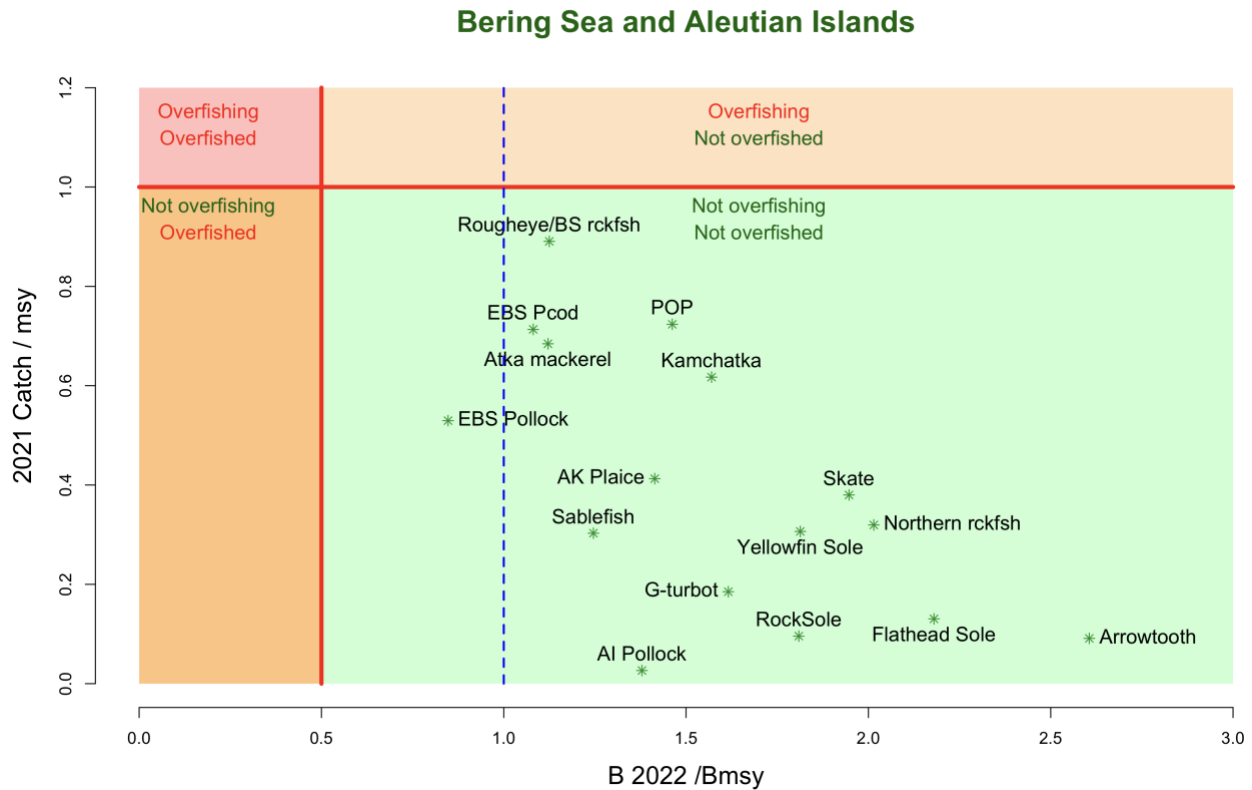


Figure 2. Summary of Bering Sea stock status next year (spawning biomass relative to  $B_{msy}$ ; horizontal axis) and current year catch relative to fishing at  $F_{msy}$  (vertical axis) where  $F_{OFL}$  is taken to equal  $F_{msy}$ .

The sum of the biomasses for 2022 listed in Table 3 (19,354,358 t) is an increase (4%) from 2021 (18,519,110 t). This is primarily due to increases in Northern rock sole, flathead sole, Alaska plaice, northern rockfish and skates despite declines in EBS pollock and Pacific cod. 2021 was a 4% decline compared to 2020. This stability and current relative increases follow periods of declines since 2010.

### Summary and Use of Terms

Stock status is summarized and OFL and ABC recommendations are presented on a stock-by-stock basis in the remainder of this section, with the following conventions observed:

“Fishing mortality rate” refers to the full-selection  $F$  (i.e., the rate that applies to fish of fully selected sizes or ages), except in the cases of stocks managed under Tier 1 (EBS pollock, yellowfin sole, and northern rock sole). For these stocks, the fishing mortality rate consists of the ratio between catch (in biomass) and biomass at the start of the year. EBS pollock uses “fishable biomass,” whereas yellowfin sole and northern rock sole use age 6+ biomass for this calculation.

“Projected age+ biomass” refers to the total biomass of all cohorts of ages greater than or equal to some minimum age, as projected for January 1 of the coming year. The minimum age varies from species to species. When possible, the minimum age corresponds to the age of recruitment listed in the respective stock assessment. Otherwise, the minimum age corresponds to the minimum age included in the assessment model, or to some other early age traditionally used for a particular species. When a biomass estimate from the trawl survey is used as a proxy for projected age+ biomass, the minimum age is assumed to correspond with the age of recruitment, even though the survey may not select that age fully and undoubtedly selects fish of younger ages to some extent.

The reported ABCs and OFLs for past years correspond to the values approved by the Council. Projected ABCs and OFLs listed for the next two years are the Team's recommendations.

Reported catches are as of November 7, 2020.

### **Two-Year OFL and ABC Projections**

Proposed and final harvest specifications are adopted annually for a two-year period. This requires the Team to provide OFLs and ABCs for the next two years in this cycle (Table 1). The 2022 harvest specifications (from Council recommendations in December 2019) 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 Scenario 2 from the standard projection model using assumed (best estimates) of actual catch levels. For stocks managed under Tiers 4-6, projections for the second year in the cycle are set equal to the Plan Team's recommended values for the first year in the cycle.

## Revised Stock Assessment Schedule

Based on consideration of stock prioritization including assessment methods and data availability, some stocks are assessed on an annual basis while others are assessed less frequently. The following table provides an overview of the level of assessment presented in this year's SAFE report, the Tier level and schedule as well as the year of the next full assessment by stock.

### Stock Assessment schedule for Bering Sea-Aleutian Islands

<b>Stock</b>	<b>2021 SAFE Assessment status</b>	<b>Tier</b>	<b>Schedule (years)</b>	<b>Year of next full assessment</b>
Eastern Bering Sea pollock	Full	1	1	2022
Bogoslof Island Pollock	None	5	2	2022
Aleutian Islands pollock	Full	3	2	2022
Eastern Bering Sea Pacific Cod	Full	3	1	2022
Aleutian Islands Pacific cod	Full	5	1	2022
Sablefish	Full	3	1	2022
Yellowfin sole	Full	1	1	2022
Greenland Turbot	Partial	3	2	2022
Arrowtooth flounder	Partial	3	2	2022
Kamchatka flounder	Partial	3	2	2022
Northern Rock sole	Partial	1	2	2022
Flathead sole	Full	3	2	2022
Alaska plaice	Full	3	2	2023
Other flatfish	None	5	4	2024
Pacific ocean perch	Partial	3	2	2022
Northern rockfish	Full	3	2	2023
Rougheye & blackspotted rockfish	Partial	3	2	2022
Shorthead rockfish	None	5	2	2022
Other rockfish	None	5	2	2022
Atka mackerel	Full	3	1	2022
Skates	Partial	3/5	2	2022
Sharks	None	5	2	2022
Octopus	None	6	2	2022
Sculpins	None	Eco	4	2024
Forage Species (including Squids)	Report	Eco	2	2023
Grenadiers (BSAI/GOA)	None	Eco	4	2024

The products anticipated under each year and by Tier are shown below depending upon the 1-,2-, or 4-year assessment cycle for different stocks.

Year	1-year cycle		2-year cycle		4-year cycle	
	Tiers 1-3	Tiers 4-6	Tiers 1-3	Tiers 4-6	Tiers 1-3	Tiers 4-6
1	full	full	full	full	full	full
2	full	full	partial	nothing	partial	nothing
3	full	full	full	full	partial	partial
4	full	full	partial	nothing	partial	nothing

## Economic Summary of the BSAI commercial groundfish fisheries in 2019-2020

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 in 2019 to \$1,504 million in 2020 (real 2020\$). The first wholesale value of 2020 groundfish catch after primary processing was \$2,102 million, a decrease from the 2019 value of \$2,529 million. The 2020 total groundfish catch decreased by 4.6%, and the total first-wholesale value of groundfish catch decreased by 16.9%, relative to 2019.

The groundfish fisheries accounted for the largest share (54 of the ex-vessel value of all commercial fisheries off Alaska with \$811 million in revenue, while the Pacific salmon (*Oncorhynchus spp.*) fishery was second with \$377 million or 25% of the total Alaska ex-vessel value. The value of the shellfish fishery amounted to \$235 million or 16% of the total for Alaska and exceeded the value of Pacific halibut (*Hippoglossus stenolepis*) with \$70 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, and current year product price and ex-vessel price projections. The final version also presents an Amendment 80 fishery economic data report (EDR) summary, an Amendment 91 fishery economic data report (EDR), market profiles for the most commercially valuable species, and a Gulf Trawl economic data report. The report will now also include a section summarizing in-season harvest and revenue estimates for groundfish and halibut through Sept. 2021. The previous section covering community participation was moved into a separate report, the Annual Community Engagement and Participation Overview (ACEPO).

Data tables are organized into four relatively distinct sections: (1) All Alaska, (2) BSAI, (3) GOA, and (4) Pacific halibut. The figures and tables in the report provide estimates of total groundfish catch, groundfish discards and discard rates, prohibited species catch (PSC) and PSC rates, the ex-vessel value of the groundfish catch, the ex-vessel value of the catch in other Alaska fisheries, the gross product value of the resulting groundfish seafood products, the number and sizes of vessels that participated in the groundfish fisheries off Alaska, vessel activity, and employment on at-sea processors. Generally, the data presented in this report cover 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 an historical perspective on catch. The data behind the tables from this and past Economic SAFE reports are publicly available online at: <https://reports.psmfc.org/akfin> and <https://psesev.psmfc.org/PSESV-2/>.

## **Summary of wholesale ex-vessel and first wholesale changes in Bering Sea revenues**

According to data reported in the current Economic SAFE report, the total real ex-vessel value of Bering Sea and Aleutian Islands (BSAI) groundfish decreased significantly from \$950 million in 2019 to \$811 million in 2020 (Figure 3), and real first-wholesale revenues from the processing and production of groundfish in the BSAI decreased by 16% between 2019 (\$2,275 million) and 2020 (\$1,912 million) (Figure 4). The total quantity of groundfish products from the BSAI decreased by 9.4% from 831 thousand metric tons to 753 thousand metric tons. In the GOA, real first wholesale revenue decreased by 25% and the quantity of products decreased by 17.5%.

## **Decomposition of the change in first-wholesale revenues from 2019-2020 in the BSAI**

The following brief analysis summarizes the overall nominal revenue changes that occurred from 2019-2020 and the quantity produced, and revenue generated from BSAI groundfish and how revenues have been impacted by changes in quantity or prices of each species and product group (Figure 5). Unlike the numbers above, these values are not adjusted for inflation, so enable a simple comparison of how changes in the price and quantity for each group combine to produce revenues.

By BSAI species group, an almost neutral price effect and large negative quantity effect resulted in a negative net effect of about \$206 million for pollock (Figure 5, top panel). For Pacific cod, a negative price effect combined with a larger negative quantity effect, resulted in a \$81 million net decrease in first-wholesale revenues for Pacific cod from the BSAI for 2019-20 (Figure 5). There was a nearly equal negative price effect and negative quantity effect for rockfish that resulted in a net negative effect of \$8.6 million. Atka mackerel had a negative price effect and a smaller positive quantity effect, combining for a net negative effect of \$6.6 million. Flatfish had a large negative price effect combined with a smaller positive quantity effect that resulted in a net revenue decrease of \$35.2 million. Sablefish had a negative price effect of \$0.9 million and a positive quantity effect of \$1.4 million, combining for a net positive effect of \$0.5 million. The “Other” species group experienced a net revenue decrease of \$0.6 million.

By product group, almost neutral price effects coupled with large negative quantity effects in the fillets category resulted in a negative net effect of \$130 million in the BSAI first-wholesale revenue decomposition for 2019-20 (Figure 5, bottom panel). For surimi, large negative price effects coupled with a slightly larger negative quantity effects resulted in a negative net effect of \$111 million. For roe, negative price effects coupled with larger negative quantity effects resulted in a negative net effect of \$21.5 million. For whole fish and head & gut, a large negative price effect combined with a smaller put still large negative quantity effect to produce a net negative effect of \$127 million. For ‘other’ products, a positive price effect combined with a smaller negative quantity effect resulted in a net positive effect of \$51.0 million.

In summary, the changes in first-wholesale revenues from the BSAI groundfish fisheries decreased significantly from 2019-20 due to negative price effects and quantity effects for most species. First-wholesale revenues also decreased from 2019-20 in the GOA, with price and quantity declines in almost all species.

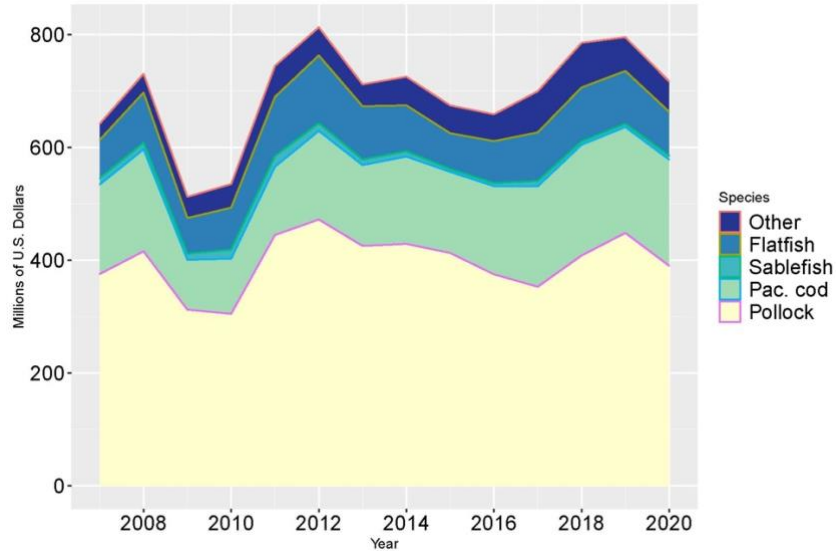


Figure 3. Real ex-vessel value of the groundfish catch in the domestic commercial fisheries in the BSAI area by species, 2007-2020 (base year = 2020).

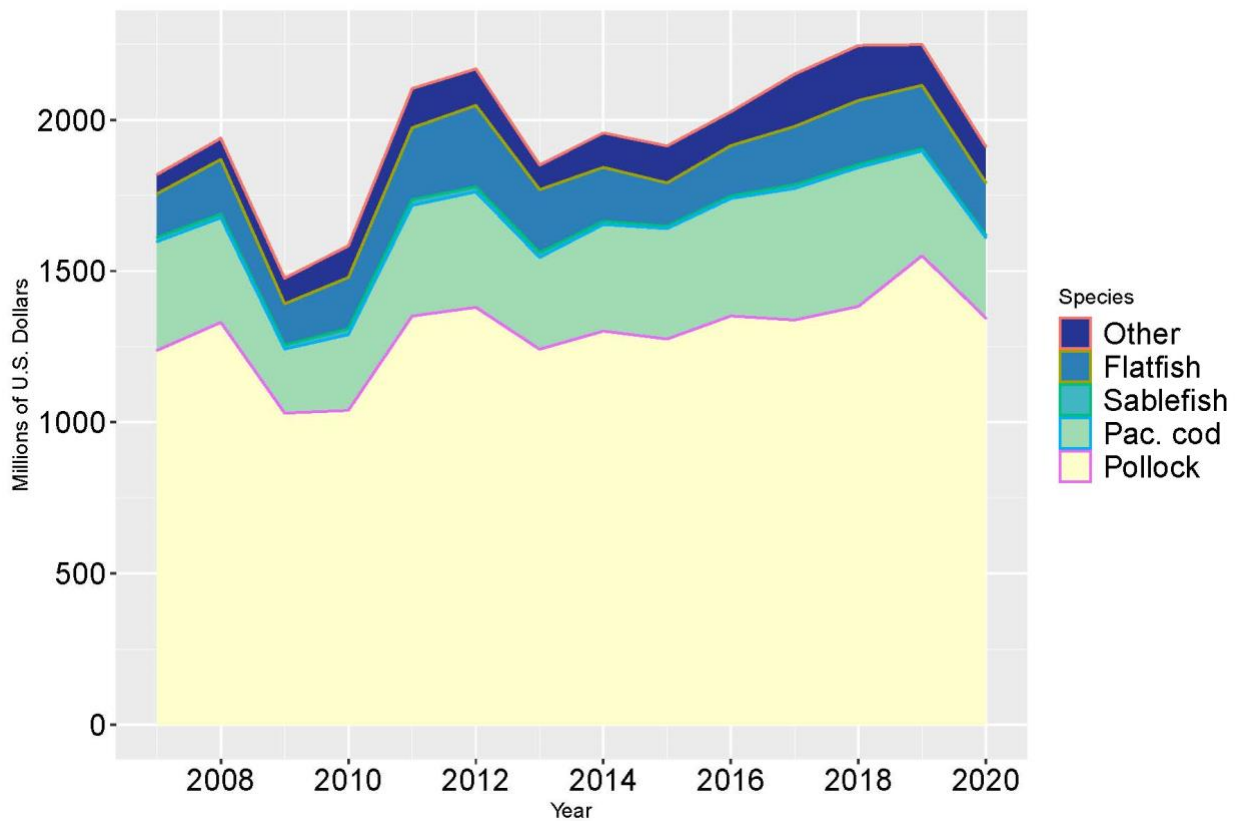


Figure 4. Real gross product value of the groundfish catch in the BSAI area by species, 2007-2020 (base year = 2019).



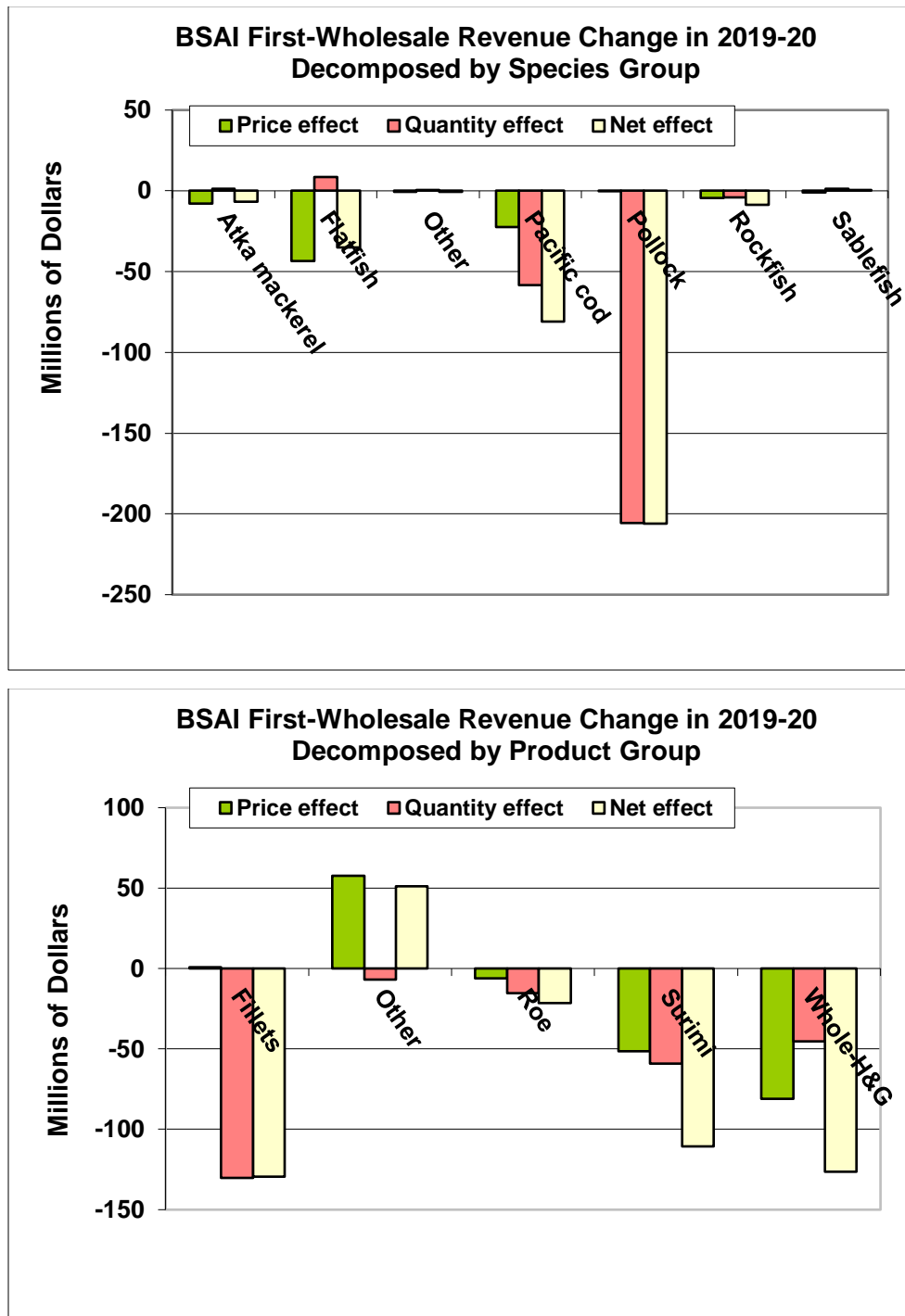


Figure 5. Decomposition of the change in first-wholesale revenues from 2019-20 in the BSAI area. The first decomposition is by the species groups used in the Economic SAFE report, and the second decomposition is by product group. The price effect refers to the change in revenues due to the change in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

### *Bering Sea Conditions*

The Eastern Bering Sea (both NEBS and SEBS) remains in an anomalously warm phase that began in 2014. Surface and bottom temperatures (SST and BT respectively) were moderately warmer than average across the SEBS. Bottom water temperatures were very warm in the inner domain of the NEBS with an area of cold BT over the middle domain to the southwest of St. Lawrence Island (resulting in overall NEBS BT nearing the long-term average). Warm anomalies are particularly noted in the winter and spring; a moderate marine heatwave briefly developed the SEBS and for a slightly longer period in the NEBS in spring-summer 2021. SEBS remained warmer than average through the summer, but NEBS cooled to near normal surface temperatures in late summer.

Sea-ice formation in fall of 2020 was delayed due to residual warmth in the system (i.e., the ‘new normal’). Over the eastern shelf sea ice thickness differed between the northern (thicker ice) and southern (thinner/no ice) regions due to opposing prevailing winds; in the NEBS cold northerly winds contributed to ice formation and stability/thickness while over the SEBS, warm southerly winds contributed to reduced sea ice. The summer 2021 cold pool remained significantly reduced in area and was shifted northwestward. The 2021 extent was the 4th lowest on record and remains more than 1 SD below the mean.

Ongoing and lagged ecosystem-wide impacts of climate shocks were observed in 2021, especially in the NEBS (i.e., following record high temperatures, and record low sea ice and cold pool extent in 2018 and 2019). In the NEBS, concerns about ecosystem carrying capacity persist, highlighted by the gray whale Unusual Mortality Event and short-tailed shearwater mass mortality event following poor feeding conditions experienced during 2018 and 2019. Multiple synchronous declines in observed in 2021 in the NEBS represent ecosystem “red flags” including crab population declines, salmon run failures in the Arctic-Yukon-Kuskokwim region, seabird die-offs combined with low colony attendance and poor reproductive success and declines in the CPUE of all fish and major invertebrate taxa sampled during the 2021 NOAA bottom trawl survey in both the NEBS and SEBS survey areas, with notable declines in the NESB between 2019 and 2021 (and absent of concurrent increases in the SEBS in 2021).

Species and fisheries have shifted distributions in response to oceanographic and ecological conditions. The center of gravity for the groundfish community shifted to the north and into shallower water between 2014–2019. Between 2019 and 2021, the mean distribution across species shifted back to the SEBS again. Corresponding northward shifts in fishing vessel activity and an increased harvest of Pacific cod in the northern regulatory areas occurred from 2016 through 2020. As the fishing fleet shifted northward following the fish, patterns in groundfish discards also shifted. Fixed gear discards in the northern Bering Sea trended upward from 2016–2018 as some vessels targeting Pacific cod moved their fishing activity northward; these increases were offset by declines in discard biomass in the southern portion. Of note, a novel interaction between a fishing vessel and a threatened spectacled eider may be a direct result of abrupt ecological changes as fishing vessels increase in areas near spectacled eider designated critical habitat.

### *Aleutian Islands*

Ecosystem-wide, several trends and conditions have persisted since 2013 including continued negative NPGO, warmer than average SST across the Aleutians, with mid-depth waters also warming since 2013, low eddy kinetic energy in the eastern AI and below average abundance of large diatoms and biomass of meso-zooplankton. Cumulatively, these conditions suggest a lower productivity level across the system with increased bioenergetic needs for fish and faster growth rates for zooplankton. However, 2021 is a La Niña year with a negative PDO, few days under marine heatwave conditions, and (newly-estimated) near-average surface chlorophyll concentrations. The result has been near average conditions through much of the year, sustaining the more favorable conditions for the biota observed in 2020 relative to recent years. Overall, sea surface temperature is expected to decrease to average levels through winter 2021 and early spring 2022.

The high abundance trend of Eastern Kamchatka pink salmon in odd years continues with this year being second to the record abundance in 2019. Pink salmon biennial patterns impact zooplankton abundances which impact fish otolith growth (Atka mackerel) and food available for seabirds. An increase of rockfish across the Aleutians has slowly changed the ratio of Atka mackerel/pollock to northern rockfish/Pacific ocean perch, with rockfish now contributing a higher percent of the local biomass across the archipelago and higher percentages in tufted puffin chick meals. Jointly these conditions might lower the availability of Atka mackerel and pollock to other predators such as Pacific cod. It is unclear whether a change in pelagic foragers has contributed to the decline of harbor seals and Steller sea lions.

While enhanced storminess was observed in all three regions, differences in oceanographic and ecological conditions were observed across the western, central, and eastern Aleutians (AI) during 2021. In the western and central AI, record high SST in August and September contributed to a 2 month long moderate (category 1) marine heat wave (MHW) while SST in the eastern AI was cooler and remained at or below average with only a few days of moderate MHW conditions in 2021. The western and central AI MHW coincided with the early portion of the spawning season of Atka mackerel when they spawn in areas 32-144 m deep, thus spawners in shallower areas may have experienced temperatures to close to 10-11°C, or near the upper limit of historical spawning temperatures.

Eddy kinetic energy was below average in the west and east and approximately average in the central AI, suggesting low fluxes of nutrients, heat and salt through the passes across the Aleutians (including Unimak Pass). In the eastern AI, chlorophyll concentration (proxy for phytoplankton biomass) was below average while in the central and western AI it was near average during early spring, and above average in June, particularly north and offshore of the islands.

In the western AI, it was an exceptionally successful season for fish-eating seabirds suggesting improved availability and variety of prey and similarly above average for zooplankton eating birds (indicating productive zooplankton conditions). An increase of rockfish in seabird diets suggests they are more available to seabirds as prey, potentially because they have displaced Atka mackerel and pollock in some areas. The eastern AI had the highest number of reports of beach-cast dead seabirds, particularly shearwaters in Atka and the Christmas Bird Count at Unalaska Island reported unusually low numbers of cormorants, guillemots, murrelets and even gulls. The low numbers of wintering seabirds may be due to the increased storminess in eastern AI during winter.

## Stock Status Summaries

Except as otherwise noted, the Team's recommended ABCs are set at the maximum permissible levels under their respective tiers.

### 1. Walleye Pollock

Status and catch specifications (t) of walleye pollock in recent years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The biomass is reported as age 3+ for eastern Bering Sea, age 2+ for the Aleutian Islands and the survey biomass for Bogoslof, as reported in the respective assessments. The OFL and ABC for 2022 and 2023 are those recommended by the Plan Team. Catch data are current through November 6, 2021.

Area	Year	Biomass	OFL	ABC	TAC*	Catch
Eastern Bering Sea	2020	9,128,000	4,085,000	2,043,000	1,425,000	1,367,223
	2021	8,145,000	2,594,000	1,626,000	1,375,000	1,373,712
	2022	6,839,000	1,469,000	1,111,000	n/a	n/a
	2023	6,969,000	1,704,000	1,289,000	n/a	n/a
Aleutian Islands	2020	340,680	66,973	55,120	19,000	3,205
	2021	292,967	61,856	51,241	19,000	1,635
	2022	308,525	61,264	50,752	n/a	n/a
	2023	330,375	61,379	50,825	n/a	n/a
Bogoslof	2020	610,267	183,080	137,310	75	99
	2021	378,262	113,479	85,109	250	50
	2022	378,262	113,479	85,109	n/a	n/a
	2023	378,262	113,479	85,109	n/a	n/a

\* In 2020, NMFS reallocated 11,900 t of pollock TAC from the Aleutian Islands to the Bering Sea, which increased the Bering Sea TAC to 1,436,902 t and decreased the Aleutian Islands TAC to 7,099 t. In 2021, NMFS reallocated 14,500 t of pollock TAC from the Aleutian Islands to the Bering Sea, which increased the Bering Sea TAC to 1,389,500 t and decreased the Aleutian Islands TAC to 4,500 t.

### Eastern Bering Sea pollock

#### *Changes from previous assessment*

New data in this year's assessment include the following:

1. Observer data for catch-at-age and average weight-at-age from the 2020 fishery were finalized and included.
2. Total catch as reported by NMFS Alaska Regional office was updated and included through 2021.
3. VAST estimates of the combined EBS and NBS survey biomass index were updated and included through 2021.
4. The AVO index for 2021 was included.
5. Length composition from the 2021 fishery and a preliminary estimate of the age composition from the 2021 fishery were included.

The authors' and Team's recommended model for setting harvest specifications is Model 20.0c, which is a minor modification of last year's model (20.0a) in that, in addition to the typical data updates, it includes fishery length composition and preliminary fishery age composition data from the current year.

#### *Spawning biomass and stock trends*

Spawning biomass in 2008 was at the lowest level since 1980 but had increased by a factor of 2.30 by 2017, and has since started trending downward again. The 2008 low was the result of extremely poor recruitments from the 2002-2005 year classes. Recent increases were fueled by recruitment from the very strong 2008, 2012, and 2013 year classes (above average by factors of 2.10, 1.93, and 2.04 for the post-1976 time series,

respectively), along with spawning exploitation rates at or below 20% from 2008 through 2018. Spawning biomass is projected to be 15% below  $B_{MSY}$  in 2022.

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

The SSC has determined that EBS pollock qualifies for management under Tier 1 because there are reliable estimates of  $B_{MSY}$  and the probability density function for  $F_{MSY}$ . The updated estimate of  $B_{MSY}$  from the present assessment is 2.220 million t. Projected spawning biomass for 2022 is 1.881 million t, placing EBS walleye pollock in sub-tier “b” of Tier 1. As has been the approach for many years, the maximum permissible ABC harvest rate was based on the ratio between MSY and the equilibrium biomass corresponding to MSY. The harmonic mean of this ratio from the present assessment, after adjusting according to the sloping portion of the harvest control rule, is 0.334. The harvest ratio of 0.334 is multiplied by the geometric mean of the projected fishable biomass for 2022 (3.750 million t) to obtain the maximum permissible ABC for 2022, which is 1.251 million t. However, as with other recent EBS pollock assessments, the authors recommend setting ABCs well below the maximum permissible levels. Their reasons for doing so are listed in the “ABC Recommendation” section of the SAFE chapter, where all categories in the risk table are scored as Level 2 (“substantially increased concern”). The authors conclude that these levels of concern warrant setting the 2022 and 2023 ABCs at 1,111,000 t and 1,289,000 t (reductions of 11% from the corresponding maxABC in both cases), which are the values associated with the Tier 2 maxABC harvest control rule (use of the Tier 2 rule was suggested by the SSC at the October 2021 meeting). This is a change from the harvest policy that has been recommended by both the Team and SSC for the EBS pollock stock since the 2014 assessment cycle, which was to base the reduction on the Tier 3 maxABC harvest control rule. As the authors note, the ratio between the maxABC values resulting from the Tier 1 and Tier 2 harvest control rules is likely to be much less variable than the ratio between the Tier 1 and Tier 3 values. The authors also note that the Tier 2 maxABC for 2022 is extremely close to the value that would be obtained by maintaining fishing effort at the current level, which is another strategy that has been used by the Team in the past. The Team concurs with the authors’ recommendation to base ABC for the 2022 and 2023 fisheries on the Tier 2 maxABC harvest control rule.

The OFL harvest ratio under Tier 1b is 0.392, corresponding to the arithmetic mean of the ratio between MSY and the equilibrium fishable biomass corresponding to MSY, after adjusting according to the sloping portion of the harvest control rule. The product of this ratio and the geometric mean of the projected fishable biomass for 2022 determines the OFL for 2022, which is 1.469 million t. Given a projected 2022 catch of 1.200 million t, the current projection for OFL in 2023 is 1.704 million t.

#### *Status determination*

The walleye pollock stock in the EBS is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

#### **Aleutian Islands pollock**

##### *Changes from previous assessment*

There were no changes made to the assessment model inputs since this was an off-cycle year. New data added to the projection model included an updated 2020 catch estimate (3,205 t) and new catch estimates for 2021. The 2022 catch was set at the 3 year average for 2018-2020 of 2,243 t. There were no changes in assessment methodology since this was an off-cycle year.

##### *Spawning biomass and stock trends*

Last year’s assessment estimated that spawning biomass reached a minimum level of about  $B_{27\%}$  in 2010, but has increased every year since, reaching a level of about  $B_{49\%}$  in 2020, with a slight projected decline to about  $B_{46\%}$  for 2021. Although nearly all of the cohorts spawned after 2008 have tended to be stronger than nearly all of the cohorts spawned between 1994 and 2008, and the 2011-2015 cohorts are all above

the median value, there have been no above-average cohorts spawned since 1989 (the average is much higher than the median, due to the fact that the 1978 year class was larger than the average of the other year classes by a factor of about 16.7).

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

The official total catch for 2020 is 3,205 t which is a small fraction of the 2020 OFL of 66,973 t; therefore, the stock is not being subjected to overfishing. The estimates of spawning biomass for 2021 and 2022 from last year's assessment model (Barbeaux et al. 2020) and the current year (2021) projection model are 89,906 t and 85,785 t, respectively. The 2021 estimate from the current year projection is above  $B_{35\%}$  at 64,916 t and the 2022 estimate is above  $\frac{1}{2} B_{35\%}$  and the stock is expected to be above  $B_{35\%}$  in 2033 under projection Scenario 7, therefore, the stock is not currently overfished nor approaching an overfished condition.

For the 2022 fishery, the Team recommends the maximum allowable ABC of 50,752 t and OFL of 61,263 t from the updated projection model. Projections assumed estimated catches of 1,656 t for 2021 and 2,243 t for 2022, the three-year average (2018- 2020), used in place of maximum permissible ABC.

#### *Status determination*

The walleye pollock stock in the Aleutian Islands is not being subject to overfishing, is not currently overfished, nor is it approaching a condition of being overfished.

#### **Bogoslof pollock**

In accordance with the approved schedule, no assessment was conducted for Bogoslof pollock 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. The grayed-out text below summarizes the 2020 assessment.

#### *Changes from previous assessment*

Estimated catches for 2019 and 2020 were updated and the 2020 acoustic-trawl survey biomass estimate and preliminary 2020 survey age data were included. Two methods for computing the survey average are provided: one using the random effects and the other using a simple 3-survey average, as in 2018. Natural mortality was re-evaluated using the age-structured model presented in previous assessments (unchanged except for new survey, fishery, and age composition data from the survey).

#### *Spawning biomass and stock trends*

NMFS acoustic-trawl survey biomass estimates are the primary data source used in this assessment. Between 1997 and 2018, the values varied between a low of 67,063 t and a high of 663,070 t in 2018. The most recent acoustic-trawl survey of the Bogoslof spawning stock was conducted in February 2020 and resulted in a biomass estimate of 344,663 t. The random-effects method of survey averaging resulted in 378,662 t, compared to the three-survey average of 505,261 t.

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

The SSC has determined that this stock qualifies for management under Tier 5. The assessment authors and the Team recommend that the maximum permissible ABC and OFL continue to be based on the random-effects survey averaging approach. The assessment authors and the Team recommend using the biomass estimate based on the random effects (378,262 t) for calculating the Tier 5 ABC.

The maximum permissible ABC value for 2021 is 85,109 t (assuming  $M = 0.3$  and  $F_{ABC} = 0.75 \times M = 0.225$  and the random effects survey estimate for biomass). The ABC for 2022 is the same.

The OFL was calculated using the random effects estimate for the survey biomass. Following the Tier 5 formula with  $M=0.3$ , OFL for 2021 is 113,479 t. The OFL for 2022 is the same.

### *Status determination*

The walleye pollock stock in the Bogoslof district is not being subjected to overfishing. It is not possible to determine whether this stock is overfished or whether it is approaching an overfished condition because it is managed under Tier 5.

## **2. Pacific cod**

Status and catch specifications (t) of Pacific cod in recent years are shown below. 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 Team. Catch data are current through November 6, 2021.

<b>Area</b>	<b>Year</b>	<b>Age 0+ biomass</b>	<b>OFL</b>	<b>ABC</b>	<b>TAC*</b>	<b>Catch</b>
Eastern Bering Sea	2020	756,811	191,386	155,873	141,799	141,484
	2021	754,000	147,949	123,805	111,380	105,537
	2022	879,978	183,012	153,383	n/a	n/a
	2023	848,615	180,909	151,709	n/a	n/a
Aleutian Islands	2020	80,700**	27,400	20,600	13,796	7,474
	2021	80,700**	27,400	20,600	13,796	7,023
	2022	80,700**	27,400	20,600	n/a	n/a
	2023	80,700**	27,400	20,600	n/a	n/a

\*\*Biomass shown for AI Pacific cod is survey biomass (Tier 5), not age 0+ biomass.

### **Eastern Bering Sea Pacific cod**

#### *Changes from previous assessment*

The most important change from the previous assessment is that the accepted model is a weighted ensemble of models rather than a single model. This approach has been recommended by the Groundfish Plan Teams and the SSC and pursued in several previous assessments, but never approved by the BSAI Groundfish Plan Team until now. Many changes have been made or considered in the stock assessment models since the 2020 assessment. Following the recommendation from a review by the Center for Independent Experts, an ensemble consisting of four models and a corresponding set of model weights was presented in this year's assessment: Model 19.12a is the current base model, and the other three models each differed from the base model with respect to a single, model-specific, feature. Model 19.12 included time-varying survey catchability, Model 21.1 allowed for the possibility that survey selectivity declines at larger sizes ("dome-shaped" selectivity), and Model 21.2 incorporated a fishery catch per unit effort (CPUE) index as a relative measure of stock biomass. A fifth model (21.3), which estimated a constant that is added to the standard deviation of each year's log-scale abundance index, was considered in the preliminary assessment, but the SSC suggested that it be omitted.

The following changes to the input data have been made in the EBS Pacific cod assessment.

1. Catches for 1991-2020 were updated, and a preliminary catch estimate for 2021 was incorporated.
2. Using the vector autoregressive spatio-temporal (VAST) approach as before, but with some adjustments to the set of hauls included in the data and an increase in the number of knots, the EBS+NBS survey abundance time series was re-estimated through 2021.
3. Commercial fishery size compositions for 1991-2020 were updated, and a preliminary size composition from the 2021 commercial fishery was incorporated.
4. The size composition data from the 2018 NBS survey were removed from the EBS+NBS survey size composition for 2018 due to the nonstandard survey design used in the NBS that year, and the size composition from the 2021 EBS+NBS survey was incorporated



5. Using the VAST approach as before, but including otolith samples from the 2010, 2017, and 2019 NBS surveys, age compositions from the combined EBS+NBS survey time series were re-estimated through 2019.
6. Long-term average weight-length parameters, and the time series of annual deviations therefrom, were re-estimated through 2020, and preliminary estimates for 2021 were incorporated.
7. For one new model, a fishery CPUE time series, based on the VAST approach, was incorporated.

#### *Spawning biomass and stock trends*

Recruitment is estimated to have been below average for the 2014-2017 year classes. Above average recruitment is estimated for the 2018 year class. Estimated spawning biomass from the ensemble increased from 2010 through 2019 to 315,000 t, and declined to 255,000 t in 2021. Spawning biomass is predicted to increase to 260,000 t in 2022 with the recommended ABC.

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

This stock is assigned to Tier 3b for the determination of 2022 and 2023 ABCs and OFLs. The 2022 maxABC in this tier as calculated using the weighted average of the models in the ensemble is 153,383 t and the projected 2023 maxABC is 151,709 t. The 2022 OFL from the weighted ensemble is 183,012 t. The 2023 projected OFL, given the respective 2022 catch from each individual model, is 180,909 t. Even though a slightly elevated risk to the stock was identified due to environmental/ecosystem considerations, the Team did not recommend a reduction in the ABC.

#### *Status determination*

EBS Pacific cod is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

### **Aleutian Islands Pacific cod**

#### *Changes from previous assessment*

This stock has been assessed separately from Eastern Bering Sea Pacific cod since 2013 and managed separately since 2014. The stock has been managed under Tier 5 since it was first assessed separately. The authors presented three alternative age-structured models this year. However, these models were not accepted for management by the Team. Therefore, no changes were made to the methodology used for recommending harvest specifications. Catch data from 1991-2020 were updated and preliminary catch data for 2021 were included in the assessment, but these have no impact on recommended harvest specifications under Tier 5.

#### *Spawning biomass and stock trends*

After declining by more than 50% between 1991 and 2002, survey biomass has since stayed in the range of 50-90 kilotons. The 2018 Aleutians survey biomass estimate (81,272 t) was down approximately 4% from the 2016 estimate (84,409 t). No Aleutian Island surveys for Pacific cod have been conducted since 2018.

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

The Team recommends using the Tier 5 assessment again for setting 2022 and 2023 harvest specifications. The Team's recommended ABC is 20,600 t, and OFL is 27,400 t. The estimate of the natural mortality rate is 0.34, which is unchanged from the previous assessment.

#### *Status determination*

This stock is not being subjected to overfishing. It is not possible to determine whether this stock is overfished or whether it is approaching an overfished condition because it is managed under Tier 5.



### 3. Sablefish

Status and catch specifications (t) of sablefish in the Bering Sea and Aleutian Islands 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 the 2020 fishery year, the OFL was made Alaska-wide (i.e., for both BSAI and GOA FMPs combined). Catch data are current through November 6, 2021.

Area	Year	Age 4+ Biomass	OFL	ABC	TAC	Catch
Alaska (all areas)	2020	657,000	50,481			19,005
	2021	707,000	60,426			18,305
	2022	529,800	40,432			
	2023	520,800	42,520			
Bering Sea	2020	116,000		2,174	1,861	5,301
	2021	142,000		3,396	3,396	3,961
	2022	168,000		5,264	n/a	n/a
	2023	165,200		6,529	n/a	n/a
Aleutian Islands	2020	154,000		2,952	2,039	1,210
	2021	175,000		4,717	4,717	1,425
	2022	121,200		6,463	n/a	n/a
	2023	119,100		7,786	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 indices 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.

The authors recommended adoption of Model 21.12, which is identical to the model recommended at the September Team meeting (Model 21.10), except that it uses an age-based GLM to estimate maturity *without* incorporating information on skipped spawning. The Teams agreed with the authors' choice of model. In addition to updating biological information, the model removed the prior constraint on 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 were 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 spawning biomass 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 remaining strong).

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

Sablefish have been classified for management under Tier 3 of the FMP. Reference points were estimated based on average recruitment from 1977 – 2017 and age-specific schedules of selectivity, weight, 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) of 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. The Teams agreed with these recommendations.

*Status determination*

This stock is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

*Area apportionment*

In 2013, the Plan 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. The authors continue to recommend this approach and the Teams agreed. Last year, the SSC recommended a phased transition to this method. This year, the authors noted that the SSC procedure 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):

Region	2021			2022		2023	
	OFL <sub>w</sub>	ABC <sub>w</sub>	TAC	OFL <sub>w</sub>	ABC <sub>w</sub>	OFL <sub>w</sub>	ABC <sub>w</sub>
BS	--	3,396	3,396	--	5,264	--	6,529
AI	--	4,717	4,717	--	6,463	--	7,786
<b>BSAI</b>	--	<b>8,113</b>	<b>8,113</b>	--	<b>11,727</b>	--	<b>14,315</b>
<b>GOA<sup>1</sup></b>	-	<b>21,475</b>	<b>12,919</b>	--	<b>22,794</b>	--	<b>22,003</b>
<b>Alaska-wide</b>	<b>60,423</b>			<b>40,432</b>	<b>34,521</b>	<b>42,520</b>	<b>36,318</b>

<sup>1</sup>GOA information included to show total breakdown. For details please see the GOA SAFE Intro document.

**4. [Yellowfin sole](#)**

Status and catch specifications (t) of yellowfin sole 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.

Area	Year	Age 6+ Biomass	OFL	ABC	TAC	Catch
BSAI	2020	2,461,850	287,307	260,918	158,518	133,799
	2021	2,755,870	341,571	313,477	200,000	104,669
	2022	2,479,370	377,071	269,649	n/a	n/a
	2023	2,512,201	382,035	274,787	n/a	n/a

The Flatfish Flexibility Exchange program increased the TAC from 150,700 t to 158,518 t in 2020.

### *Changes from previous assessment*

Changes to the input data include:

1. The 2020 fishery age composition was added.
2. The estimate of the total catch made through the end of 2020 was updated as reported by the NMFS Alaska Regional office. The catch through the end of 2021 was estimated to be 108,086 t. Catch for the 2022 and 2023 projections were assumed to be equal to the mean of the past 5 years (126,929 t).
3. The 2021 NMFS survey biomass estimate and standard error were included.

The authors and Team recommend retaining the current base model (18.2) for use in setting 2022 and 2023 harvest specifications.

### *Spawning biomass and stock trends*

The projected female spawning biomass estimate for 2022 is 899,129 t, which is  $1.81 \times B_{MSY}$ . This is a 10% decrease from last year's 2022 estimate (996,044 t). A general slow decline in spawning biomass has prevailed for the most part since 1995.

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

The lead author presented the results from three assessment models. One is last year's model (18.2); one is the same as last year's model, except with VAST estimated survey biomass for the EBS (18.2a); and another with VAST estimated survey biomass for both the EBS and NBS (18.2b). The author recommended use of model 18.2 for this year's management and the Team concurred. The risk table indicated "substantially increased concerns" (level 2) for all but the fishery performance category (which was scored as level 1), and the Team concurred with the author's recommendation of reducing ABC to the average of the Tier 1 and Tier 3 maximum ABCs. This corresponds to a 24% reduction from the Tier 1a maximum ABC.

The SSC has determined that reliable estimates of  $B_{MSY}$  and the probability density function for  $F_{MSY}$  exist for this stock. The estimate of  $B_{MSY}$  from the present assessment is 495,904 t, and projected spawning biomass for 2022 is 899,126 t, meaning that yellowfin sole qualify for management under Tier 1a. Corresponding to the approach used in recent years, the 1978-2015 age-1 recruitments (and corresponding spawning biomass estimates) were used this year to determine the Tier 1 harvest recommendations. This provided a maximum permissible ABC harvest ratio (the harmonic mean of the  $F_{MSY}$  harvest ratio) of 0.143. The current value of the OFL harvest ratio (the arithmetic mean of the  $F_{MSY}$  ratio) is 0.152. The product of the maximum permissible ABC harvest ratio and the geometric mean of the 2022 biomass estimate produced the 2022 maximum ABC of 354,014 t. The authors and Team recommend reducing the 2022 ABC to 269,649 t. The corresponding product using the OFL harvest ratio produces the 2022 OFL of 377,071 t. For 2023, the corresponding quantities are a maximum ABC of 358,675 t, reduced to an ABC of 274,787 t, and an OFL of 382,035 t, respectively.

### *Status determination*

Yellowfin sole is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

## 5. Greenland turbot

Status and catch specifications (t) of Greenland turbot 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 6, 2021.

Area	Year	Age 1+ Biomass	OFL	ABC	TAC	Catch
BSAI	2020	106,101	11,319	9,625	5,300	2,326
	2021	87,849	8,568	7,326	6,025	1,586
	2022	84,341	7,687	6,572	n/a	n/a
	2023	80,404	6,698	5,724	n/a	n/a
Eastern Bering Sea	2020	n/a	n/a	8,403	5,125	1,648
	2021	n/a	n/a	6,175	5,125	1,129
	2022	n/a	n/a	5,540	n/a	n/a
	2023	n/a	n/a	4,825	n/a	n/a
Aleutian Islands	2020	n/a	n/a	1,222	175	678
	2021	n/a	n/a	1,150	900	457
	2022	n/a	n/a	1,032	n/a	n/a
	2023	n/a	n/a	899	n/a	n/a

### *Changes from previous assessment*

In accordance with the approved schedule, a partial assessment was conducted for Greenland Turbot this year. However, a full stock assessment will be conducted in 2022. The full assessment model was not rerun but instead a Tier 3 projection model was run to estimate the stock level in future years using updated 2020 catch, estimated 2021 catch, and assumed future catches. This incorporates the most current catch information without re-estimating model parameters and biological reference points. The Tier 3 projection operates outside the full assessment model by projecting estimates of future female spawning biomass, age 1+ total biomass, ABC, and OFL from the full model estimate of 2020 numbers-at-age and weight-at-age. Catch projections for 2021 in the previous assessment were assumed to be at ABC levels, whereas this year's partial assessment used actual 2021 catches, which were much lower than ABC. Please refer to last year's stock assessment for details regarding the rolled-over estimates.

### *Spawning biomass and stock trends*

The projected 2022 female spawning biomass is 50,361 t, which is a 7% increase from last year's 2022 projection of 47,197 t. This increase is due to using actual catches from 2021 in the partial assessment, rather than assuming catch to be equal to ABC in 2021, which is higher than actual catch. Exploitation rates are generally low (less than 5% since 2017) and catches are generally well below TACs (~55% of TAC between 2016 and 2020). Female spawning biomass is projected to decrease slightly to 47,376 t in 2023. The previous assessment (2020) indicated that the 2007-2009 recruitment classes appear to be fully integrated into the fishery, and overall the stock is continuing its downward trend from the last several years. The 2021 survey showed a 33% reduction in survey biomass from the 2019 survey.

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

The  $B_{40\%}$  value, using the mean recruitment estimated for the period 1978-2018 is 35,622 t. The projected 2022 female spawning biomass of 50,361 t is well above the estimate of  $B_{40\%}$ . Because the projected spawning biomass in year 2021 is above  $B_{40\%}$ , Greenland turbot ABC and OFL levels will be determined under Tier 3a of Amendment 56. The OFLs for 2022 and 2023 are 7,687 t and 6,698 t respectively, and the corresponding maximum permissible ABCs are 6,572 t and 5,724 t, respectively. Last year's assessment noted ecosystem-related concerns for future recruitment given recent warming in the Bering Sea and shrinking of the cold pool, but no reduction from maxABC was recommended. This year, the author again recommended setting ABC at the maximum permissible values for 2022 and 2023, and the Team approved this recommendation.

*Area apportionment*

The authors and Team recommend that apportionment of ABC between the EBS and the Aleutian Islands be based on the assumption that 15.7% of the biomass is in the Aleutian Islands. This is documented in the 2018 and 2020 assessments, and as in previous assessments, is based on unweighted averages of EBS slope and AI survey biomass estimates from the four most recent years in which both areas were surveyed. The Team’s recommended 2022 and 2023 ABCs in the EBS are 5,540 t and 4,825 t. The 2022 and 2023 ABCs for the AI are 1,032 t and 899 t. As in previous years, area apportionment of the OFL is not recommended.

*Status determination*

Greenland turbot is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

**6. Arrowtooth flounder**

Status and catch specifications (t) of arrowtooth flounder in recent years are below. 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.

Area	Year	Age 1+ Bio	OFL	ABC	TAC	Catch
BSAI	2020	934,008	84,057	71,618	10,000	10,681
	2021	923,646	90,873	77,349	15,000	8,286
	2022	921,690	94,445	80,389	n/a	n/a
	2023	914,915	97,944	83,389	n/a	n/a

*Changes from previous assessment*

In accordance with the approved schedule, this is an off-year for arrowtooth flounder and a partial assessment was conducted. A full stock assessment will be conducted in 2022. There were no changes in the assessment methodology. Changes in the input data include:

1. Updated 2020 catch estimate of 10,681 t.
2. Estimates of catch through October 30, 2021 of 8,698 t.
3. To estimate future catches, the “yield ratio” (the average of the catch/ABC ratio from 2016-2020) was updated to 0.13, which was then multiplied by the future ABCs.

*Spawning biomass and stock trends*

The projected age 1+ total biomass for 2022 is 921,690 t, which is roughly the same as the 921,074 t projected for 2022 in last year’s assessment. The projected female spawning biomass for 2022 is 509,672 t, which is a slight increase from last year’s 2022 estimate of 509,208 t. Overall stock trends remain fairly stable.

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

The SSC has determined that reliable estimates of  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$  exist for this stock. Arrowtooth flounder therefore qualifies for management under Tier 3. The point estimates of  $B_{40\%}$  and  $F_{40\%}$  from this year’s assessment are 223,530 t and 0.135. The projected 2022 spawning biomass is well above  $B_{40\%}$ , so ABC and OFL recommendations for 2022 were calculated under sub-tier “a” of Tier 3. The authors recommend setting  $F_{ABC}$  at the  $F_{40\%}$  level, which is the maximum permissible level under Tier 3a, resulting in 2022 and 2023 ABCs of 80,389 t and 83,389 t, respectively. Projected harvesting at  $F_{35\%}$  (0.160) gives 2022 and 2023 OFLs of 94,445 t and 97,944 t respectively.

*Status determination*

Arrowtooth flounder is a lightly exploited stock in the BSAI. Arrowtooth flounder is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

**7. Kamchatka flounder**

Status and catch specifications (t) of Kamchatka flounder in recent years are below. 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.

Area	Year	Age 2+ Biomass	OFL	ABC	TAC	Catch
BSAI	2020	145,368	11,495	9,708	6,800	7,442
	2021	144,671	10,630	8,982	8,982	6,561
	2022	143,983	10,903	9,214	n/a	n/a
	2023	142,762	11,115	9,393	n/a	n/a

*Changes from previous assessment*

In accordance with the approved schedule, this is an off-year for Kamchatka flounder and a partial assessment was conducted. A full stock assessment will be conducted in 2022. No changes were made to the assessment model methodology or inputs.

Changes to the *projection* data include:

1. The 2020 catch was reduced to 7,422 t from 7,427 t.
2. The 2021 catch input used in the projection model was set equal to 6,770 t. The 2021 catch was estimated by expanding the catch as of October 8th by a factor of 1.0493. This expansion factor represents the average proportion of catch after October 8th between 2016 and 2020.
3. The 2021 catch estimate was also used as the catch value for 2022 and 2023.

*Spawning biomass and stock trends*

The projected 2022 female spawning biomass is 55,701 t, above the  $B_{40\%}$  level of 40,550 t (which remained constant), and spawning biomass is projected to remain above  $B_{40\%}$  for the foreseeable future. Last year's assessment noted that the early shelf survey size composition data suggest that some significant recruitment events (assessed at age 2) occurred prior to 1991. Since 1991, the preferred assessment model (16.0b) estimates that the 2001, 2002, 2008, and 2014 year classes are all at least 80% above average. Female spawning biomass has been increasing since 2015.

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

This stock was managed under Tier 3 for the first time in 2014. As noted above, projected spawning biomass for 2022 is above  $B_{40\%}$ , placing Kamchatka flounder in sub-tier "a" of Tier 3. For the 2022 fishery, the authors and Team recommend setting 2022 ABC at the maximum permissible value of 9,214 t from the projection model. This value is an increase of 2.6% from the 2021 ABC currently specified (8,982 t). The recommended 2022 OFL is 10,903 t, also a 2.6% increase from the 10,630 t currently specified for 2021.

*Status Determination*

Kamchatka flounder is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

**8. Northern rock sole**

Status and catch specifications (t) of northern rock sole 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.



Area	Year	Age 6+ Biomass	OFL	ABC	TAC	Catch
BSAI	2020	1,068,000	157,300	153,300	47,100	25,937
	2021	923,197	145,180	140,306	54,500	13,898
	2022	1,361,360	214,084	206,896	n/a	n/a
	2023	1,784,460	280,621	271,199	n/a	n/a

### *Changes from previous assessment*

In accordance with the approved schedule, a partial assessment was conducted for northern rock sole this year. However, a full stock assessment will be conducted in 2022. The full assessment model was not rerun but instead a Tier 1a projection model was run to estimate the stock level in future years using updated 2021 catches and assumed future catches. Catch projections for 2021 in the previous assessment were assumed as a 10-year average of catch, whereas this year's partial assessment used actual 2021 catches which were ~2,000 t less than that projection. Please refer to last year's stock assessment for details regarding the rolled-over estimates.

### *Spawning biomass and stock trends*

As estimated in last year's assessment, spawning biomass was at a low in 2008, increased through the early 2010s, steadily decreased from 2015-2020, and models indicate a leveling off since then. Recruitment was maintained at near historic lows for several years straight in the mid 2010s. More recently a pulse of recruits has begun to show up in the surveys (see previous assessment). The stock assessment model projects a 2022 female spawning biomass of 287,600 t, similar to the previous 2022 female spawning biomass estimate of 286,381 t. The projected spawning biomass for 2023 is 320,399 t. Exploitation rates are relatively low and catches are typically well below TAC's.

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

The SSC has determined that northern rock sole qualifies for management under Tier 1. Spawning biomass for 2022 is projected to be well above the  $B_{MSY}$  estimate of 158,972, placing northern rock sole in sub-tier "a" of Tier 1. The Tier 1 2022 and 2023 ABC harvest recommendations are 206,896 t and 271,199 t, respectively ( $F_{ABC} = 0.152$ ). The 2022 and 2023 OFLs are 214,084 t and 280,621 t ( $F_{OFL} = 0.157$ ). Recommended ABCs correspond to the maximum permissible levels.

This is a stable fishery that lightly exploits the stock because it is constrained by PSC limits and the BSAI optimum yield cap. Usually the average catch/biomass ratio is about 3-4 percent.

### *Status determination*

Northern rock sole is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

## **9. Flathead sole**

Status and catch specifications (t) of flathead sole 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 11, 2021.

Area	Year	Age 3+Biomass	OFL	ABC	TAC	Catch
BSAI	2020	684,768	82,810	68,134	16,655	9,392
	2021	602,497	75,863	62,567	25,000	9,898
	2022	608,631	77,967	64,288	n/a	n/a
	2023	612,001	80,034	65,988	n/a	n/a

The Flatfish Flexibility Exchange Program decreased the TAC from 19,500 t to 16,655 t in 2020.

*Changes from previous assessment*

This assessment was changed to a biennial cycle beginning with the 2014 assessment; this is a partial assessment year. Changes to the input data in this analysis include updated catch information for 2020 and estimated catches for 2021 and 2022-2023. There were no changes to the assessment methodology.

*Spawning biomass and stock trends*

Spawning biomass is projected to increase slightly in 2022 and in 2023. Age 3+ biomass is also projected to have small increases in 2022 and 2023.

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

The SSC has determined that reliable estimates of  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$  exist for this stock, thereby qualifying flathead sole for management under Tier 3. The current values of these reference points are  $B_{40\%}=81,463$  t,  $F_{40\%}=0.37$ , and  $F_{35\%}=0.46$ . Because projected spawning biomass for 2022 (155,379 t) is above  $B_{40\%}$ , flathead sole is in Tier 3a. The authors and Team recommend setting ABCs for 2022 and 2023 at the maximum permissible values under Tier 3a, which are 64,288 t and 65,988 t, respectively. The 2022 and 2023 OFLs under Tier 3a are 77,967 t and 80,034 t, respectively.

*Status determination*

Flathead sole is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

**10. [Alaska plaice](#)**

Status and catch specifications (t) of Alaska plaice 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.

Area	Year	Age 3 + Biomass	OFL	ABC	TAC	Catch
BSAI	2020	428,800	37,600	31,600	17,000	20,078
	2021	427,587	37,924	31,657	24,500	15,653
	2022	442,946	39,305	32,697	n/a	n/a
	2023	454,030	39,685	32,998	n/a	n/a

*Changes from previous assessment*

In accordance with the approved schedule, a full assessment was conducted for Alaska plaice this year. Changes to the input data included updated catch data through 2020, estimated catch for 2021, projected catches for 2022-2023, 2021 EBS trawl survey biomass estimates and standard errors (no survey in 2020 due to COVID-19), 2019 survey ages (no otoliths collected in 2020 due to no survey), and 2019 and 2020 fishery length compositions. There were no changes to the assessment methodology.

*Spawning biomass and stock trends*

The survey biomass estimate for 2021 (333,830 t) was 9% lower than the 2019 estimate and is the lowest value in the survey time series. Similarly, model estimates of female spawning biomass (158,090 t in 2021) continued their decline since 2013. In contrast, model estimates of total biomass (455,187 t in 2021) show an increasing trend since 2019. These results are likely due to estimates of relatively strong recruitment since 2017, a pattern which began to emerge in the 2019 assessment. The Alaska plaice stock is projected to remain above the  $B_{35\%}$  level of female spawning biomass while declining over the next several years. Alaska plaice continue to be found in high abundance in the NBS and the 2021 NBS estimate (344,578 t) exceeded the EBS estimate for the first time.



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

Reliable estimates of  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$  exist for this stock, therefore qualifying it for management under Tier 3. The current estimates are  $B_{40\%} = 114,635$  t,  $F_{40\%} = 0.140$ , and  $F_{35\%} = 0.170$ . Given that the projected 2022 spawning biomass of 141,838 t exceeds  $B_{40\%}$ , the ABC and OFL recommendations for 2022 were calculated under sub-tier “a” of Tier 3. Projected harvesting at the  $F_{40\%}$  level gives a 2022 ABC of 32,697 t and a 2023 ABC of 32,998 t. The recommended Tier 3a OFLs are 39,305 t and 39,685 t for 2022 and 2023, respectively.

*Status determination*

Alaska plaice is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

**11. Other Flatfish Complex**

In accordance with the approved schedule, no assessment was conducted for the other flatfish complex this year. However, a full stock assessment will be conducted in 2024. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year’s stock assessment for details regarding the rolled over estimates. The grayed-out text following the table below summarizes the 2020 assessment.

Status and catch specifications (t) of other flatfish 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.

Area	Year	Total Biomass	OFL	ABC	TAC	Catch
BSAI	2020	113,450	21,824	16,368	4,000	4,174
	2021	146,679	22,919	17,189	6,500	2,510
	2022	146,679	22,919	17,189	n/a	n/a
	2023	146,679	22,919	17,189	n/a	n/a

*Changes from previous assessment*

This stock is managed on a four-year cycle and 2021 was an off year. Therefore there was no update to this assessment. The last full assessment was in 2020 and the next full assessment is scheduled for 2024.

*Spawning biomass and stock trends*

EBS shelf survey biomass estimates for this complex were all below 100,000 t from 1983-2003, and reached a high of 150,480 t in 2006. This is a not-targeted species complex and in 2019 approximately 23% of the ABC was caught. The random effects model estimates indicate that the other flatfish species group is at a high level relative to the time series average and is lightly exploited.

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

The SSC has classified other flatfish as a Tier 5 species complex with harvest recommendations calculated from estimates of biomass and natural mortality. Natural mortality rates for rex (0.17) and Dover sole (0.085) borrowed from the Gulf of Alaska are used, along with a value of 0.15 for all other species in the complex. The resultant 2022 OFL and ABC are 22,919 t and 17,189 t respectively.

*Status determination*

This assemblage is not being subjected to overfishing. It is not possible to determine whether this assemblage is overfished or whether it is approaching an overfished condition because it is managed under Tier 5.

## 12. Pacific ocean perch

Status and catch specifications (t) of Pacific ocean perch (POP) 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 Team. Catch data are current through November 6, 2021.

Area	Year	Age 3+ Bio	OFL	ABC	TAC	Catch
BSAI	2020	908,529	58,956	48,846	42,875	40,417
	2021	756,011	44,376	37,173	35,899	32,112
	2022	738,710	42,605	35,688	n/a	n/a
	2023	724,085	40,977	34,322	n/a	n/a
Eastern Bering Sea	2020			14,168	14,168	11,944
	2021			10,782	10,782	8,679
	2022			10,352	n/a	n/a
	2023			9,956	n/a	n/a
Eastern Aleutian Islands	2020			11,063	10,613	10,621
	2021			8,419	8,419	7,442
	2022			8,083	n/a	n/a
	2023			7,774	n/a	n/a
Central Aleutian Islands	2020			8,144	8,094	7,966
	2021			6,198	6,198	5,885
	2022			5,950	n/a	n/a
	2023			5,722	n/a	n/a
Western Aleutian Islands	2020			15,471	10,000	9,886
	2021			11,774	10,500	10,107
	2022			11,303	n/a	n/a
	2023			10,870	n/a	n/a

### *Changes from previous assessment*

In accordance with the approved schedule, a partial assessment was conducted for Pacific ocean perch this year. In a partial assessment year, the full assessment model is not rerun but instead a Tier 3 projection model with an assumed future catch is run to estimate the stock level in future years. This incorporates the most current catch information without re-estimating model parameters and biological reference points. Changes to the input data include updated 2020 catch and estimated 2021-2022 catches. There were no changes to the assessment methodology.

### *Spawning biomass and stock trends*

Spawning biomass is projected to be lower in 2022 than in 2021 and decline in 2023. Last year's assessment estimated that exploitation rates (i.e., catch/biomass) have averaged 0.030 from 2004-2021, which is below the exploitation rate associated with fishing at  $F_{40\%}$ . Exploitation rates from the BSAI subareas are similar to the overall BSAI exploitation rates, with the exception of low exploitation rates in the EBS area in the early 2000s and in recent years in the western Aleutians. The similarity in exploitation rates between areas is expected because BSAI POP are managed with subarea ABCs based on the spatial distribution of survey biomass.

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

The SSC has determined that reliable estimates of  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$  exist for this stock, thereby qualifying POP for management under Tier 3. The updated point estimates of  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$  are 233,899 t, 0.073, and 0.089, respectively. Given that the projected spawning biomass for 2022 (299,232 t) exceeds  $B_{40\%}$ , ABC and OFL recommendations for 2022 were calculated under the sub-tier "a" of Tier 3.

The maximum permissible value of  $F_{ABC}$  under Tier 3a is 0.073, which results in the author and Plan Team recommended 2022 ABC of 35,688 t and 2023 ABC of 34,322 t. The OFL fishing mortality rate is 0.089, which results in a 2022 OFL of 42,605 t and 2023 OFL of 40,977 t.

#### *Area apportionment*

The Team agreed with the author's recommendation that ABCs be set regionally based on the proportions of combined survey biomass as follows (values are for 2022): EBS = 10,352 t, Eastern Aleutians (Area 541) = 8,083 t, Central Aleutians (Area 542) = 5,950 t, and Western Aleutians (Area 543) = 11,303 t. The recommended OFLs for 2022 and 2023 are not regionally apportioned.

#### *Status determination*

This stock is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

### **13. Northern rockfish**

Status and catch specifications (t) of northern 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 Team. Catch data are current through September 25, 2021.

Area	Year	Age 3+ Biomass	OFL	ABC	TAC	Catch
BSAI	2020	256,262	19,751	16,243	10,000	8,443
	2021	244,600	18,917	15,557	13,000	5,721
	2022	279,584	23,420	19,217	n/a	n/a
	2023	275,210	22,594	18,538	n/a	n/a

#### *Changes from previous assessment*

This chapter was presented as a full assessment. Changes to the input data included the following:

- Updated catch data through 2020
- Projected 2021 catch estimates
- Fishery age data from 2019-2020

Constraints on the selectivity curves used in 2019 to ensure that selectivity at age 15 was close to 1.0 were loosened in this assessment to ensure that full selectivity was achieved at age 30. Failing to apply these constraints results in selectivity curves that fail to reach 1, implying higher biomass. Changing the constraint from age 15 to age 30 allowed more flexibility in the model and better aligns with current understanding of rockfish whereby they are thought to be fully selected after some relatively old age. Furthermore, the constraint at age 30 is close to the plus age group for other Alaska rockfish. The fit to the AI survey biomass was relatively similar in multiple exploratory models, but the model with a constraint on the logistic curve at age-30 produced a slight downward trend in abundance in recent years, which is consistent with the empirical survey biomass estimates. Some of the positive changes in biomass and associated harvest levels in this assessment are due to changes in selectivity curves.

#### *Spawning biomass and stock trends*

Overall, the stock abundance is high and the exploitation rates are low. The survey biomass estimates decreased by 10% from a peak in 2014, with decreases in all AI sub-areas and a large increase in the southern Bering Sea area. The survey biomass data show an increasing trend to a peak in 2014 and a decline since then. Estimated spawning and total biomass show a similar pattern, increasing until 2015 and 2014, respectively, and then decreasing through 2021. Spawning biomass is projected to increase to 121,126 t in 2022 and decline to 117,333 t in 2023. Spatial management of the stock is not consistent with the genetic spatial structure; however, stock abundance is high and exploitation rates are low. Catches have been increasing since 2013 but showed a drop in 2021.

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

Since reliable estimates of the 2022 spawning biomass ( $B$ ),  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$  exist and  $B > B_{40\%}$  (121,126 t > 68,707 t), northern rockfish is in Tier 3a. For this tier,  $F_{ABC}$  is defined as  $F_{40\%}$  and  $F_{OFL}$  is defined as  $F_{35\%}$ . The values of  $F_{40\%}$  and  $F_{35\%}$  are 0.069 and 0.085, respectively. The 2022 overfishing level is 23,420 t and the 2022 maximum permissible ABC is 19,217 t.

*Status determination*

This stock is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

**14. Blackspotted and rougheye rockfish**

Status and catch specifications (t) of blackspotted and rougheye rockfish complex in recent years. 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.

Area/subarea	Year	Total Biomass (t)	OFL	ABC	TAC	Catch
BSAI	2020	50,376	861	708	349	517
	2021	19,003	576	482	482	513
	2022	19,145	598	503	n/a	n/a
	2023	19,233	615	517	n/a	n/a
Western/ Central Aleutian Islands	2020			264	264	368
	2021			169	169	302
	2022			177	n/a	n/a
	2023			183	n/a	n/a
Eastern AI/ Eastern Bering Sea	2020			444	85	149
	2021			313	313	211
	2022			326	n/a	n/a
	2023			334	n/a	n/a

*Changes from previous assessment*

This assessment was changed to a biennial cycle beginning with the 2014 assessment; this is a partial assessment year. Changes to the input data include catch data being updated for 2020 and revisions to the 2021 and 2022 catch estimates. There were no changes to the assessment methodology.

*Spawning biomass and stock trends*

Spawning biomass for AI blackspotted and rougheye rockfish in 2022 is projected to be 3,468 t and is projected to increase slightly in 2023.

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

The stock assessment is separated into AI and EBS. For the AI, this stock qualifies for management under Tier 3 due to the availability of estimates for  $B_{40\%}$ ,  $F_{40\%}$ , and  $F_{35\%}$ . Because the projected female spawning biomass for 2022 of 3,468 t is less than  $B_{40\%}$  (3,524 t), the stock qualifies as Tier 3b but is projected to slightly exceed  $B_{40\%}$  in 2023 (3,568 t). For the EBS, this stock is managed under Tier 5 with a projected biomass for both 2022 and 2023 of 1,371 t.

The authors and Team recommend an overall 2022 ABC of 503 t and a 2022 OFL of 598 t. The apportionment of the 2022 ABC to subareas is 177 t for the Western and Central AI and 326 t for the Eastern AI and EBS

*Area apportionment*

Ongoing concerns about fishing pressure relative to biomass in the Western Aleutians have been noted by the Team. The maximum subarea species catch (MSSC) levels within the WAI/CAI, based on the random effects model, are as follow:

	<b>WAI</b>	<b>CAI</b>
2022 MSSCs	32	145
2023 MSSCs	33	150

*Status determination*

The BSAI blackspotted and rougheye stock complex is not being subjected to overfishing. For the AI region, the blackspotted and rougheye rockfish complex is not overfished, and is not approaching an overfished condition. It is not possible to determine whether the complex in the EBS region is overfished or whether it is approaching an overfished condition because it is managed under Tier 5.

**15. Shortraker rockfish**

In accordance with the approved schedule, no assessment was conducted for shortraker rockfish this year. However, a full stock assessment will be conducted in 2022. Until then, the values generated from the previous stock assessment (below) will be rolled over for 2021 specifications. Please refer to last year’s stock assessment for details regarding the rolled over estimates. The grayed-out text following the table below summarizes the 2020 assessment.

Status and catch specifications (t) of 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 2021 and 2022 are those recommended by the Plan Team. Catch data are current through November 6, 2021.

<b>Area</b>	<b>Year</b>	<b>Survey Biomass</b>	<b>OFL</b>	<b>ABC</b>	<b>TAC</b>	<b>Catch</b>
BSAI	2020	24,055	722	541	375	294
	2021	24,055	722	541	500	521
	2022	24,055	722	541	n/a	n/a
	2023	24,055	722	541	n/a	n/a

*Changes from previous assessment*

This assessment was changed to a biennial cycle beginning with the 2014 assessment; this is a full assessment year.

Changes to the input data:

1. The catch data have been revised and updated through October 25, 2020.
2. There were no survey updates this year for the Aleutian Islands (AI) trawl survey or the eastern Bering Sea slope survey.

No changes were made to the assessment model from the previous full assessment.

*Spawning biomass and stock trends*

Estimated shortraker rockfish biomass in the BSAI has been relatively stable since 2002. Increases in the 2018 AI survey biomass estimates occurred in the western and eastern AI with a decrease in the central AI. According to the random effects model, total biomass (AI and EBS slope combined) from 2002-2018 has been very stable. The time series from the random effects model is much smoother than the time series for the raw data, due to large standard errors associated with the survey biomass estimates. Exploitation rates have generally been well below the ABC levels in all areas, except for the western area, where exploitation rates exceeded the ABC levels from 2011-2013.

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

The SSC has previously determined that reliable estimates of only biomass and natural mortality exist for shorttraker rockfish, qualifying the species for management under Tier 5. The Team recommends basing the biomass estimate on the random effects model. The Team recommended setting  $F_{ABC}$  at the maximum permissible level under Tier 5, which is 75 percent of  $M$ . The accepted value of  $M$  for this stock is 0.03 for shorttraker rockfish, resulting in a  $maxF_{ABC}$  value of 0.0225. The ABC is 541 t for 2021 and 2022 and the OFL is 722 t for 2021 and 2022.

*Status determination*

Shorttraker rockfish is not being subjected to overfishing. It is not possible to determine whether this stock is overfished or whether it is approaching an overfished condition because it is managed under Tier 5.

**16. Other rockfish complex**

In accordance with the approved schedule, no assessment was conducted for the other rockfish complex 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 2021 specifications. Please refer to last year’s stock assessment for details regarding the rolled over estimates. The grayed-out text following the table below summarizes the 2020 assessment.

Status and catch specifications (t) of other 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 2021 and 2022 are those recommended by the Plan Team. Catch data are current through November 6, 2021.

<b>Area</b>	<b>Year</b>	<b>Survey Biomass</b>	<b>OFL</b>	<b>ABC</b>	<b>TAC</b>	<b>Catch</b>
BSAI	2020	53,290	1,793	1,345	1,088	996
	2021	53,248	1,751	1,313	916	900
	2022	53,248	1,751	1,313	n/a	n/a
	2023	53,248	1,751	1,313	n/a	n/a
Eastern Bering Sea	2020	n/a	n/a	956	700	293
	2021	n/a	n/a	919	522	332
	2022	n/a	n/a	919	n/a	n/a
	2023	n/a	n/a	919	n/a	n/a
Aleutian Islands	2020	n/a	n/a	388	388	703
	2021	n/a	n/a	394	394	568
	2022	n/a	n/a	394	n/a	n/a
	2023	n/a	n/a	394	n/a	n/a

*Changes from previous assessment*

A full stock assessment was conducted this year.

Changes to the input data:

1. Catch and fishery lengths updated through October 13, 2020.
2. The only new survey biomass for this assessment is a zero biomass observation for non-SST species in the 2019 Eastern Bering Sea (EBS) shelf survey. The 2020 AI and EBS shelf surveys were canceled due to Covid-19, and there has been no EBS slope survey since 2016.
3. Following guidance from the Resource Assessment and Conservation Engineering Division (RACE) division, survey biomass inputs to the random effects (RE) model were limited to: AI (1991-present), EBS shelf (1982-present), and EBS slope (2002-present).

There were no changes in the assessment methodology.

### *Spawning biomass and stock trends*

This is a Tier 5 complex, thus trends in spawning biomass are unknown. The random effects survey biomass estimates for shortspine thornyhead (SST) in the Aleutian Islands and EBS slope have been variable. The non-SST portion of the complex varies dramatically among surveys, although there was no survey this year. Biomass estimates are frequently zero or very small for the non-SST portion of the complex in both the eastern Bering Sea slope and shelf surveys.

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

The Team agrees with the approach recommended by the author of setting  $F_{ABC}$  at the maximum allowable under Tier 5 ( $F_{ABC} = 0.75M$ ). The accepted values of  $M$  for species in this complex are 0.03 for SST and 0.09 for all other species. Multiplying these rates by the best biomass estimates of shortspine thornyhead and the non-SST portion of the complex yields 2021 and 2022 ABCs of 919 t in the eastern Bering Sea and 394 t in the Aleutian Islands. The Team recommends that OFL be set for the entire BSAI area, which under Tier 5 is calculated by multiplying the best estimates of total biomass for the area by the separate natural mortality values and adding the results, yielding an OFL of 1,751 t for 2021 and 2022.

### *Status determination*

The “other rockfish” complex is not being subjected to overfishing. It is not possible to determine whether this complex is overfished or whether it is approaching an overfished condition because it is managed under Tier 5.

## **17. Atka mackerel**

Status and catch specifications (t) of Atka mackerel 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.

	<b>Area</b>	<b>Year</b>	<b>Age 1+ Biomass</b>	<b>OFL</b>	<b>ABC</b>	<b>TAC</b>	<b>Catch</b>
		2020	515,890	81,200	70,100	59,305	58,884
	BSAI	2021	560,360	85,580	73,590	62,257	58,571
		2022	554,490	91,870	78,510	n/a	n/a
		2023	570,080	84,440	71,990	n/a	n/a
		2020	n/a	n/a	24,535	24,535	22,926
	E Aleutian Islands/EBS	2021	n/a	n/a	25,760	25,760	22,598
		2022	n/a	n/a	27,260	n/a	n/a
		2023	n/a	n/a	25,000	n/a	n/a
		2020	n/a	n/a	14,721	14,721	14,596
	Central Aleutian Islands	2021	n/a	n/a	15,450	15,450	15,272
		2022	n/a	n/a	16,880	n/a	n/a
		2023	n/a	n/a	15,470	n/a	n/a
		2020	n/a	n/a	30,844	20,049	19,997
	Western Aleutian Islands	2021	n/a	n/a	32,380	21,047	20,701
		2022	n/a	n/a	34,370	n/a	n/a
		2023	n/a	n/a	31,520	n/a	n/a

### *Changes from previous assessment*

The following new data were included in this year’s assessment:



1. The 2020 catch estimate was updated and estimated total catch for 2021 was set equal to the TAC (62,257 t).
2. Estimated 2022 and 2023 catches are 66,740 t and 61,320 t, respectively.
3. The 2020 fishery age composition data were added.

There were no changes to the assessment methodology.

### *Spawning biomass and stock trends*

Spawning biomass in 2005 was at the highest level since 1982, after which it decreased almost continuously through 2020 with a slight uptick in 2021, but continued decline projected for 2022 and 2023 (the estimated spawning biomass in 2022 is projected to be roughly 40% of what it was in 2005). Total biomass follows a similar decreasing trend. The 1999-2001 year classes were all very strong, and the 2006, 2007, and 2012 year classes were 52%, 30%, and 59% above the post-1977 average. The projected female spawning biomass for 2022 (109,360 t) is projected to be below  $B_{40\%}$  (111,470 t), and the stock is projected to remain below  $B_{40\%}$  through 2027.

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

The projected female spawning biomass under the recommended harvest strategy is estimated to be below  $B_{40\%}$ , thereby placing BSAI Atka mackerel in Tier 3b. The projected 2022 yield (ABC) at  $F_{40\%adj} = 0.54$  is 78,510 t, up 7% from the 2021 ABC and up 15% from last year's projected ABC for 2022. The projected 2022 overfishing level at  $F_{35\%} = 0.65$  is 91,870 t, up 7% from the 2021 OFL and up 15% from last year's projected OFL for 2022.

A risk table was completed for this stock with Level 1 ratings for all four categories. No adjustment to maximum permissible ABC was proposed.

### *Area apportionment*

A four-survey weighted averaging method was used to apportion ABC among areas. The recommended ABC apportionments by subarea for 2022 are 27,260 t for Area 541 and the EBS region (a 5.8% increase from 2020), 16,880 t for Area 542 (a 9.3% increase from 2021), and 34,370 t for Area 543 (a 6.1% increase from 2020).

### *Status determination*

Atka mackerel is not being subjected to overfishing, is not overfished, and is not approaching an overfished condition.

## **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.

Area	Year	Age 0+ Biomass	OFL	ABC	TAC	Catch
BSAI	2020	611,761	49,792	41,543	16,313	19,128
	2021	611,865	49,297	41,257	20,000	18,729
	2022	597,042	47,790	39,958	n/a	n/a
	2023	583,927	46,475	38,824	n/a	n/a

For 2021, NMFS increased the TAC to 20,000 t with a reallocation of 2,000 t from the non-specified reserves.

### *Changes from previous assessment*

This assessment was changed to a biennial cycle beginning with the 2014 assessment; this is a partial assessment year.



The following new data were included in this year’s assessment:

1. Catch data have been updated through October 17, 2021. The 2020 catch data used in the projection model have been updated, and new estimates of 2021 and 2022 catches were created for use in the projection model.
2. Survey biomass estimates from the 2021 eastern Bering Sea (EBS) shelf bottom trawl survey were reported for informational purposes, but the assessment model was not re-run.

There were no changes to the assessment methodology. The projection model for harvest recommendations was re-run with updated catch data.

*Spawning biomass and stock trends*

Last year’s assessment estimated that recruitment of Alaska skate was above average for all but two cohorts spawned between 1995 and 2011, but has been below average for all cohorts spawned since 2012. Spawning biomass of Alaska skate increased continuously from 2006 (198,418 t) through 2020 (284,268 t), and in 2020 was at an all-time high for the post-1976 environmental regime. With lower recent recruitment, spawning biomass is expected to decrease in the future. The biomass of Other Skates on the EBS shelf is declining, but is still above the long-term mean.

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

Since 2011, the Alaska skate portions of the ABC and OFL have been specified under Tier 3, while the “other skates” portions have been specified under Tier 5.

Because projected spawning biomass for 2022 (121,575 t) exceeds  $B_{40\%}$  (71,370 t), Alaska skates are managed in sub-tier “a” of Tier 3. Other reference points are  $maxF_{ABC} = F_{40\%} = 0.079$  and  $F_{OFL} = F_{35\%} = 0.092$ . The Alaska skate portions of the 2022 and 2023 ABCs are 31,920 t and 30,786 t, respectively, and the Alaska skate portions of the 2022 and 2023 OFLs are 37,073 t and 35,758 t. The “other skates” component is assessed under Tier 5, based on a natural mortality rate of 0.10 and a biomass estimated using the random effects model. The “other skates” portion of the 2022 and 2023 ABCs is 8,038 t for both years and the “other skates” portion of the 2022 and 2023 OFLs is 10,717 t for both years.

For the skate complex as a whole, ABCs for 2022 and 2023 total 39,958 t and 38,824 t, respectively, and OFLs for 2022 and 2023 total 47,790 t and 46,475 t, respectively.

*Status determination*

Alaska skate, which may be viewed as an indicator stock for the complex, is not overfished and is not approaching an overfished condition. The skate complex is not being subjected to overfishing.

**19. Sharks**

In accordance with the approved schedule, no assessment was conducted for the shark stock complex this year. However, a full assessment will be conducted in 2022. Until then, the values generated from the previous stock assessment are rolled over for 2022 specifications. The grayed-out text following the table below summarizes the 2020 assessment.

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

Area	Year	Biomass	OFL	ABC	TAC	Catch
BSAI	2020	n/a	689	517	150	179
	2021	n/a	689	517	200	354
	2022	n/a	689	517	n/a	n/a
	2023	n/a	689	517	n/a	n/a

*Changes from previous assessment*

This assessment was changed to a biennial cycle beginning with the 2014 assessment; this is a full assessment.

Changes to the input data in this analysis include:

1. Total catch for BSAI sharks is updated for 2003–2020 (as of Oct 13, 2020).
2. International Pacific Halibut Commission (IPHC) longline survey relative population numbers (RPNs) are updated through 2019.
3. Biomass estimates have been updated for the Bering Sea shelf trawl survey through 2019 (no surveys were conducted in 2020).

There were no changes in the assessment methodology.

*Spawning biomass and stock trends*

The main shark species taken in the BSAI fisheries (mainly pollock and Pacific cod) are Pacific sleeper sharks and salmon sharks. Beginning around 2000, catch rates of sleeper sharks in both the IPHC longline survey and the bycatch fisheries declined steeply for several years, causing possible concern about depletion. In 2017, the IPHC RPN showed a slight increase, which was the first increase in a decade. All sleeper sharks taken in the survey and fisheries are likely juveniles, so it is impossible to know what effect those catches have on spawning stock biomass. Bycatch of salmon sharks has generally increased since 2010. Recent catch levels have been well below the ABC.

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

The SSC has placed sharks in Tier 6, where OFL and ABC are typically based on historical catches. The OFL is fixed at the maximum catch during 2003–2015 (689 t) and ABC at 75% of OFL, 517 t.

*Status determination*

The shark complex is not being subjected to overfishing. It is not possible to determine whether this species complex is overfished or whether it is approaching an overfished condition because it is managed under Tier 6.

**20. Octopus**

In accordance with the approved schedule, no assessment was conducted for the octopus stock complex this year. However, a full assessment will be conducted in 2022. Until then, the values generated from the previous stock assessment are rolled over for 2022 specifications. The grayed-out text following the table below summarizes the 2020 assessment.

Status and catch specifications (t) of the octopus complex in recent years. The octopus stock complex is made up of at least nine distinct species and is assessed on even years. Biomass for each year corresponds to the projection given in the SAFE report issued in the preceding year. The OFL and ABC for 2021 and 2022 are those recommended by the Team. Catch data are current through November 7, 2020.

Area	Year	Biomass	OFL	ABC	TAC	Catch
BSAI	2020	n/a	4,769	3,576	275	691
	2021	n/a	4,769	3,576	700	161
	2022	n/a	4,769	3,576	n/a	n/a
	2023	n/a	4,769	3,576	n/a	n/a

*Changes from previous assessment*

The following new data were included in this year’s assessment:

1. Updated 2019 and preliminary 2020 incidental catch
2. Biomass estimates from the 2019 EBS shelf survey have been added. No relevant surveys were conducted during 2020.

Since the 2015 assessment, no changes have been made in the methodology for assessing octopus based on consumption of octopus by Pacific cod. The consumption estimate using Pacific cod predation of octopus as an estimator of biomass lost due to natural mortality first was accepted in 2011. New Pacific cod stomach data through 2015 were added previously. Increases in both Pacific cod and percentage of octopus in Pacific cod diet increased the annual consumption estimates from 2009-2015.

#### *Spawning biomass and stock trends*

Species composition and size frequencies from the surveys were similar to previous years. Survey biomass estimates increased in 2019 for the EBS shelf survey when compared to 2018 estimates and the 2018 estimate decreased in the AI survey when compared to the 2016 estimate.

On the EBS shelf and in the commercial catch, giant Pacific octopus is the most abundant of at least nine octopus species found in the BSAI. Octopuses are commonly caught in pot and trawl fisheries, especially in the Pacific cod pot fishery. Trawl surveys sample octopus poorly, and biomass estimates from trawl surveys are not considered reliable.

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

The ABC and OFL values were determined under Tier 6. Usually, Tier 6 specifications are based on average catch, but starting in 2011, the assessment authors recommended setting harvest specifications using an alternative mortality estimate based on species composition of Bering Sea Pacific cod diet from 1984-2008 survey data and weight-at-age data. This method was also recommended for 2017 and 2018 with additional years from 1984-2015 of Pacific cod diet data based on the requested five-year review of Pacific cod diet estimates. Data availability has not changed from the 2016 assessment, so harvest recommendations are the same as in 2016. The recommended ABCs and OFLs for 2020 and 2021 are 3,576 t and 4,769 t, respectively.

A risk table was completed for this stock with Level 1 ratings for all four categories and no adjustment to maxABC was proposed.

#### *Status determination*

The octopus complex is not being subjected to overfishing. It is not possible to determine whether the octopus complex is overfished or whether it is approaching an overfished condition because it is managed under Tier 6.

## **Appendix 1. Forage Fish**

A report on the status of forage species in the Bering Sea and Aleutian Islands is prepared on a biennial basis. While not a formal stock assessment, forage populations are analyzed if data are available. Species in the forage fish category have been identified as having ecological importance as prey, and directed fishing is prohibited for the group. As of 2011, the forage fish category in the BSAI Groundfish FMP is managed within the “ecosystem component” of the FMP which now also includes squid and sculpins.

The two main objectives of the report are to investigate trends in the abundance and distribution of forage populations and describe interactions between federal fisheries and species that make up the forage base (i.e., to monitor potential impacts of bycatch).

Primary findings in this report are the following:

- 1) Capelin, eulachon, and other FMP forage species have decreased greatly in abundance since 2015. This general pattern occurs in the EBS and NBS.
- 2) Herring abundance is relatively high in the eastern Bering Sea shelf bottom trawl survey.
- 3) Surface-trawl indices in the NBS indicate an overall reduction in the availability of forage fishes.

4) Incidental catches of FMP forage species continue to be very low by historical standards. The preliminary 2019 catch is 24 t, and as is typical is dominated by osmerids, especially eulachon.

5) The reclassification of squids as Ecosystem Components, for which catch limits are not required, has resulted in substantially increased squid catches in the EBS during 2019-2021. These catches are now similar in scale to catch levels during the 1970s and 1980s.

6) Prohibited Species catch (PSC) of Pacific herring exceeded the limit, an event discussed in the 2020 ESR; the herring bycatch in 2021 is high relative to previous years but is below the limit.

## Tables

Table 1. BSAI Groundfish Plan Team Recommended OFLs and ABCs for 2022 and 2023 (metric tons); OFL, ABC, TAC and catch through November 6, 2021.

Species	Area	2021		TAC	Catch as of 11/6/2021	Plan Team Final 2022		Plan Team Final 2023	
		OFL	ABC			OFL	ABC	OFL	ABC
Pollock	EBS	2,594,000	1,626,000	1,375,000	1,373,712	1,469,000	1,111,000	1,704,000	1,289,000
	AI	61,856	51,241	19,000	1,635	61,264	50,752	61,379	50,825
	Bogoslof	113,479	85,109	250	50	113,479	85,109	113,479	85,109
Pacific cod	BS	147,949	123,805	111,380	105,537	183,012	153,383	180,909	151,709
	AI	27,400	20,600	13,796	7,023	27,400	20,600	27,400	20,600
	BSAI/GOA	60,426	29,558			40,432	34,521	42,520	36,318
Sablefish	BS	n/a	3,396	3,396	3,961		5,264		6,529
	AI	n/a	4,717	4,717	1,425		6,463		7,786
Yellowfin sole	BSAI	341,571	313,477	200,000	104,669	377,071	269,649	382,035	274,787
Greenland turbot	BSAI	8,568	7,326	6,025	1,586	7,687	6,572	6,698	5,724
	BS	n/a	6,176	5,125	1,129		5,540		4,825
	AI	n/a	1,150	900	457		1,032		899
Arrowtooth flounder	BSAI	90,873	77,349	15,000	8,286	94,445	80,389	97,944	83,389
Kamchatka flounder	BSAI	10,630	8,982	8,982	6,561	10,903	9,214	11,115	9,393
Northern rock sole	BSAI	145,180	140,306	54,500	13,898	214,084	206,896	280,621	271,199
Flathead sole	BSAI	75,863	62,567	25,000	9,898	77,967	64,288	80,034	65,988
Alaska plaice	BSAI	37,924	31,657	24,500	15,653	39,305	32,697	39,685	32,998
Other flatfish	BSAI	22,919	17,189	6,500	2,510	22,919	17,189	22,919	17,189
Pacific Ocean perch	BSAI	44,376	37,173	35,899	32,112	42,605	35,688	40,977	34,322
	BS	n/a	10,782	10,782	8,679		10,352		9,956
	EAI	n/a	8,419	8,419	7,442		8,083		7,774
	CAI	n/a	6,198	6,198	5,885		5,950		5,722
	WAI	n/a	11,774	10,500	10,107		11,303		10,870
Northern rockfish	BSAI	18,917	15,557	13,000	6,045	23,420	19,217	22,594	18,538
Blackspotted/Rougheye Rockfish	BSAI	576	482	482	513	598	503	615	517
	EBS/EAI	n/a	313	313	211		326		334
	CAI/WAI	n/a	169	169	302		177		183
Shortraker rockfish	BSAI	722	541	500	521	722	541	722	541
Other rockfish	BSAI	1,751	1,313	916	900	1,751	1,313	1,751	1,313
	BS	n/a	919	522	332	n/a	919	n/a	919
	AI	n/a	394	394	568	n/a	394	n/a	394
Atka mackerel	BSAI	85,580	73,590	62,257	58,571	91,870	78,510	84,440	71,990
	EAI/BS	n/a	25,760	25,760	22,598		27,260		25,000
	CAI	n/a	15,450	15,450	15,272		16,880		15,470
	WAI	n/a	32,380	21,047	20,701		34,370		31,520
Skates	BSAI	49,297	41,257	18,000	18,729	47,790	39,958	46,475	38,824
Sharks	BSAI	689	517	200	354	689	517	689	517
Octopuses	BSAI	4,769	3,576	700	161	4,769	3,576	4,769	3,576
<b>Total</b>	BSAI	<b>3,945,315</b>	<b>2,747,727</b>	<b>2,000,000</b>	<b>1,774,309</b>	<b>2,953,182</b>	<b>2,322,082</b>	<b>3,253,770</b>	<b>2,564,366</b>

Sources: 2020 OFLs, ABCs, and TACs and 2021 OFLs and ABCs are from harvest specifications adopted by the Council in December 2019 and December 2020, respectively; 2020 catches through December 31, and 2021 catches through November 6, 2021 from AKR Catch Accounting.

Table 2. Summary of groundfish tier designations under Amendment 56, maximum permissible ABC fishing mortality rate ( $\max F_{ABC}$ ), the Plan Team’s recommended tier designation, ABC fishing mortality rate ( $F_{ABC}$ ), the maximum permissible value of ABC ( $\max ABC$ ), the Plan Team’s recommended ABC, and the percentage reduction (% Red.) between  $\max ABC$  and the Plan Team’s recommended ABC for 2022-2023. Stock-specific  $\max ABC$  and ABC are in metric tons, reported to three significant digits (four significant digits are used EBS pollock and when a stock-specific ABC is apportioned among areas on a percentage basis). Fishing mortality rates are reported to two significant digits.

Species or Complex	Area	2022					
		Tier	$\max F_{ABC}$	$F_{ABC}$	$\max ABC$	ABC	% Red.
Pollock	EBS	1b	0.392	0.296	1,251,000	1,111,000	11%
Yellowfin sole	BSAI	1a	0.152	0.13	354,014	269,649	24%
		2023					
		Tier	$\max F_{ABC}$	$F_{ABC}$	$\max ABC$	ABC	% Red.
Pollock	EBS	1b	0.392	0.314	1,451,000	1,289,000	11%
Yellowfin sole	BSAI	1a	0.152	0.13	358,675	274,787	23%

Table 3. Summary of stock abundance (biomass), overfishing level (OFL), acceptable biological catch (ABC), the fishing mortality rate corresponding to ABC ( $F_{ABC}$ ), and the fishing mortality rate corresponding to OFL ( $F_{OFL}$ ) for the eastern Bering Sea (EBS), Aleutian Islands (AI), and Bogoslof district as projected for 2022 and 2023. “Biomass” corresponds to projected January abundance for the age+ range reported in the summary. Stock-specific biomass, OFL, and ABC are in metric tons.

Species or Complex	Tier	Area	2022					2023			
			Biomass	OFL	ABC	$F_{OFL}$	$F_{ABC}$	OFL	ABC	$F_{OFL}$	$F_{ABC}$
Pollock	1b	EBS	6,969,000	1,469,000	1,111,000	0.392	0.296	1,704,000	1,289,000	0.415	0.314
	3a	AI	308,525	61,264	50,752	0.390	0.313	61,379	50,825	0.390	0.313
	5	Bogoslof	378,262	113,479	85,109	0.300	0.225	113,479	85,109	0.300	0.225
Pacific cod	3b	BS	879,978	183,012	153,383	0.38	0.31	180,909	151,709	0.37	0.31
	5	AI	80,700	27,400	20,600	0.34	0.255	27,400	20,600	0.34	0.255
Sablefish	3a	BS	168,000	40,432*	5,264	0.094	0.080	42,520*	6,529	0.094	0.080
	3a	AI	121,200		6,463				7,786		
Yellowfin sole	1a	BSAI	2,479,370	377,071	269,649	0.152	0.13	382,035	274,787	0.152	0.13
Greenland turbot	3a	BSAI	84,341	7,687	6,572	0.22	0.18	6,698	5,724	0.22	0.18
Arrowtooth flounder	3a	BSAI	921,690	94,445	80,389	0.160	0.135	97,944	83,389	0.160	0.135
Kamchatka flounder	3a	BSAI	143,983	10,903	9,214	0.108	0.090	11,115	9,393	0.108	0.090
Northern rock sole	1a	BSAI	1,361,360	214,084	206,896	0.157	0.152	280,621	271,199	0.157	0.152
Flathead sole	3a	BSAI	608,631	77,967	64,288	0.46	0.37	80,034	65,988	0.46	0.37
Alaska plaice	3a	BSAI	442,946	39,305	32,697	0.17	0.14	39,685	32,998	0.17	0.14
Other flatfish	5	BSAI	146,679	22,919	17,189	0.17 / 0.085 / 0.15	0.128 / 0.064 / 0.113	22,919	17,189	0.17 / 0.085 / 0.15	0.128 / 0.064 / 0.113
Pacific ocean perch	3a	BSAI	738,710	42,605	35,688	0.089	0.073	40,977	34,322	0.089	0.073
Northern rockfish	3a	BSAI	279,584	23,420	19,217	0.085	0.069	22,594	18,538	0.085	0.069
Blackspotted/Rougheye	3b/5	BSAI	19,145	598	503	0.039 / 0.049	0.033 / 0.037	615	517	0.039 / 0.049	0.033 / 0.037
Shortraker rockfish	5	BSAI	24,055	722	541	0.03	0.0225	722	541	0.03	0.0225
Other rockfish	5	BSAI	53,248	1,751	1,313	0.03 / 0.09	0.0225 / 0.0675	1,751	1,313	0.03 / 0.09	0.0225 / 0.0675
Atka mackerel	3b	BSAI	554,490	91,870	78,510	0.65	0.54	84,440	71,990	0.61	0.51
Skate	3a/5	BSAI	597,042	47,790	39,958	0.092 / 0.100	0.079 / 0.075	46,475	38,824	0.092 / 0.100	0.079 / 0.075
Shark	6	BSAI	n/a	689	517	n/a	n/a	689	517	n/a	n/a
Octopus	6	BSAI	n/a	4,769	3,576	n/a	n/a	4,769	3,576	n/a	n/a
<b>Total</b>		<b>BSAI</b>	<b>19,354,358</b>	<b>2,912,750</b>	<b>2,299,288</b>			<b>3,211,250</b>	<b>2,542,363</b>		

\*Sablefish OFL is specified BSAI/GOA

Table 4. Groundfish catches (metric tons) in the eastern Bering Sea, 1954-2021.

Year	Pollock	Pacific Cod	Sablefish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Kamchatka Flounder/b	Rock Sole	Flathead Sole	Alaska Plaice	Other Flatfish/c
1954				12,562							
1955				14,690							
1956				24,697							
1957				24,145							
1958	6,924	171	6	44,153							
1959	32,793	2,864	289	185,321							
1960			1,861	456,103	36,843						
1961			15,627	553,742	57,348						
1962			25,989	420,703	58,226						
1963			13,706	85,810	31,565						35,643
1964	174,792	13,408	3,545	111,177	33,729						30,604
1965	230,551	14,719	4,838	53,810	9,747						11,686
1966	261,678	18,200	9,505	102,353	13,042						24,864
1967	550,362	32,064	11,698	162,228	23,869						32,109
1968	702,181	57,902	4,374	84,189	35,232						29,647
1969	862,789	50,351	16,009	167,134	36,029						34,749
1970	1,256,565	70,094	11,737	133,079	19,691	12,598					64,690
1971	1,743,763	43,054	15,106	160,399	40,464	18,792					92,452
1972	1,874,534	42,905	12,758	47,856	64,510	13,123					76,813
1973	1,758,919	53,386	5,957	78,240	55,280	9,217					43,919
1974	1,588,390	62,462	4,258	42,235	69,654	21,473					37,357
1975	1,356,736	51,551	2,766	64,690	64,819	20,832					20,393
1976	1,177,822	50,481	2,923	56,221	60,523	17,806					21,746
1977	978,370	33,335	2,718	58,373	27,708	9,454					14,393
1978	979,431	42,543	1,192	138,433	37,423	8,358					21,040
1979	913,881	33,761	1,376	99,017	34,998	7,921					19,724
1980	958,279	45,861	2,206	87,391	48,856	13,761					20,406
1981	973,505	51,996	2,604	97,301	52,921	13,473					23,428
1982	955,964	55,040	3,184	95,712	45,805	9,103					23,809
1983	982,363	83,212	2,695	108,385	43,443	10,216					30,454
1984	1,098,783	110,944	2,329	159,526	21,317	7,980					44,286
1985	1,179,759	132,736	2,348	227,107	14,698	7,288					71,179
1986	1,188,449	130,555	3,518	208,597	7,710	6,761					76,328
1987	1,237,597	144,539	4,178	181,429	6,533	4,380					50,372
1988	1,228,000	192,726	3,193	223,156	6,064	5,477					137,418
1989	1,230,000	164,800	1,252	153,165	4,061	3,024					63,452
1990	1,353,000	162,927	2,329	80,584	7,267	2,773					22,568
1991	1,268,360	165,444	1,128	94,755	3,704	12,748		46,681			30,401
1992	1,384,376	163,240	558	146,942	1,875	11,080		51,720			34,757
1993	1,301,574	133,156	669	105,809	6,330	7,950		63,942			28,812
1994	1,362,694	174,151	699	144,544	7,211	13,043		60,276			29,720
1995	1,264,578	228,496	929	124,746	5,855	8,282		54,672	14,699		20,165
1996	1,189,296	209,201	629	129,509	4,699	13,280		46,775	17,334		18,529
1997	1,115,268	209,475	547	166,681	6,589	8,580		67,249	20,656		22,957
1998	1,101,428	160,681	586	101,310	8,303	14,985		33,221	24,550		15,355
1999	988,703	146,738	678	69,275	5,401	10,585		40,505	18,534		15,515
2000	1,132,736	151,372	742	84,057	5,888	12,071		49,186	20,342		16,453
2001	1,387,452	142,452	863	63,563	4,252	12,836		28,949	17,757		9,930
2002	1,481,815	166,552	1,143	74,956	3,150	10,821		40,700	15,464		2,588
2003	1,492,039	174,687	1,039	81,050	2,565	13,667		36,375	14,132	10,118	2,922
2004	1,480,552	183,745	1,041	75,502	1,825	17,367		47,862	17,361	7,888	4,755
2005	1,483,022	182,936	1,070	94,383	2,140	13,409		36,814	16,074	11,194	4,566
2006	1,488,031	168,814	1,079	99,156	1,453	11,966		35,878	17,942	17,318	3,123
2007	1,354,502	140,129	1,182	120,962	1,481	11,082		36,364	18,929	19,522	5,699
2008	990,587	139,802	1,141	148,893	2,089	18,897		50,934	24,521	17,377	3,578
2009	810,857	147,174	916	107,512	2,252	19,212		48,145	19,535	13,944	2,133
2010	810,390	142,868	755	118,624	2,273	14,782		52,644	20,097	16,165	2,158
2011	1,199,216	209,222	705	151,166	3,136	16,864	4,478	60,353	13,546	23,655	3,121
2012	1,205,276	232,674	743	147,186	3,058	18,978	2,510	75,777	11,355	16,612	3,501
2013	1,270,823	236,700	634	164,944	1,449	14,056	2,110	59,590	17,344	23,522	1,501
2014	1,297,846	238,735	315	156,772	1,479	14,928	3,268	51,569	16,505	19,447	4,340
2015	1,322,312	232,832	210	126,937	2,090	10,330	3,386	45,347	11,293	14,614	2,386
2016	1,353,711	231,511	532	135,350	2,117	9,777	3,165	44,860	10,358	13,385	2,827
2017	1,356,445	196,761	1,150	125,620	2,691	5,680	3,166	34,877	8,859	15,549	4,089
2018	1,379,320	186,702	1,598	131,539	1,672	6,182	1,373	28,059	11,045	23,342	5,945
2019	1,409,235	164,092	3,157	128,046	2,678	9,410	2,940	25,403	15,831	16,163	3,716
2020	1,367,232	155,584	5,301	133,788	1,648	8,406	2,929	25,810	9,368	20,075	4,098
2021/f	1,374,009	118,084	3,982	105,163	1,129	6,506	2,299	13,807	9,903	15,660	2,477

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69. Note: Numbers don't include fish taken for research.

b/ Kamchatka flounder included in Arrowtooth flounder prior to 2011. c/ Rock sole prior to 1991 and flathead sole prior to 1995 are included in other flatfish catch statistics. d/ Includes POP, northern, rougheye, shortraker, and sharpchin rockfish until 2004. e/ Octopus, sculpin, sharks, skates included in Other species prior to 2011. Squid moved in 2019 and sculpin moved in 2020 to Ecosystem Component. f/ Data through November 7, 2020.



Table 4 (continued). Groundfish catches (metric tons) in the eastern Bering Sea, 1954-2021.

Year	POP Complex/d	POP	N. Rockfish	RE Rockfish	BS/SR Rockfish	Other Rockfish	Atka Mack.	Other Species/e	Skate	Sculpin	Shark	Squid	Octo	Total
1954														12,562
1955														14,690
1956														24,697
1957														24,145
1958								147						51,401
1959								380						221,647
1960	6,100													500,907
1961	47,000													673,717
1962	19,900													524,818
1963	24,500													191,224
1964	25,900							736						393,891
1965	16,800							2,218						344,369
1966	20,200							2,239						452,081
1967	19,600							4,378						836,308
1968	31,500							22,058						967,083
1969	14,500							10,459						1,192,020
1970	9,900							15,295						1,593,649
1971	9,800							13,496						2,137,326
1972	5,700							10,893						2,149,092
1973	3,700							55,826						2,064,444
1974	14,000							60,263						1,900,092
1975	8,600							54,845						1,645,232
1976	14,900							26,143						1,428,565
1977	2,654					311		35,902				4,926		1,168,144
1978	2,221					2,614	831	61,537				6,886		1,302,509
1979	1,723					2,108	1,985	38,767				4,286		1,159,547
1980	1,097					459	4,955	34,633				4,040		1,221,944
1981	1,222					356	3,027	35,651				4,182		1,259,666
1982	224					276	328	18,200				3,838		1,211,483
1983	221					220	141	15,465				3,470		1,280,285
1984	1,569					176	57	8,508				2,824		1,458,299
1985	784					92	4	11,503				1,611		1,649,109
1986	560					102	12	10,471				848		1,633,911
1987	930					474	12	8,569				108		1,639,121
1988	1,047					341	428	12,206				414		1,810,470
1989	2,017					192	3,126	4,993				300		1,630,382
1990	5,639					384	480	5,698				460		1,644,109
1991	4,744					396	2,265	16,285				544		1,647,455
1992	3,309					675	2,610	29,993				819		1,831,954
1993	3,763					190	201	21,413				597		1,674,406
1994	1,907					261	190	23,430				502		1,818,628
1995	1,210					629	340	20,928				364		1,745,893
1996	2,635					364	780	19,717				1,080		1,653,828
1997	1,060					161	171	20,997				1,438		1,641,829
1998	1,134					203	901	23,156				891		1,486,704
1999	654					141	2,267	18,916				392		1,318,304
2000	704					239	239	23,098				375		1,497,502
2001	1,148					296	264	23,148				1,761		1,694,671
2002	858					401	572	26,639				1,334		1,826,993
2003	1,391					336	6,362	26,986				1,246		1,864,915
2004		731	116	24	119	318	7,159	27,588				1,000		1,874,953
2005		879	112	12	108	178	3,540	28,066				1,170		1,879,673
2006		1,041	246	7	47	157	3,176	25,077				1,403		1,875,914
2007		870	70	10	114	220	3,005	24,746				1,175		1,740,061
2008		513	22	22	41	222	392	27,152				1,494		1,427,678
2009		623	48	13	69	208	244	25,369				269		1,198,523
2010		3,547	299	30	161	268	151	20,697				305		1,206,215
2011		5,601	196	36	106	328	1,217		22,422	4,872	103	237	576	1,721,158
2012		5,589	91	17	117	211	966		23,740	4,991	94	560	126	1,754,172
2013		5,051	137	26	104	191	147		25,972	5,222	99	158	185	1,829,966
2014		7,437	147	23	96	323	136		26,326	4,487	134	1,568	410	1,846,290
2015		7,918	199	31	75	185	267		26,871	4,055	103	2,281	423	1,814,145
2016		8,221	208	41	51	280	360		27,952	4,381	117	1,328	585	1,851,117
2017		8,904	218	32	89	252	255		27,002	4,152	174	2,057	187	1,798,209
2018		9,635	188	15	170	212	1,146		29,475	4,397	96	1,701	132	1,823,944
2019		14,022	478	55	298	697	1,128		18,867	4,816	148	0	175	1,821,355
2020		11,944	307	53	186	352	1,064		17,613	4,355	168		457	1,770,739
2021/f		8,901	232	124	402	333	974		17,659		343		119	1,682,106

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69. Note: Numbers don't include fish taken for research.

b/ Kamchatka flounder included in Arrowtooth flounder prior to 2011. c/ Rock sole prior to 1991 and flathead sole prior to 1995 are included in other flatfish catch statistics. d/ Includes POP, northern, rougheye, shorttraker, and sharpchin rockfish until 2004. e/ Octopus, sculpin, sharks, skates included in Other species prior to 2011. Squid moved in 2019 and sculpin moved in 2020 to Ecosystem Component. f/ Data through November 6 2021.

Table 5. Groundfish catches (metric tons) in the Aleutian Islands, 1954-2021.

Year	Pollock	Pacific Cod	Sable fish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Kamchatka Flounder/b	Rock Sole	Flathead Sole	Alaska Plaice	Other Flat/c
1954											
1955											
1956											
1957											
1958											
1959											
1960											
1961											
1962											
1963			664		7						
1964		241	1,541		504						
1965		451	1,249		300						
1966		154	1,341		63						
1967		293	1,652		394						
1968		289	1,673		213						
1969		220	1,673		228						
1970		283	1,248		285	274					
1971		2,078	2,936		1,750	581					
1972		435	3,531		12,874	1,323					
1973		977	2,902		8,666	3,705					
1974		1,379	2,477		8,788	3,195					
1975		2,838	1,747		2,970	784					
1976		4,190	1,659		2,067	1,370					
1977	7,625	3,262	1,897		2,453	2,035					
1978	6,282	3,295	821		4,766	1,782					
1979	9,504	5,593	782		6,411	6,436					
1980	58,156	5,788	274		3,697	4,603					
1981	55,516	10,462	533		4,400	3,640					
1982	57,978	1,526	955		6,317	2,415					
1983	59,026	9,955	673		4,115	3,753					
1984	81,834	22,216	999		1,803	1,472					
1985	58,730	12,690	1,448		33	87					
1986	46,641	10,332	3,028		2,154	142					
1987	28,720	13,207	3,834		3,066	159					
1988	43,000	5,165	3,415		1,044	406					
1989	156,000	4,118	3,248		4,761	198					
1990	73,000	8,081	2,116		2,353	1,459					
1991	78,104	6,714	2,071	1,380	3,174	938					88
1992	54,036	42,889	1,546	4	895	900		236			68
1993	57,184	34,234	2,078	0	2,138	1,348		318			59
1994	58,708	22,421	1,771	0	3,168	1,334		308			55
1995	64,925	16,534	1,119	6	2,338	1,001		356	16		31
1996	28,933	31,389	720	654	1,677	1,330		371	10		51
1997	26,872	25,166	779	234	1,077	1,071		271	32		7
1998	23,821	34,964	595	5	821	694		446	19		35
1999	981	28,117	671	13	460	774		580	34		20
2000	1,244	39,684	1,070	13	1,086	1,157		480	80		32
2001	824	34,207	1,074	15	1,060	1,220		526	54		43
2002	1,177	30,801	1,118	29	485	1,032		1,165	111		39
2003	1,653	32,459	1,009	0	965	913		964	49		32
2004	1,158	28,873	955	9	434	818		818	38	0	33
2005	1,621	22,699	1,481	2	468	834		549	34	0	26
2006	1,745	24,211	1,151	4	537	1,476		578	39	0	36
2007	2,519	34,356	1,168	2	523	834		762	29	0	25
2008	1,278	31,229	899	0	822	2,473		342	18	0	46
2009	1,662	28,582	1,100	1	2,263	10,688		570	23	0	45
2010	1,235	29,001	1,097	0	1,873	24,098		577	29		41
2011	1,208	10,858	1,024	1	532	3,269	5,493	279	7		56
2012	975	18,220	1,205	1	1,658	3,400	6,995	322	12	0	42
2013	2,964	13,607	1,062	0	296	6,485	5,656	210	10	0	35
2014	2,375	10,595	818	0	177	4,181	3,190	155	9	0	51
2015	915	9,225	430	0	114	937	1,608	120	14	0	29
2016	1,257	12,359	349	0	121	1,328	1,685	241	26	0	21
2017	1,492	12,286	588	1	122	509	1,296	246	19	0	32
2018	1,860	14,719	660	4	161	820	1,735	216	17	0	39
2019	1,663	12,941	663	5	171	642	1,547	318	27	0	49
2020	3,205	#####	1,210	11	678	2,278	4,513	127	23	3	77
2021/f	1,638	#####	1,428	54	457	1,819	4,263	94	14	0	40

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69. Note: Numbers don't include fish taken for research.

b/ Kamchatka flounder included in Arrowtooth flounder prior to 2011. c/ Rock sole prior to 1991 and flathead sole prior to 1995 are included in other flatfish catch statistics. d/ Includes POP, northern, rougheye, shortraker, and sharpchin rockfish until 2004. e/ Octopus, sculpin, sharks, skates included in Other species prior to 2011. Squid moved in 2019 and sculpin moved in 2020 to Ecosystem Component. f/ Data through November 6, 2021.

Table 5 (continued). Groundfish catches (metric tons) in the Aleutian Islands, 1954-2021.

Year	POP Complex/d	POP	N. Rockfish	RE Rockfish	BS/SR Rockfish	Other Rockfish	Atka Mack.	Other Species/e	Skate	Sculpin	Shark	Squid	Octopus	Total	
1954														0	
1955														0	
1956														0	
1957														0	
1958														0	
1959														0	
1960														0	
1961														0	
1962		200												200	
1963		20,800												21,471	
1964		90,300						66						92,652	
1965		109,100						768						111,868	
1966		85,900						131						87,589	
1967		55,900						8,542						66,781	
1968		44,900						8,948						56,023	
1969		38,800						3,088						44,009	
1970		66,900					949	10,671						80,610	
1971		21,800						2,973						32,118	
1972		33,200					5,907	22,447						79,717	
1973		11,800					1,712	4,244						34,006	
1974		22,400					1,377	9,724						49,340	
1975		16,600					13,326	8,288						46,553	
1976		14,000					13,126	7,053						43,465	
1977		8,080				3,043	20,975	16,170		1,808				67,348	
1978		5,286				921	23,418	12,436		2,085				61,092	
1979		5,487				4,517	21,279	12,934		2,252				75,195	
1980		4,700				420	15,533	13,028		2,332				108,531	
1981		3,622				328	16,661	7,274		1,763				104,199	
1982		1,014				2,114	19,546	5,167		1,201				98,233	
1983		280				1,045	11,585	3,675		510				94,617	
1984		631				56	35,998	1,670		343				147,022	
1985		308				99	37,856	2,050		9				113,310	
1986		286				169	31,978	1,509		20				96,259	
1987		1,004				147	30,049	1,155		23				81,364	
1988		1,979				278	21,656	437		3				77,383	
1989		2,706				481	14,868	108		6				186,494	
1990		14,650				864	21,725	627		11				124,886	
1991		2,545				549	22,258	91		30				117,942	
1992		10,277				3,689	46,831	3,081		61				164,513	
1993		13,375				495	65,805	2,540		85				179,659	
1994		16,959				301	69,401	1,102		86				175,614	
1995		14,734				220	81,214	1,273		95				183,862	
1996		20,443				278	103,087	1,720		87				190,750	
1997		15,687				307	65,668	1,555		323				139,049	
1998		13,729				385	56,195	2,448		25				134,182	
1999		18,501				657	53,966	1,670		9				106,453	
2000		14,893				601	46,990	3,010		8				110,348	
2001		15,587				610	61,296	4,029		5				120,550	
2002		14,996				551	44,722	1,980		10				98,216	
2003		18,765				401	52,988	1,326		36				111,560	
2004			11,165	4,567	185	123	337	53,405	1,866					104,798	
2005			9,548	3,852	78	62	286	58,474	1,417					101,446	
2006			11,826	3,582	196	165	426	58,719	1,943					106,650	
2007			17,581	3,946	157	210	435	55,742	2,053					120,357	
2008			16,923	3,265	171	91	390	57,690	2,322					118,010	
2009			14,725	3,064	184	116	403	72,563	2,514					138,594	
2010			14,304	4,033	202	139	503	68,496	2,713			105		148,446	
2011			18,403	2,566	129	227	616	50,600		732	502	4	99	96,616	
2012			18,554	2,388	174	227	736	46,863		1,083	808	2	128	111,804	
2013			26,311	1,900	296	267	623	23,034		1,058	606	17	141	84,619	
2014			24,944	2,195	173	101	621	30,815		1,185	373	3	110	82,089	
2015			23,507	6,998	150	78	501	53,003		1,252	925	4	83	99,916	
2016			23,097	4,333	117	54	506	54,125		1,174	511	11	50	101,375	
2017			23,240	4,461	165	62	568	63,401		1,387	882	4	42	110,824	
2018			25,114	5,579	223	80	775	69,248		1,733	712	8	35	123,896	
2019			29,097	8,851	336	82	569	56,081		1,272	786	3	0	93	114,926
2020			28,473	8,136	464	109	739	57,820		1,515	814	11	234	124,687	
2021/f			23,629	5,836	390	120	580	58,952		1,125		11	43	114,225	

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69. Note: Numbers don't include fish taken for research.

b/ Kamchatka flounder included in Arrowtooth flounder prior to 2011. c/ Rock sole prior to 1991 and flathead sole prior to 1995 are included in other flatfish catch statistics. d/ Includes POP, northern, rougheye, shortraker, and sharpchin rockfish until 2004. e/ Octopus, sculpin, sharks, skates included in Other species prior to 2011. Squid moved in 2019 and sculpins moved in 2020 to Ecosystem Component. f/ Data through November 6, 2021.

Table 6. Groundfish catches (metric tons) in the Bering Sea and Aleutian Islands, 1954-2021.

Year	Pollock	Pacific Cod	Sablefish	Yellowfin Sole	Greenland Turbot	Arrowtooth Flounder/a	Kamchatka Flounder/b	Rock Sole	Flathead Sole	AK Plaice	Other Flatfish/c
1954	0	0	0	12,562	0	0	0	0	0	0	0
1955	0	0	0	14,690	0	0	0	0	0	0	0
1956	0	0	0	24,697	0	0	0	0	0	0	0
1957	0	0	0	24,145	0	0	0	0	0	0	0
1958	6,924	171	6	44,153	0	0	0	0	0	0	0
1959	32,793	2,864	289	185,321	0	0	0	0	0	0	0
1960	0	0	1,861	456,103	36,843	0	0	0	0	0	0
1961	0	0	15,627	553,742	57,348	0	0	0	0	0	0
1962	0	0	25,989	420,703	58,226	0	0	0	0	0	0
1963	0	0	14,370	85,810	31,572	0	0	0	0	0	35,643
1964	174,792	13,649	5,086	111,177	34,233	0	0	0	0	0	30,604
1965	230,551	15,170	6,087	53,810	10,047	0	0	0	0	0	11,686
1966	261,678	18,354	10,846	102,353	13,105	0	0	0	0	0	24,864
1967	550,362	32,357	13,350	162,228	24,263	0	0	0	0	0	32,109
1968	702,181	58,191	6,047	84,189	35,445	0	0	0	0	0	29,647
1969	862,789	50,571	17,682	167,134	36,257	0	0	0	0	0	34,749
1970	1,256,565	70,377	12,985	133,079	19,976	12,872	0	0	0	0	64,690
1971	1,743,763	45,132	18,042	160,399	42,214	19,373	0	0	0	0	92,452
1972	1,874,534	43,340	16,289	47,856	77,384	14,446	0	0	0	0	76,813
1973	1,758,919	54,363	8,859	78,240	63,946	12,922	0	0	0	0	43,919
1974	1,588,390	63,841	6,735	42,235	78,442	24,668	0	0	0	0	37,357
1975	1,356,736	54,389	4,513	64,690	67,789	21,616	0	0	0	0	20,393
1976	1,177,822	54,671	4,582	56,221	62,590	19,176	0	0	0	0	21,746
1977	985,995	36,597	4,615	58,373	30,161	11,489	0	0	0	0	14,393
1978	985,713	45,838	2,013	138,433	42,189	10,140	0	0	0	0	21,040
1979	923,385	39,354	2,158	99,017	41,409	14,357	0	0	0	0	19,724
1980	1,016,435	51,649	2,480	87,391	52,553	18,364	0	0	0	0	20,406
1981	1,029,021	62,458	3,137	97,301	57,321	17,113	0	0	0	0	23,428
1982	1,013,942	56,566	4,139	95,712	52,122	11,518	0	0	0	0	23,809
1983	1,041,389	93,167	3,368	108,385	47,558	13,969	0	0	0	0	30,454
1984	1,180,617	133,170	3,328	159,526	23,120	9,452	0	0	0	0	44,286
1985	1,238,489	145,426	3,796	227,107	14,731	7,375	0	0	0	0	71,179
1986	1,235,090	140,887	6,546	208,597	9,864	6,903	0	0	0	0	76,328
1987	1,266,317	157,746	8,012	181,429	9,599	4,539	0	0	0	0	50,372
1988	1,271,000	197,891	6,608	223,156	7,108	5,883	0	0	0	0	137,418
1989	1,386,000	168,918	4,500	153,165	8,822	3,222	0	0	0	0	63,452
1990	1,426,000	171,008	4,445	80,584	9,620	4,232	0	0	0	0	22,568
1991	1,346,464	172,158	3,199	96,135	6,878	13,686	0	46,681	0	0	30,489
1992	1,438,412	206,129	2,104	146,946	2,770	11,980	0	51,956	0	0	34,825
1993	1,358,758	167,390	2,747	105,809	8,468	9,298	0	64,260	0	0	28,871
1994	1,421,402	196,572	2,470	144,544	10,379	14,377	0	60,584	0	0	29,775
1995	1,329,503	245,030	2,048	124,752	8,193	9,283	0	55,028	14,715	0	20,196
1996	1,218,229	240,590	1,349	130,163	6,376	14,610	0	47,146	17,344	0	18,580
1997	1,142,140	234,641	1,326	166,915	7,666	9,651	0	67,520	20,688	0	22,964
1998	1,125,249	195,645	1,181	101,315	9,124	15,679	0	33,667	24,569	0	15,390
1999	989,684	174,855	1,349	69,288	5,861	11,359	0	41,085	18,568	0	15,535
2000	1,133,980	191,056	1,812	84,070	6,974	13,228	0	49,666	20,422	0	16,485
2001	1,388,276	176,659	1,937	63,578	5,312	14,056	0	29,475	17,811	0	9,973
2002	1,482,992	197,353	2,261	74,985	3,635	11,853	0	41,865	15,575	0	2,627
2003	1,493,692	207,146	2,048	81,050	3,530	14,580	0	37,339	14,181	10,118	2,954
2004	1,481,710	212,618	1,996	75,511	2,259	18,185	0	48,681	17,398	7,888	4,788
2005	1,484,643	205,635	2,551	94,385	2,608	14,243	0	37,362	16,108	11,194	4,592
2006	1,489,776	193,025	2,229	99,160	1,989	13,442	0	36,456	17,981	17,318	3,160
2007	1,357,021	174,485	2,350	120,964	2,004	11,916	0	37,126	18,958	19,522	5,724
2008	991,865	171,030	2,040	148,894	2,911	21,370	0	51,276	24,540	17,377	3,624
2009	812,520	175,756	2,016	107,513	4,515	29,900	0	48,716	19,558	13,944	2,178
2010	811,625	171,869	1,852	118,624	4,146	38,880	0	53,221	20,127	16,165	2,199
2011	1,200,424	220,080	1,730	151,168	3,668	20,133	9,971	60,632	13,553	23,655	3,177
2012	1,206,252	250,894	1,948	147,187	4,716	22,378	9,505	76,099	11,366	16,612	3,543
2013	1,273,787	250,307	1,697	164,944	1,745	20,541	7,766	59,800	17,354	23,522	1,535
2014	1,300,221	249,330	1,133	156,772	1,656	19,109	6,458	51,724	16,514	19,447	4,391
2015	1,323,227	242,057	640	126,937	2,204	11,267	4,994	45,467	11,307	14,614	2,415
2016	1,354,968	243,870	881	135,350	2,238	11,105	4,850	45,101	10,384	13,385	2,848
2017	1,357,937	209,047	1,738	125,621	2,813	6,189	4,462	35,123	8,878	15,549	4,121
2018	1,381,180	201,421	2,258	131,543	1,833	7,002	3,108	28,275	11,062	23,342	5,984
2019	1,410,898	177,033	3,820	128,051	2,849	10,052	4,487	25,721	15,858	16,163	3,765
2020	1,370,437	169,834	6,511	133,799	2,326	10,684	7,442	25,937	9,392	20,078	4,174
2021/f	1,375,647	131,817	5,410	105,217	1,586	8,325	6,562	13,901	9,916	15,660	2,516

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69. Note: Numbers don't include fish taken for research.

b/ Kamchatka flounder included in Arrowtooth flounder prior to 2011. c/ Rock sole prior to 1991 and flathead sole prior to 1995 are included in other flatfish catch statistics. d/ Includes POP, northern, rougheye, shorttraker, and sharpchin rockfish until 2004. e/ Octopus, sculpin, sharks, skates included in Other species prior to 2011. Squids moved in 2019 and sculpins moved in 2020 to Ecosystem Component. f/ Data through November 6, 2021.

Table 6 (continued). Groundfish catches (metric tons) in the Bering Sea and Aleutian Islands, 1954-2021.

Year	POP Complex/d	POP	N. Rockfish	RE Rockfish	BS/SR Rockfish	Other Rockfish	Atka Mack.	Other Species/e	Skate	Sculpin	Shark	Squid	Octopus	Total
1954	0	0	0	0	0	0	0	0				0		12,562
1955	0	0	0	0	0	0	0	0				0		14,690
1956	0	0	0	0	0	0	0	0				0		24,697
1957	0	0	0	0	0	0	0	0				0		24,145
1958	0	0	0	0	0	0	0	147				0		51,401
1959	0	0	0	0	0	0	0	380				0		221,647
1960	6,100	0	0	0	0	0	0	0				0		500,907
1961	47,000	0	0	0	0	0	0	0				0		673,717
1962	20,100	0	0	0	0	0	0	0				0		525,018
1963	45,300	0	0	0	0	0	0	0				0		212,695
1964	116,200	0	0	0	0	0	0	802				0		486,543
1965	125,900	0	0	0	0	0	0	2,986				0		456,237
1966	106,100	0	0	0	0	0	0	2,370				0		539,670
1967	75,500	0	0	0	0	0	0	12,920				0		903,089
1968	76,400	0	0	0	0	0	0	31,006				0		1,023,106
1969	53,300	0	0	0	0	0	0	13,547				0		1,236,029
1970	76,800	0	0	0	0	0	949	25,966				0		1,674,259
1971	31,600	0	0	0	0	0	0	16,469				0		2,169,444
1972	38,900	0	0	0	0	0	5,907	33,340				0		2,228,809
1973	15,500	0	0	0	0	0	1,712	60,070				0		2,098,450
1974	36,400	0	0	0	0	0	1,377	69,987				0		1,949,432
1975	25,200	0	0	0	0	0	13,326	63,133				0		1,691,785
1976	28,900	0	0	0	0	0	13,126	33,196				0		1,472,030
1977	10,734	0	0	0	0	3,354	20,975	52,072			6,734			1,235,492
1978	7,507	0	0	0	0	3,535	24,249	73,973				8,971		1,363,601
1979	7,210	0	0	0	0	6,625	23,264	51,701				6,538		1,234,742
1980	5,797	0	0	0	0	879	20,488	47,661				6,372		1,330,475
1981	4,844	0	0	0	0	684	19,688	42,925				5,945		1,363,865
1982	1,238	0	0	0	0	2,390	19,874	23,367				5,039		1,309,716
1983	501	0	0	0	0	1,265	11,726	19,140				3,980		1,374,902
1984	2,200	0	0	0	0	232	36,055	10,178				3,167		1,605,321
1985	1,092	0	0	0	0	191	37,860	13,553				1,620		1,762,419
1986	846	0	0	0	0	271	31,990	11,980				868		1,730,170
1987	1,934	0	0	0	0	621	30,061	9,724				131		1,720,485
1988	3,026	0	0	0	0	619	22,084	12,643				417		1,887,853
1989	4,723	0	0	0	0	673	17,994	5,101				306		1,816,876
1990	20,289	0	0	0	0	1,248	22,205	6,325				471		1,768,995
1991	7,289	0	0	0	0	945	24,523	16,376				574		1,765,397
1992	13,586	0	0	0	0	4,364	49,441	33,074				880		1,996,467
1993	17,138	0	0	0	0	685	66,006	23,953				682		1,854,065
1994	18,866	0	0	0	0	562	69,591	24,532				588		1,994,242
1995	15,944	0	0	0	0	849	81,554	22,201				459		1,929,755
1996	23,078	0	0	0	0	642	103,867	21,437				1,167		1,844,578
1997	16,747	0	0	0	0	468	65,839	22,552				1,761		1,780,878
1998	14,863	0	0	0	0	588	57,096	25,604				916		1,620,886
1999	19,155	0	0	0	0	798	56,233	20,586				401		1,424,757
2000	15,597	0	0	0	0	840	47,229	26,108				383		1,607,850
2001	16,735	0	0	0	0	906	61,560	27,177				1,766		1,815,221
2002	15,854	0	0	0	0	952	45,294	28,619				1,344		1,925,209
2003	20,156	0	0	0	0	737	59,350	28,312				1,282		1,976,475
2004		11,896	4,684	209	242	656	60,564	29,454				1,014		1,979,752
2005		10,427	3,964	90	170	465	62,014	29,482				1,186		1,981,119
2006		12,867	3,828	203	212	583	61,895	27,021				1,418		1,982,564
2007		18,451	4,016	168	323	655	58,747	26,799				1,188		1,860,418
2008		17,436	3,287	193	133	612	58,082	29,474				1,542		1,545,687
2009		15,347	3,111	197	184	611	72,807	27,883				360		1,337,116
2010		17,852	4,332	232	300	771	68,647	23,410				410		1,354,662
2011		24,004	2,762	165	333	944	51,817		23,154	5,374	107	336	587	1,817,774
2012		0 24,143	2,479	191	344	947	47,829		0 24,823	5,799	96	688	137	1,857,977
2013		0 31,362	2,038	322	371	815	23,181		0 27,030	5,828	116	300	224	1,914,585
2014		0 32,381	2,342	196	197	944	30,951		0 27,511	4,860	137	1,678	428	1,928,379
2015		0 31,425	7,197	181	153	686	53,270		0 28,123	4,980	107	2,364	446	1,914,061
2016		0 31,318	4,541	158	105	786	54,485		0 29,126	4,892	128	1,378	595	1,952,492
2017		0 32,144	4,679	197	151	820	63,656		0 28,389	5,034	178	2,099	208	1,909,033
2018		0 34,749	5,767	238	250	987	70,394		0 31,208	5,109	104	1,736	290	1,947,840
2019		0 43,119	9,059	391	380	1,266	57,209		0 20,139	5,602	151	0	268	1,936,281
2020		0 40,417	8,443	517	294	1,090	58,884		0 19,128	5,169	179	0	691	1,895,427
2021/f		32,530	6,068	515	522	913	59,926		0 18,784		354		161	1,796,332

a/ Arrowtooth flounder included in Greenland turbot catch statistics, 1960-69. Note: Numbers don't include fish taken for research.  
b/ Kamchatka flounder included in Arrowtooth flounder prior to 2011. c/ Rock sole prior to 1991 and flathead sole prior to 1995 are included in other flatfish catch statistics. d/ Includes POP, northern, rougheye, shorttraker, and sharpchin rockfish until 2004. e/ Octopus, sculpin, sharks, skates included in Other species prior to 2011. Squids moved in 2019 and sculpins moved in 2020 to Ecosystem Component. f/ Data through November 6, 2021.

Table 7. Final 2022 and 2023 Pacific halibut Discard Mortality Rates (DMR) for the BSAI

Gear	Sector	Halibut discard mortality rate (percent)
Pelagic trawl	All	100
Non-pelagic trawl	Mothership and catcher/process	84
Non-pelagic trawl	Catcher vessel	62
Hook-and-line	Catcher vessel	10
Hook-and-line	Catcher/processor	10
Pot	All	33