North Pacific Fishery Management Council

Simon Kinneen, Chair | David Witherell, Executive Director
1007 W. 3rd Avenue, Suite 400, Anchorage, AK 99501
Phone 907-271-2809 | www.npfmc.org

SCIENTIFIC AND STATISTICAL COMMITTEE
DRAFT REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
December 2nd – 3rd & December 6th – 7th, 2021

The SSC met from December 2nd – 3rd and December 6th – 7th remotely.

Members present were:

Anne Hollowed, Co-Chair *NOAA Fisheries – AFSC*	Sherri Dressel, Co-Chair *Alaska Dept. of Fish and Game*	Alison Whitman, Vice Chair *Oregon Dept. of Fish and Wildlife*
Amy Bishop *University of Alaska Fairbanks*	Curry Cunningham *University of Alaska Fairbanks*	Mike Downs *Wislow Research*
Jason Gasper *NOAA Fisheries–Alaska Region*	Dana Hanselman *NOAA Fisheries—AFSC*	Brad Harris *Alaska Pacific University*
George Hunt *University of Washington*	Kathryn Meyer *Washington Dept. of Fish and Wildlife*	Franz Mueter *University of Alaska Fairbanks*
Andrew Munro *Alaska Dept. of Fish and Game*	Matt Reimer *University of California, Davis*	Chris Siddon *Alaska Dept. of Fish and Game*
Ian Stewart *Intl. Pacific Halibut Commission*	Patrick Sullivan *Cornell University*	

Members absent were:

Chris Anderson
University of Washington

General SSC Comments

The SSC recognizes the outstanding service of Anne Hollowed and Matt Reimer on the SSC. Dr. Hollowed served as a member of the SSC from 2003 – 2021 and as co-chair 2018 – 2021. Dr. Hollowed has supported science-based fisheries management both with her service on the SSC and with her work at NOAA-AFSC on the implications of climate variability, climate change and fishing on fish and crab stocks. Her integrative and forward-thinking work has led the way for ongoing development of ecosystem-based fisheries management in the North Pacific. Dr. Reimer served on the SSC from 2013 – 2021. His advice on economic impacts of Council decisions has been invaluable over the years. This advice has ensured that Council decisions were based on clear, complete, and scientifically defensible foundations that considered the diverse impacts of each decision on communities dependent on the valuable federally managed living marine resources off the coast of Alaska. The SSC will miss the insight, guidance, and careful evaluation of the scientific issues facing the NPFMC that were provided by these two SSC members. The SSC is deeply grateful for their service and contributions to management of sustainable fisheries.

The SSC also wishes to thank Grant Thompson for his long-standing work as BSAI Plan Team co-chair. Dr. Thompson was instrumental in the development of a Tier system of management that has served the NPFMC for decades and introduced cutting edge analytical approaches that advanced sustainable management of Pacific cod stocks. The SSC is grateful for Dr. Thompson's assistance and guidance during his tenure.

The SSC also wants to recognize the work of Olav Ormseth, who will be moving back to his home state of Minnesota in March of 2022. The SSC thanks him for his work on flatfish, skates, squid and forage fish assessments as well as his work in establishing frameworks for management of non-target species.

Finally, the SSC wishes to thank Martin Dorn for his work on advancements to the GOA pollock assessment and for his leadership as the Crab Plan Team co-chair. His innovative work has been instrumental in advancing sustainable harvest of this valuable resource. The SSC appreciates that Dr. Dorn is continuing to serve as a member of the Crab Plan team and thus the SSC will continue to receive the benefits of his sage advice.

General Stock Assessment Comments

The SSC had a number of recommendations that apply across groundfish and crab stock assessments.

With respect to Risk Tables, the SSC would like to highlight that "risk" is the risk of the ABC exceeding the true (but unknown) OFL, as noted in the October 2021 SSC Risk Table workshop report. Therefore, for all stocks with a risk table, assessment authors should evaluate the risk of the ABC exceeding the true (but unknown) OFL and whether a reduction from maximum ABC is warranted, even if past TACs or exploitation rates are low.

The SSC noted that the GOA Pacific cod assessment includes a short period of elevated natural mortality in the time series, as is the case for some other assessments (e.g., Bristol Bay red king crab). The SSC requests that in these cases authors provide a discussion of whether the period of elevated M should be included in the calculation of reference points and/or stock status. The SSC encourages authors to consider whether changes in mortality (and potentially growth) represent anomalies or actual shifts in the underlying dynamics. The goal of this exercise should be to ensure consistency among different calculations within an assessment and also to foster evaluation by the GPTs, CPT, and SSC of whether approaches taken among assessments are consistent with understanding of species dynamics and/or environmental/ecosystem change.

During review of the EBS Pacific cod assessment the SSC noted that the VAST model results were sensitive to the number of knots used to structure the analysis. That assessment increased the number of knots from 100 to 750, recognizing that this would likely provide a better approximation to the underlying spatial process. The SSC recommends that all assessment authors consider whether the number of knots used for their species is sufficient to provide a robust analysis, and to compare alternative models including more knots where possible.

The SSC recommends that groundfish, crab and scallop assessment authors do not change recommendations in documents between the Plan Team and the SSC meetings, because it makes it more difficult to understand the context of the Plan Team's rationale and seems counter to the public process without seeing a revision history of the document. This occurred several times during this groundfish assessment cycle with changes to both assessment recommendations and risk table scores. The SSC prefers that deliberations and disagreements over assessment and risk table recommendations be documented in the Plan Team minutes to maintain the order of author, Plan Team and SSC recommendations. *However, this recommendation is not meant to prevent correcting typos, transcription errors, figure labels and other editorial issues for the final posted documents.*

C-3 BSAI and C-4 GOA Ecosystem Status Reports

The SSC received presentations by Drs. Elizabeth Siddon (NOAA-AFSC), Bridget Ferriss (NOAA-AFSC), and Ivonne Ortiz (UW- CICOES) on the Ecosystem Status Reports (ESR) for the eastern Bering Sea, Gulf of Alaska, and the Aleutian Islands. The presentations were informative and highlighted the great strides that the authors and editors of the ESRs have made in producing documents that are insightful and of benefit to the management of federal fisheries off Alaska. The SSC appreciates the consistent high quality of the ESRs and their presentations. There was no public testimony.

General Comments applicable to all three ESRs

The general summaries and integrated sections on the physical environment and seabirds (GOA, EBS, AI), and Regional Highlights (AI) were information-dense and provided excellent syntheses of the individual reports. The SSC appreciates the efforts that went into these components of the reports. The Noteworthy Topics sections continue to highlight observations and issues that demand attention. The excision of the Executive Summary reduced redundancy and streamlined the summary portion of the ESR. The Report Card remains very useful.

The SSC notes that a holistic review of how economic and social science information is communicated and applied to Council decision-informing analytic products is planned for 2022. The SSC requests that the holistic review be transparent and inclusive, consistent with the it's suggestion for such a review during the October 2021 meeting. The SSC looks forward to the planned synthesis products for the Fishing and Human Dimensions section. In anticipation of this holistic review, some human dimensions indicators were not included in the 2021 report to better align the focus of the ESR on informing next year's ABC determinations.

The "Purpose of the ESR" section (p.4) in each report indicates that the SSC is the primary audience (for setting ABCs/OFLs) but also the AP and Council. The SSC has frequently discussed the numerous ecosystem-related documents that are produced through the Council process and some excellent infographics have been developed to indicate how and when they are used and how they differ (e.g., through the Climate Change Task Force, BS FEP). While the SSC/AP/Council are the main audiences for the report, many industry and community stakeholders use the ESRs as well as the "In Briefs". **The SSC suggests including such a flow chart/infographic in this section of the ESR to visualize the process.**

"In Briefs" are planned for the EBS, GOA, and AI and a second outreach video is being developed - summarizing the ESR products and process. The authors have settled on a strategy that includes the annual production of "In Briefs". The authors noted there will be intermittent production of storymaps focused on specific ecosystem stories and no additional videos at this time. **The SSC is supportive of these continued efforts to disseminate ESR information to stakeholders and communities and appreciates the efforts to provide hard-copy products to remote communities where digital media may be difficult to download or otherwise access.** The SSC looks forward to hearing any feed-back from end-users on how these products are used and valued. The SSC notes the ESR author participation at the recent Coastal Communities Forum in Unalaska/Dutch Harbor hosted by the Qawalangin Tribe as a potentially rich context for the two-way flow of information on ESR topics of relevance to local communities and is supportive of similar future outreach efforts whenever practicable.

Harmful Algal Blooms

Harmful Algal Blooms (HABs) were reported from all three regions (EBS, AI, GOA), as well as in the NBS and Chukchi Sea. Toxins were detected in shellfish (GOA, AI) and marine mammal flesh (NBS,

Chukchi). No human fatalities were reported in 2021.

BSAI Ecosystem Status Reports

Bering Sea

Issues of Concern:

(1) The integration of information from many discipline-specific reports in both the Northern Bering Sea (NBS) and the eastern Bering Sea (EBS) in the overview section identified **multiple indications of warming in the EBS and declining productivity in the Bering Sea as a whole**. Whereas, the response of individual stocks to ocean warming was more mixed, with some stocks exhibiting declines in the availability of species for harvest (due to declining abundance or shifting spatial distributions) and/or changes in weight at length or age, while others showed more mixed responses.

(2) **The extremely weak returns of Yukon River Chinook and chum salmon remain issues of concern**. The SSC supports continued research on the potential causes of these weak runs. Hypotheses considered in the ESR include: (a) reduced ocean survival; (b) reduced stocks of lipid-rich large crustacean zooplankton in the NBS (see paragraph below on seabird die-offs in the NBS); (c) competition with, or even predation by, Asian pink salmon; and (d) recent changes in PSC of chum salmon. The factors responsible for the weak runs are areas of active research.

(3) **Continued seabird die-offs and reduced reproductive success in the NBS are of concern**. The die-offs were a mix of planktivorous (e.g., shearwaters) and piscivorous species, as was the case for reproductive failures (e.g., both murre species, and puffins), indicating that the abundance of large, lipid-rich zooplankton and forage fish may be reduced. Since these zooplankton are also important prey of forage fish and pollock, these seabird die-offs may indicate that the NBS has a limited ability to support increasing abundances of commercially important fish species.

Physical environment synthesis

In 2021, there was a decoupling of the winds in the northern Bering Sea (strong winds from the north) and the southeastern Bering Sea (moderate to strong winds from the south). As a result, there was widespread and thick sea ice in the northern Bering, and continued low sea-ice extent and thickness in the southeast. Over the southeastern shelf, the advancement of sea ice stalled at the end of January, resulting in a relatively small cold pool, similar in size to those occurring in the warm years of the early 2000s.

Indicators showing warming in the EBS included: St. Paul air temperatures show a strong positive trend over the past 40 years, freeze-up occurs later in the season (March versus December), sea-ice extent (October 15- December 15) is approximately 50% of its long-term mean, reduction in cold pool area and its southern boundary has shifted northwestward, and bottom temperatures were elevated in 2018 and 2019 (~ 2 °C above long-term mean, compare to 0.5 °C above the mean in 2021).

If the available weather models as a group are correct, late winter and early spring of 2022 will bring near-normal water temperatures to most of the Bering Sea and Aleutian Islands. Despite considerable inter-model variability, most, but not all, of the models project sea ice extending south of 60° N, and possibly to M2 in the EBS.

Reduced productivity

Indicators showing productivity declines throughout the Bering Sea since the beginning of the warm period

in 2014 included: (1) declines in surface chlorophyll concentrations as measured by satellite, with below average values since 2016, (southern and middle shelf) or since 2014 (NBS outer shelf), (2) for 2020, the Continuous Plankton Recorder showed that the diatom abundance anomaly was negative in 2020, and that the mesozooplankton biomass and the size distribution of copepods were reduced, (3) the CPUE of benthic foragers measured during the bottom trawl survey (June–Aug) in 2021 was at the lowest level over the times series, more than one and a half standard deviations below 1982–2021 levels, (4) the biomass of crabs, including hermit, king, tanner and snow crab, are all below their long-term means, (5) the CPUE of all fish combined and major invertebrate taxa sampled in 2021 NOAA bottom-trawl survey decreased in both the NBS and the EBS, with the southern portion at the lowest level since 2009, and (6) fish condition (length-weight or weight at age residuals) declined between 2019 and 2021 for benthic, pelagic and apex predators, though juvenile pollock condition has trended upward.

In the NBS, specifically, there is evidence of a decline in pelagic food availability since 2017. Piscivorous seabirds had below average reproductive success, with black-legged kittiwakes experiencing complete failure at Hall Island. Murres and puffins had delayed nesting and/or reduced reproductive success. Least auklets, primarily zooplankton eaters, had average success. AYK Chinook and chum salmon had low returns in 2021. It has been suggested that these return failures may be due to low ocean survival. A number of hypotheses have been suggested that might account for this poor ocean survival. **The SSC is very supportive of continued research and monitoring efforts to explore the various hypotheses the ESR authors presented that may explain the observed changes in the EBS/NBS including cumulative impacts of increased thermal exposure and metabolic demands, vertical mismatch/stratification in prey distribution in the water column, and functional redundancy within the ecosystem.**

It is noteworthy that, in the face of COVID-19 cancellations of most NOAA Fisheries surveys in the eastern and northern Bering Sea in 2020, some data gaps were partially filled by state/university partners, tribal governments, and coastal community members who provided new and innovative contributions to inform the ESR team's understanding of the ecosystem status. **The SSC suggests that going forward it will be important to build on lessons learned from these collaborations** and to examine how such collaborations**,** and the value of the information derived therefrom, may be strengthened and remain relevant and useful after regular NOAA survey efforts again approximate those of pre-pandemic conditions. As an example**, the SSC suggested that local partners in Nome (e.g. Kawerak, Inc. or NSEDC) could be approached to see if they might help organize a local effort to monitor sea temperatures in the Norton Sound region.**

The SSC suggests that the editors and authors consider the development of a single, "all-purpose" map of the eastern and northern Bering Sea*,* combined*,* that would show an agreed upon set of zones, such as those used for the BSIERP map (Ortiz, I., Wiese, F., Greig, A., 2013. Marine Regions Boundary Data for the Bering Sea Shelf and Slope, Version 1.0. UCAR/NCAR - Earth Observing Laboratory. http://dx.doi.org/10.5065/D6DF6P6C) with whatever modifications seem appropriate. This map would be in addition to the maps of the eastern Bering Sea and northern Bering Sea bottom trawl surveys and the slope survey. In the present EBS ESR, there were at least four different maps presented, each with a unique set of zones or divisions. These differences make integration of information across disciplines challenging.

Aleutian Islands

Issues of Concern

***(1) Mercury in AI Food Webs*:** Relatively high total mercury concentrations have been found in Steller sea lion pups in the central and western Aleutian Islands. Exposure was in utero, and mercury is known to have deleterious impacts on fetal development. Pups with total mercury concentrations above 0.1 µg/g wet weight in whole blood show decreased immune function, poor antioxidant function which can lead to tissue

oxidative damage during active breath-hold diving, and negative impacts on the immune system. The mercury is obtained from fish or squid prey, and the problem has been increasing over the past ten years. A similar range of mercury concentrations has also been found in Aleutian Islands harbor seals. Mercury concentrations in several fish species are significantly higher in the western Aleutian Islands compared to fish sampled to the east. Researchers at UAF are exploring the pathways of mercury through the food web through collaborations with industry (Ocean Peace, Inc.) and agency partners (MML, USFWS), and further exploring spatial and temporal patterns in this region.

***(2) Plastics in AI seabirds*:** Phtalates, derived from plastics, were detected in 115 Aleutian Island seabirds that were tested, with concentrations varying from 3.64–539.64 ng/g. Bird species that feed on plankton by diving had significantly higher concentrations compared to piscivores and opportunistic feeders. Additionally, ingesting marine debris can lead to seabird mortality, with the leading cause of death being obstruction of the gastro-intestinal tract.

The SSC appreciates information on these topics, and notes the detection levels in fish are not of concern for human consumption and plastics are rarely found in stomach contents of fish. With the potential increasing patterns over time, the SSC suggests authors continue to include information on plastics and mercury in the Aleutian Islands food web in these reports where data are available, as a baseline for detecting any future changes.

Aleutian Islands Synthesis

In the Aleutian Islands, west to east winds suppressed flow through the passes, and during summer 2021, some of the warmest SSTs were recorded in the western and central Aleutians. All three Aleutian Islands regions experienced Marine Heatwaves (MHW). Throughout the Aleutian chain, eddy kinetic energy was near or below its long-term average in 2021.

The spring phytoplankton bloom was somewhat later (late May/early June) in 2021 than usual (mid-May). The Continuous Plankton Recorder record for 2020 (2021 results are not yet available) shows that copepod community size and meso-zooplankton biomass anomalies for 2020 were negative, where they had been positive in 2019. The mean diatom abundance anomaly was also negative in 2020. The low meso-zooplankton biomass may be related to the high abundance of pink salmon, but that would not explain the negative diatom anomaly. In 2021, both plankton and fish-eating seabird species had good reproductive success, and there were no remarkable die-offs reported. Recent status assessment of northern sea otters in the western Aleutians found the population to be low, but stable. In the eastern Aleutians, the northern sea otter population was larger and also stable. Harbor seals in the Aleutians have declined in recent years (8-year population trend is -131 seals per year) and is now estimated at 5,588 (∓SE 274). The stock is not listed as Threatened or Endangered. To date in 2021, eight marine mammals were reported as stranded, mostly from the area near Dutch Harbor, where potential observers are concentrated. There was no 2021 update on the status of Steller sea lions in the Aleutian Islands.

The SSC appreciates the addition of new indicators for the ESR, but notes that there has been no integrated ecosystem study for the AI in over a decade. The AI Fisheries Ecosystem Plan is past its review time, there is no Regional Plan specific to the AI, and there has been no survey since 2018. Other than the ESR, the most comprehensive study at the ecosystem level was a special journal issue in 2005, and the FEP in 2007. This creates significant challenges for interpreting the impacts of the various indicators presented in the ESR and for fisheries management in the region. **The SSC strongly highlights the need for surveys in this region in 2021, and supports any efforts for taking a more integrative approach to studying this ecosystem.**

Gulf of Alaska Ecosystem Status Report

Noteworthy topics

As discussed in the minutes of the October 2021 SSC meeting, there were two noteworthy occurrences in the GOA in 2021, both in the western Gulf of Alaska. First, there was a mid-July die-off of kittiwakes and gulls on Middleton Island. Tests for avian influenza and products of harmful algal blooms (saxitoxin and domoic acid) were negative, but tests for *Clostridia botulinum* and botulism toxin type C were positive. It is likely, but not yet confirmed, that these birds ingested *Clostridia* organisms while bathing in a small freshwater pond on Middleton Island. It is very unlikely that this problem will migrate to commercially important fish species, though the bacteria may reappear on Middleton Island or on the mainland where the birds may roost while foraging.

The second issue was the observation of four unique North Pacific Right Whales along the shelf southeast of Kodiak Island (Albatross Bank, with two near Barnabas Trough, and two near the Trinity Islands). This is extremely positive news from a conservation point of view, as there are believed to be only 30 individuals of this species in the eastern North Pacific. On the east coast of the United States, right whales are subject to entanglement in fishing gear (particularly the lines between lobster buoys and the traps on the bottom) and ship strikes. **At the very least, the SSC recommends that the GOA fishing fleets be made aware of where these whales were sighted and requested to do their best to avoid harming them.**

Key metrics of stability in the groundfish community, including high total biomass, low average biomass, variability over time, high species richness and diversity, and stable (eastern GOA) or slightly increasing (western GOA) mean length and lifespan of groundfish, point to overall high stability and resilience in the GOA (represented by species regularly caught by the AFSC bottom trawl survey). **The SSC notes that is a promising key message of stability for groundfish (in bottom trawls) to perturbations. The SSC encourages consideration of observed groundfish responses within the context of the overall responses of across multiple trophic levels and species within the Gulf of Alaska large marine ecosystem (e.g., Suryan et al. 2021).**

Western Gulf of Alaska Synthesis

Ocean temperatures in both winter (2020-2021) and summer 2021 cooled, with summer SSTs within 1 SD of the long-term mean, though warmer temperatures than average were present in spring. The warmer than average temperatures observed at depth in 2020 have cooled, and further cooling is expected in 2022 given the expected La Niña winter of 2021-2022. Westerly winds in spring and summer 2021 over much of the shelf created up-welling favorable conditions, and strong, persistent eddies were located off the shelf near Seward and Kodiak, which likely contributed increased transport of nutrients onto and across the shelf. Downwelling-favorable northeasterly winds which are favorable to the retention of pollock larvae were present in Shelikof Strait. These aspects of the physical oceanography all suggested that the western GOA was returning to a more "normal" state after the heatwaves of 2014-2016 and 2019 and may become more productive.

Despite these favorable developments in the physical oceanography of the western GOA, the recovery of the biological components was somewhat uneven. Although the peak of the spring phytoplankton bloom was about average, the average biomass was lower. The impact of a large, three-week bloom in the central Gulf (near the Seward Line at the shelf edge) was not determined. Around Kodiak Island, low abundances of large copepods were characteristic of warmer conditions, whereas in the large phytoplankton bloom along the Seward Line in the central GOA, the abundance of large copepods was average to above average. Capelin, a cold-water forage fish, has remained depleted since the 2014 marine heatwave, as have eulachon, and herring (PWS), whereas sand lance, a species associated with relatively warm waters, was locally

abundant, as were age-1 pollock. Likewise, age-1 pollock and Pacific cod were present in relatively high numbers. Some piscivorous groundfish had improved weight to length ratios in 2021 as compared to 2020, although these ratios declined for most species. Pacific cod condition was above the long-term mean near Kodiak Island, but other species remained below the long-term mean in the western GOA.

Some of these patterns were reflected in seabird reproductive success and diets. Piscivorous seabirds had average to above average reproductive success (glaucous-winged gulls, common murres, and tufted puffins on Chowiet Island). However, the high primary productivity along the Seward line was not reflected in the reproductive success of planktivorous fork-tailed storm-petrels nesting on East Amatuli Island.

Eastern Gulf of Alaska Synthesis

The eastern GOA experienced a second, consecutive year of near average to above average SSTs, although temperatures were above average for waters at 200 m depth on the shelf and upper slope. Chlorophyll a concentrations, an indication of phytoplankton biomass, was below average, as has been the case for the past six years. In Icy Strait, the numbers of euphausiids and small calanoid copepods increased from 2020. However, the average to low reproductive success of planktivorous seabirds on St. Lazaria suggests that the availability of larger species of crustacean zooplankton was reduced in the shelf and slope waters.

Forage fish, including herring, experienced increased abundance. Herring biomass continues to increase as a result of the strong 2016 year-class. These herring are important prey for groundfish, humpback whales in Glacier Bay and for piscivorous seabirds. Juvenile salmon in Icy Strait had above average energy density but were present in below average numbers. Groundfish biomass in the eastern GOA is still decreasing, and adult pollock, Pacific cod, Pacific ocean perch and dusky rockfish had below average weight at length ratios, while southern rock sole had an above average ratio in the eastern GOA.

Although the numbers of adult salmon returning to spawn in 2021 were above those in 2020, this was mainly due to the high returns of pink salmon. Returns of other salmon species continued to be low, with sockeye salmon returns to Auke Creek experiencing their 10th lowest return on record. Chinook salmon numbers remain low.

Prince William Sound Synthesis

The addition of a summary of findings in Prince William Sound was a welcome addition to the GOA ESR. Ocean temperature in PWS returned to near average after the 2014-2016 and 2019 heatwaves. Herring stocks, important forage for humpback whales, increased, though the whale stock remained low. Examination of intertidal species showed that algal abundances remained low, though mussels (plankton feeders) were near or above long-term mean abundances.

C-3 BSAI and C-4 GOA specifications and SAFE Report

Jim Ianelli (NOAA-AFSC) presented the Joint Groundfish Plan Team (JGPT) report from the November 2021 JGPT meeting. Grant Thompson (NOAA-AFSC) gave an overview of the November 2021 BSAI GPT meetings and on recommendations for BSAI groundfish OFLs and ABCs. Finally, the SSC received a presentation by Dr. Ianelli (NOAA-AFSC) on the November 2021 GOA GPT meeting and on GOA groundfish OFL and ABC recommendations.

The SSC reviewed the SAFE chapters and 2021 OFLs with respect to status determinations for GOA and BSAI groundfish. **The SSC-approved models indicated that no stocks were subject to overfishing in 2020. Also, in reviewing the status of stocks with reliable biomass reference points (all Tier 3 and above stocks and rex sole), the SSC concurs that these stocks are not overfished or approaching an**

overfished condition. The SSC notes that for multiple stocks, no assessment was conducted in 2021 and harvest specifications for 2022 were rolled over. These include: BSAI Bogoslof pollock, BSAI other flatfish, BSAI shortraker rockfish, BSAI other rockfish, BSAI sharks, BSAI octopus, GOA thornyhead rockfish and GOA sharks.

To streamline and simplify the SSC report, recommended ABC/OFLs and area apportionments are summarized exclusively in Table 1 (BSAI) and Table 2 (GOA). Recommendations that differ from GPTs are marked in **bold**.

Table 1. SSC recommended OFL, ABC for Groundfish in the Bering Sea/Aleutian Islands (metric tons) for 2022-2023. Bold text indicates where the SSC recommendation differed from the BSAI Plan Team.

		2021			Catch as of	SSC Final 2022		SSC Final 2023	
Species	**Area**	**OFL**	**ABC**	**TAC**	**11/6/2021**	**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	**354,014**	347,483	**326,235**
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
Total	BSAI	3,945,315	2,747,727	2,000,000	1,774,309	2,953,182	2,406,447	3,219,218	2,615,814

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. SSC recommended OFLs and ABCs for Groundfish in the Gulf of Alaska (metric tons) for 2022 and 2023. Bold text indicates where the SSC recommendation differed from the GOA Plan Team.

Species	Area	2021 OFL	2021 ABC	2021 TAC	Catch 11/6/2021	SSC Rec 2022 OFL	SSC Rec 2022 ABC	SSC Rec 2023 OFL	SSC Rec 2023 ABC
Pollock [1]	State GHL	n/a	2,643	n/a		n/a	3,327	n/a	3,298
	W (610)	n/a	18,477	18,477	18,112	n/a	23,714	n/a	23,506
	C (620)	n/a	54,870	54,870	52,432	n/a	69,250	n/a	68,642
	C (630)	n/a	24,320	24,320	23,079	n/a	30,068	n/a	29,803
	WYAK	n/a	5,412	5,412	5,145	n/a	6,722	n/a	6,663
	Subtotal	123,455	105,722	103,079	98,768	154,983	133,081	153,097	131,912
	EYAK/SEO	13,531	10,148	10,148	1	15,150	11,363	15,150	11,363
	Total	136,986	115,870	113,227	98,769	170,133	144,444	168,247	143,275
Pacific Cod	W	n/a	7,986	5,590	3,792	n/a	**9,942**	n/a	**8,699**
	C	n/a	13,656	10,242	8,258	n/a	**19,752**	n/a	**17,282**
	E	n/a	1,985	1,489	222	n/a	**3,117**	n/a	**2,727**
	Total	28,977	23,627	17,321	12,272	**39,555**	**32,811**	**34,673**	**28,708**
Sablefish	W	n/a	3,224	2,428	1,763	n/a	3,727	n/a	3,951
	C	n/a	9,527	8,056	6,551	n/a	9,965	n/a	9,495
	WYAK	n/a	3,451	2,929	2,188	n/a	3,437	n/a	3,159
	SEO	n/a	5,273	4,579	3,613	n/a	5,665	n/a	5,398
	GOA Total [2]	n/a	21,475	17,992	14,115	n/a	22,794	n/a	22,003
Alaska-wide OFL and ABC [3]	AK Total	60,426	29,588	n/a		40,432	34,521	42,520	36,318
Shallow-water Flatfish	W	n/a	24,151	13,250	26	n/a	21,256	n/a	22,464
	C	n/a	28,082	28,082	1,654	n/a	25,305	n/a	26,743
	WYAK	n/a	2,808	2,808	1	n/a	2,531	n/a	2,674
	EYAK/SEO	n/a	1,123	1,123	1	n/a	1,518	n/a	1,605
	Total	68,841	56,164	45,263	1,682	62,273	50,610	65,676	53,486
Deep-water Flatfish	W	n/a	225	225	1	n/a	256	n/a	256
	C	n/a	1,914	1,914	79	n/a	2,139	n/a	2,105
	WYAK	n/a	2,068	2,068	5	n/a	1,431	n/a	1,408
	EYAK/SEO	n/a	1,719	1,719	4	n/a	2,082	n/a	2,049
	Total	7,040	5,926	5,926	89	7,026	5,908	6,920	5,818
Rex Sole	W	n/a	3,013	3,013	14	n/a	2,981	n/a	3,222
	C	n/a	8,912	8,912	269	n/a	12,076	n/a	13,054
	WYAK	n/a	1,206	1,206	2	n/a	1,361	n/a	1,439
	EYAK/SEO	n/a	2,285	2,285	-	n/a	2,723	n/a	2,879
	Total	18,779	15,416	15,416	285	23,302	19,141	25,049	20,594
Arrowtooth Flounder	W	n/a	32,377	14,500	332	n/a	33,658	n/a	33,214
	C	n/a	69,072	69,072	9,114	n/a	68,394	n/a	67,493
	WYAK	n/a	8,380	6,900	47	n/a	6,707	n/a	6,619
	EYAK/SEO	n/a	17,141	6,900	24	n/a	11,020	n/a	10,875
	Total	151,723	126,970	97,372	9,517	143,100	119,779	141,231	118,201
Flathead Sole	W	n/a	14,209	8,650	106	n/a	14,755	n/a	14,708
	C	n/a	20,826	15,400	555	n/a	22,033	n/a	21,962
	WYAK	n/a	2,427	2,427	-	n/a	1,511	n/a	1,506
	EYAK/SEO	n/a	1,915	1,915	-	n/a	1,876	n/a	1,870
	Total	47,982	39,377	28,392	661	48,928	40,175	48,757	40,046
Pacific ocean perch	W	n/a	1,643	1,643	1,654	n/a	2,602	n/a	2,523
	C	n/a	27,429	27,429	24,809	n/a	30,806	n/a	29,869
	WYAK	n/a	1,705	1,705	1,663	n/a	1,409	n/a	1,366
	W/C/WYAK	36,563	30,777	30,777	28,126	41,470	34,817	40,211	33,758
	SEO	6,414	5,400	5,400	-	4,110	3,451	3,985	3,346
	Total	42,977	36,177	36,177	28,126	45,580	38,268	44,196	37,104
Northern Rockfish	W	n/a	2,023	2,023	708	n/a	1,944	n/a	1,859
	C	n/a	3,334	3,334	1,670	n/a	3,202	n/a	3,061
	E	n/a	1	-	-	n/a	-	n/a	-
	Total	6,396	5,358	5,357	2,378	6,143	5,146	5,874	4,920
Shortraker Rockfish	W	n/a	52	52	5	n/a	51	n/a	51
	C	n/a	284	284	197	n/a	280	n/a	280
	E	n/a	372	372	273	n/a	374	n/a	374
	Total	944	708	708	475	940	705	940	705
Dusky Rockfish	W	n/a	270	270	146	n/a	269	n/a	259
	C	n/a	4,548	4,548	2,748	n/a	4,534	n/a	4,373
	WYAK	n/a	468	468	30	n/a	427	n/a	412
	EYAK/SEO	n/a	103	103	-	n/a	142	n/a	137
	Total	8,655	5,389	5,389	2,924	8,614	5,372	8,146	5,181

Table 2. cont.

Species	Area	2021 OFL	2021 ABC	2021 TAC	Catch 11/6/2021	SSC Rec 2022 OFL	SSC Rec 2022 ABC	SSC Rec 2023 OFL	SSC Rec 2023 ABC
Rougheye and Blackspotted Rockfish	W	n/a	168	168	21	n/a	184	n/a	182
	C	n/a	456	456	175	n/a	235	n/a	234
	E	n/a	588	588	185	n/a	369	n/a	365
	Total	1,456	1,212	1,212	381	947	788	937	781
Demersal shelf rockfish	Total	405	257	257	105	**579**	**365**	**579**	**365**
Thornyhead Rockfish	W	n/a	352	352	42	n/a	352	n/a	352
	C	n/a	910	910	99	n/a	910	n/a	910
	E	n/a	691	691	133	n/a	691	n/a	691
	Total	2,604	1,953	1,953	274	2,604	1,953	2,604	1,953
Other Rockfish	W/C	n/a	940	940	1,060	n/a	940	n/a	940
	WYAK	n/a	369	369	119	n/a	370	n/a	370
	EYAK/SEO	n/a	2,744	300	40	n/a	2,744	n/a	2,744
	Total	5,320	4,053	1,609	1,219	5,320	4,054	5,320	4,054
Atka mackerel	Total	6,200	4,700	3,000	940	6,200	4,700	6,200	4,700
Big Skate	W	n/a	758	758	142	n/a	591	n/a	591
	C	n/a	1,560	1,560	752	n/a	1,482	n/a	1,482
	E	n/a	890	890	193	n/a	794	n/a	794
	Total	4,278	3,208	3,208	1,087	3,822	2,867	3,822	2,867
Longnose Skate	W	n/a	158	158	26	n/a	151	n/a	151
	C	n/a	1,875	1,875	447	n/a	2,044	n/a	2,044
	E	n/a	554	554	417	n/a	517	n/a	517
	Total	3,449	2,587	2,587	890	3,616	2,712	3,616	2,712
Other Skates	GOA-wide	1,166	875	875	632	1,311	984	1,311	984
Sharks	GOA-wide	5,006	3,755	3,755	1,639	5,006	3,755	5,006	3,755
Octopuses	GOA-wide	1,307	980	980	51	1,307	980	1,307	980
TOTAL		610,917	484,150	407,976	178,511	626,738	520,038	622,931	517,507

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

[1] Area apportionments for GOA pollock were updated with minor corrections following the December SSC meeting

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

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

General Groundfish Stock Assessment Comments

The SSC supports the GPTs plan to review methods for projecting catch in partial assessments and encourages the development of clear guidelines for a standardized approach, while allowing authors to deviate from the approach with justification. The SSC has no specific recommendation on which approach to use but considers all of the approaches that were presented this year to be reasonable.

As the BSAI GPT noted for EBS pollock, the choice of what selectivity to use in projections, when time-varying selectivity is estimated, is an issue for several Tier 1-3 assessments. The SSC agrees with the GPTs recommendation to prioritize research on best practices for specifying the selectivity schedules used in Tier 1-3 assessments that employ time-varying selectivity and encourages the development of general guidance to assessment authors based on performance evaluations. The SSC highlighted that BSAI Atka mackerel would be a good case study to examine.

Joint Groundfish Plan Team Report

The SSC appreciated the summary of the JGPT meeting including Essential Fish Habitat, Comments on Assessments in General, and the Economic SAFE. The JGPT minutes also include information about the 2021 EBS/NBS Survey.

EBS/NBS Survey

The JGPT minutes included a summary of the EBS and NBS surveys which, despite the effects of the pandemic, were successfully conducted with no changes in methodology. Several special projects were highlighted including the NBS Pacific cod PSAT (tagging) project, a comparison of 15 and 30 minute trawl hauls to improve efficiency of the surveys and results, research on examining fish condition using a FatMeter and physiological stress using blood chemistry and mucus, and an analysis of the effects of removing corner stations from the EBS survey grid to reallocate those resources elsewhere. The JGPT was supportive of these efforts in general and noted that input from the Crab Plan Team should be incorporated before further consideration of changes to survey station design. The SSC concurs.

The SSC appreciates the sustained effort of NMFS staff to ensure successful surveys under the current conditions and looks forward to seeing the results of the special projects. Several recent publications (Kroska et al. 2019, 2021) examining mucus cross-contamination and multi-tissue perspectives on stress hormones in Pacific halibut may be of interest.

Essential Fish Habitat

The JGPT Chairs noted that they received a presentation on the iterative review of Components 1 (EFH descriptions and maps) and 7 (prey species lists and locations) of the 2022 Essential Fish Habitat 5-year Review. The next steps in the EFH process are presentations to the Crab Plan Team and Ecosystem Committee in January 2022, and to the SSC in February 2022. The JGPT commended the EFH analysts for the development and application of the EFH models, the responsiveness to stock assessment author reviews, and for the detailed report describing the review process. The SSC concurs.

General Assessment Comments

In their comments on assessments in general, the JGPT acknowledged the added challenges of conducting stock assessments during the pandemic and under extended telework orders; which has meant that

assessment authors can no longer "walk down the hall" to discuss assessment issues. To make the process more efficient, consistent, and streamlined under these conditions, they suggested that informal reviews be conducted out of cycle and encouraged authors to collaborate on common issues to develop shared tools for all authors. The JGPT also noted the challenge of distinguishing management changes from biological changes in some of the ESP indicator time series and ambiguity in some ESP indicators (e.g., the decrease in BSAI incidental sablefish catch). The JGPT recommends that, for ESPs in general, when a fishery performance indicator may have ambiguous interpretations a "grey" traffic light color coding should be assigned, but the scoring, which is indicative of a trend, should be maintained. **The SSC appreciates the on-going efforts of the assessment authors and GPTs to provide high-quality assessments under these difficult conditions. Further, the SSC notes that there are a number of vacancies on the Teams and encourages the Council to fill these as soon as possible given the importance the SSC places on Plan Team review.**

The SSC discussed the truncated time between the receipt of new survey information and the due dates for delivery of stock assessments for Plan Team review. The SSC also discussed the short time between Plan Team and SSC meetings and the challenges that scheduling poses for both the Plan Teams and the SSCs. **The SSC recommends a working group be formed to explore options for altering the timing of reviews of select crab and groundfish assessments to address this timing issue.**

Sablefish

The SSC received a presentation from Dr. Dan Goethel (NOAA-AFSC) on the 2021 sablefish stock assessment and Dr. James Ianelli (NOAA-AFSC) on the JGPT's comments. The SSC thanks the authors for a strong effort to address previous JGPT and SSC comments and a series of improvements to the assessment.

The SSC received written comments and public testimony from Linda Behnken (Alaska Longline Fishermen's Association). This testimony supported the improvements to the model and identified several concerns about further increases in the TAC, in light of recent fishery performance and economic considerations and the reliance of the fishery on a limited number of year classes. The SSC responded as noted below. The ALFA representative also highlighted support for research to explore alternative management procedures that may reduce risk and foster long-term stability.

The SSC recognizes that the sablefish ESP continues to be a model for similar efforts, providing critical context for the assessment. For a 'mature' ESP, the SSC finds that the report card approach provides a clear and efficient way to present the information on an annual basis.

Since the last assessment, the authors have made improvements including: updated weight and growth inputs, adding a revised maturity schedule reflecting recent histological data (but not yet including skip-spawning), removing all catchability priors, adding a time block (2016+) for estimation of fishery and survey selectivity and fishery CPUE catchability, and using a data weighting approach (the Francis method) consistent with current best practices.

The SSC agrees with the authors and the JGPT, to support Model 21.12 and the associated OFL and ABC, which based on the current stock status, places the stock in Tier 3a at the beginning of 2022. Further, the SSC supports the continuation of the four-year stair-step approach to apportioning catch among regions (a 50% step from the 2021 apportionment toward the survey-based estimate). The SSC agrees with the choice to use the maximum ABC with no additional buffer beyond the Tier system to account for scientific uncertainty, as the major uncertainties supporting a buffer in recent assessments have largely been addressed. The SSC also supports the application of a modification to the maximum ABC to account for whale depredation.

The SSC notes that although no additional buffer was warranted this year, there are continued concerns over ongoing changes in fishery dynamics associated with the transition to pots from longline gear and the potential for targeting of older/larger fish due to economic considerations. **Following the SSC recommendation from October 2021, the SSC requests further consideration of alternative methods for constraining time-varying selectivity as an alternative to a single time-block. In particular, the SSC requests that the authors develop a method (e.g., random walk, autoregressive) that can allow the data to update the model structure and avoid annual evaluation of when bias in selectivity has reached a threshold beyond which it can no longer be ignored. Further, the SSC encourages consideration of adding a fleet variable to the model or to allow greater flexibility in the shape of the selectivity curve to better represent the growing importance of pot gear.**

The SSC has supported the stair-step approach from the 2013 fixed apportionment percentages toward the current estimates based purely on biological considerations, as this is the standard practice for groundfish. However, the SSC recognizes (and has commented to the Council) that socio-economic considerations may be relevant, and that the highly migratory nature of sablefish may allow for some flexibility in relation to a purely biological approach to apportionment. Further, the SSC recognizes that the stair-step approach may lead to apportionment to areas with proportionally higher catch than biomass. The SSC continues to suggest that the Council provide guidance to the authors if it wishes to include other factors in guiding the apportionment approach. **The SSC notes that the fishery did not utilize the full TAC in 2021 and encourages further investigation into the factors contributing to this.**

The SSC also notes that both the authors and public testimony highlighted a range of considerations relevant to the consideration of the TAC (vs. the OFL/ABC) that the Council may want to consider.

Other SSC recommendations for sablefish:

Provide additional description of the specific mechanism for a change in survey availability. Explore whether this is due to changes in abundance within strata of the surveyed area or increased entry of smaller fish to the survey. This rationale is critically important for understanding whether design changes may be needed and/or whether further shifts in availability may occur in the future.

Explore potential changes in historical weight-at-age further. The SSC finds it plausible that changes may have occurred despite sparse historical data.

Provide bubble plots of Pearson residuals for all age and length data including the sign and scale of residuals; this is standard practice to effectively evaluate tuning and lack of fit.

Evaluate what information is available on the sex-ratio of the commercial catch. To the degree that dimorphic growth is present in this species, and the economic incentive to target larger fish, the current assumption of equal sex-ratio in the catch could be improved.

Provide additional information on the uncertainty reported for maturity curves, particularly the confidence intervals exceeding 1.0 for the GAM. The SSC suggests that further research on skip spawning should be a high priority as this process, if prevalent, could be important to understanding stock dynamics and reference points.

The SSC requests that the method for accounting for whale depredation be updated to reflect the additional years of data now available since its development. However, the SSC recognized that the contribution to the overall mortality appears to be low (given current methods) and therefore the priority of this work may be lower than some other issues.

This assessment has identified a broad spectrum in the age structure as a biological objective. The SSC suggests that specific hypotheses on why this is the case for sablefish would be helpful to review how important it is and to structure future research.

The SSC supports the JGPT recommendation to evaluate how information available to the assessment (logbooks and biological information) may change as electronic monitoring and observer coverage for fixed gear may change in the future.

The SSC also supports the JGPT recommendation to improve the process for ensuring that CPUE information is included in the assessment in a timely manner.

Economic SAFE

The Economic SAFE chapter information provided to the JGPT is complete through 2020. An updated, more current report will be available early next year, including further detail about tariff and COVID-19 impacts. In October 2021, the SSC suggested a comprehensive review of how socioeconomic information is incorporated in a range of evolving Council decision-informing products and to consider holding a regional workshop similar to the national Socioeconomic Aspects in Stock Assessment Workshop (SEASAW). The JGPT agrees that it would be useful to have a coordinated effort to improve the integration of socioeconomic work, but recommends that this be done in careful consideration of existing workload as part of the process and that a broad discussion with NOAA, SSPT, and Council staff be undertaken in this planning process. The SSC supports this recommendation.

C-3 BSAI SAFE and Harvest Specifications for 2022/2023

BSAI Walleye Pollock

Eastern Bering Sea Pollock

The SSC received a presentation on the 2021 assessment for the EBS pollock stock from Dr. Jim Ianelli (NOAA-AFSC). Public testimony was provided by Austin Estabrooks (At-Sea Processors Association), Mike Hyde (American Seafoods), Brent Paine (United Catcher Boats) and Trent Hartill (American Seafoods). Additional written comments were received from At-Sea Processors Association. All public testimony focused on concerns over the risk table and apparent discrepancies in how it is applied across stocks. For EBS walleye pollock, all testifiers felt that excessive caution was applied to this stock, even though the status of the stock is assessed using a state-of-the-art stock assessment model supported by an extensive data collection program; several testifiers urged the SSC to adopt the Tier 1 maximum permissible ABC. The SSC shares concerns over the application of the risk table and re-evaluated the proposed risk levels as described below. Regarding inconsistencies across stocks, the SSC refers to SSC guidance from October 2021, which provided a number of recommendations regarding risk scores, including the following:

> *"Risk scores should be specific to a given stock or stock complex. While comparison across species (e.g., within a tier, with similar life histories) or stocks is useful for consistency, the SSC does not support trying to prescribe a common reduction from the maximum permissible ABC for a given risk score across species or stocks because the processes underlying the score may differ among species and stocks. The SSC recommends that considerations of reductions in ABCs below the maximum permissible continue to be made on a case-by-case basis with justification based on risk scoring. The risk table rankings include qualitative information that requires a certain amount of subjective but well-informed interpretation of the available data by the author(s), the Plan Teams and the SSC, and as such, the SSC feels that blanket comparisons across species or stocks for the*

purpose of explicitly defining reductions in ABC below the maximum permissible are not prudent." (SSC Workshop on Risk Tables for ABC Advice to Council, June 2021)

This year's assessment includes the current base model (Model 20.0a), updated with new fishery data and with data from the 2021 EBS bottom trawl survey (biomass, age comps) and from Acoustic Vessels of Opportunity (AVO, biomass index). Two alternative models were considered that included additional data from the 2021 fishery, specifically length composition data (Model 20.0b) and, additionally, preliminary age compositions based on a global age-length key (Model 20.0c). These models were developed to address the unusual size composition during the B season fishery, which caught fish that were almost entirely less than 500 mm. In addition to the unusual size composition, fishery average weights-at-age were well below average, similar to last year. The only other years in the time series with similar anomalies were 2008 and 2012.

The SSC agrees with the author and BSAI GPT recommendation to use Model 20.0c for specifications this year as the model better accounts for recent anomalies in the age and size composition observed in the fishery and survey. The SSC notes that preliminary, length-based ages used in this assessment will be replaced with estimated ages from the aging lab in the next assessment. While this was an acceptable solution to address highly unusual patterns in size composition, the SSC does not recommend adopting this approach on a routine basis in future assessments due to concerns over the use of the global age-length key and over appropriate data weighting when measured lengths are used twice in the assessment as length composition data and to derive preliminary ages.

This year's bottom trawl survey indicated a substantial drop in biomass from the last survey in 2019 with the design-based estimate declining from ~5.5 million tons in 2019 to ~3.0 million tons in 2021. The 2021 AVO data suggests that a larger portion of the stock occurred off bottom, particularly on the northwest portion of the shelf, during the 2021 fishery compared to other years, resulting in a higher AVO index that was not well fit by the model. Public testimony highlighted this observation as a potentially positive sign. **The recommended model suggests that the estimated 2022 spawning biomass (1,881 kt), is below B_{MSY} (2,220 kt), placing the stock in Tier 1b.**

The SSC had a lengthy discussion about the continued placement of the EBS pollock stock in Tier 1 and the use of Tier 2 or Tier 3 calculations for catch specifications. Pollock have been managed as a Tier 1 stock, but the SSC has often used a more precautionary approach and has reduced the ABC from the maximum permissible ABC based on Tier 3 calculations, at least in part based on concerns over uncertainty in the spawner-recruitment relationship (SRR). These concerns were confirmed in analyses conducted by the authors last year, which highlighted the sensitivity of the SRR to prior specifications but concluded that the shape of the SRR was reasonable. Importantly, the current prior on the steepness parameter ensures that the SRR provides a better fit to the data near the origin and results in conservative estimates of the MSY reference points. However, the true uncertainty in F_{MSY} is likely substantially higher than that implied by its probability density function (pdf). For example, there have been concerns over reduced productivity during warm periods since at least the unusual warm period in 2001-2005, suggesting a time-varying SRR. **This is a concern because projections are based on the mean recruitment from 1977-2019, whereas mean recruitment in the last two decades has been notably lower** (Fig. 1-58 in the assessment). Under Tier 1, the pdf typically results in a relatively small reduction in F_{ABC} from F_{MSY} that does not adequately reflect the full uncertainty in F_{MSY}. The SSC further notes that the most probable value of F_{MSY} based on its posterior density (Fig. 1-44 in the assessment) is lower than the harmonic mean (which defines the maximum ABC under Tier 1), due to asymmetry in the distribution.

The authors, BSAI GPT and SSC have proposed various adjustments over the last decade to account for additional uncertainty, most commonly a Tier 3 approach that can result in a large buffer between the OFL and ABC. Since 2018, the rationale for this approach has been based on risk table considerations. As noted

in public testimony, the perceived additional risks and the Tier 3 approach have resulted in larger buffers for EBS pollock than for almost any other stock. Due to concerns over the lack of a rationale for the large buffer implied in the Tier 3 calculations, the SSC in October 2021 suggested that pollock may be a good candidate for the rarely used Tier 2 approach, which assumes that a reliable estimate of F_{MSY} is available, but not of its uncertainty (as quantified by the pdf). Previous analyses by the stock assessment authors suggest that, although there is substantial uncertainty in the estimate, the SRR and the resulting F_{MSY} as estimated in the model provide a reasonable description of pollock stock dynamics.

The SSC discussed whether managing EBS pollock under Tier 1 is still appropriate and concluded that the current best understanding of density-dependent dynamics in the stock related to cannibalism and density-dependent growth, and the advanced stock assessment model supported by extensive data collection programs, continue to support the Tier 1 designation. The SSC notes that Tier 2 also includes the same modeling and understanding of dynamics, but designates that the estimates of uncertainty are understated or not well understood, and this increases the buffer between OFL and ABC relative to the Tier 1 buffer. **Therefore, based on reviewing the risk table considerations, the SSC concludes that the retrospective bias, considerable uncertainty in the SRR and F_{MSY}, and environmentally-driven variability in recruitment still warrant additional precaution prescribed by the uncertainty in F_{MSY}. The SSC concurs with the author and BSAI GPT recommendation to use the Tier 2 ABC calculations for 2022 and 2023, which results in a reduction of 11% from the Tier 1 maxABC,** based on the ratio between $F_{40\%}$ and $F_{35\%}$ for this stock instead of the Tier 1 buffer based on the estimated uncertainty in F_{MSY}. The SSC notes that the approach has a solid basis in analyses that supported the development of the tier system for groundfish species. As noted in the document, the Tier 2 calculation is less variable than a Tier 3 calculation because it is directly tied to the Tier 1 OFL, and could provide a more stable buffer in future years if and when additional precaution is needed.

The SSC notes that although a buffer is still warranted, the recommended buffer (11%) is considerably smaller than last year's buffer (30%). A reduction in perceived risk is justified by the availability of a new bottom trawl survey in 2021, the observation of recent year classes estimated to be above average, and the outlook for improved environmental conditions in the coming year. Nevertheless, **the SSC agrees with the authors and BSAI GPT that increased risk remains a concern, but recommends a reduced risk level score in one case**:

- With regard to assessment considerations, the SSC agrees that the increased retrospective bias and uncertainty related to the need to constrain steepness with an informative prior justifies a level 2 risk score. Public testimony suggested that the reduction in the estimated spawning stock biomass (SSB) in 2021 already accounts for the retrospective bias, but the SSC notes that the concern with a (positive) retrospective bias is that the model may again overestimate SSB in the projections, regardless of the estimated trend in SSB and does not enter into the ABC calculation.

- **With regard to population dynamics considerations, the SSC recommends a change in the risk level from level 2 to level 1, noting that the stock being below B_{MSY} is not a reason for an increased level of concern because the harvest control rule already accounts for the low spawning stock biomass, which in this case is an additional 15% buffer.**

- With regard to ecosystem considerations, the SSC notes that recent shifts in distribution, unusual patterns in growth and size composition, and low mean recruitment in the last two decades remain a cause for concern. These patterns are associated with warmer ocean conditions and the cumulative effects from a series of recent warm years are likely to have some legacy effects, despite an apparent return to cooler conditions that are forecast to continue into 2022. The SSC therefore agrees with the level 2 score in this category. The SSC also discussed whether changes in fish condition are

already captured in annual weight-at-age information used in the assessment. Additional information about interpreting fish condition relative to assessment uncertainty would be helpful.

- With regard to fishery performance, the SSC agrees with the level 2 score recommended by the authors and GPT.

The SSC provides the following additional observations and recommendations:

- The SSC has previously highlighted the sensitivity of projections and F_{OFL} estimates to the assumed selectivity for future years and appreciates the authors' retrospective analysis of how the assumed selectivities have performed in projections. Results showed some systematic deviations between assumed selectivities and subsequent estimates of selectivity, but little apparent bias overall. However, the analysis also highlights the strong effect of selectivity on the estimated F_{MSY}. The SSC suggests that this kind of approach could be used to evaluate the performance of different selectivity assumptions in this and other stocks by assessing how alternative selectivity functions (recent averages, random effects estimates, etc.) compare to the subsequent estimates or, preferably, to the current best estimate. As noted by the BSAI GPT, the choice of what selectivity to use in projections is an issue for several Tier 1-3 assessments and the SSC recommends that the GPTs develop general guidance to assessment authors based on such performance evaluations.

- The SSC notes that new research on the genetics of walleye pollock largely supports a distinct stock of walleye pollock in the eastern and northern Bering Sea, consistent with current management. Pollock from the EBS and NBS (as well as the Chukchi Sea) are genetically similar to each other and are distinct from pollock in the Gulf of Alaska, in the Aleutians and around Bogoslof Island. However, there appears to be some mixing of stocks, given that some fish sampled in the Bering Sea were genetically more similar to GOA pollock and some fish in the western GOA were more similar to Bering Sea pollock. **The SSC was encouraged by these results and supports recommendations to obtain samples from Russia to include in future analyses**.

- The SSC appreciates the continuing work on the multi-species, climate-enhanced model and notes that results from this model support additional precaution for the pollock stock based on multi-species considerations. Compared to the assessment model, the multi-species model generally estimated a higher biomass but very similar trends for walleye pollock. The model projects an increase in SSB in 2022, followed by a decrease in 2023 to 72-100% of the 2021 SSB based on ensemble projections using climate-informed recruitment. Additionally, the model resulted in a larger reduction in projected ABCs from 2021 when run in multi-species mode compared to the single-species mode, suggesting that multi-species considerations support the use of more conservative ABCs.

Aleutian Islands

A partial assessment was presented for Aleutian Islands pollock, which are assessed on a biennial basis. No changes were made to the assessment, but the projection model was updated with new catch data without re-estimating parameters or reference points. The stock is managed under Tier 3 and remains in Tier 3a as the spawning biomass is above $B_{40\%}$. **The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs, with no reduction from maxABC.**

BSAI Pacific Cod

Eastern Bering Sea Pacific Cod

The SSC received a presentation from Dr. Grant Thompson (NOAA-AFSC) on the 2021 Eastern Bering Sea Pacific cod assessment, and BSAI GPT comments and recommendations. The SSC would like to thank

Dr. Thompson for his dedicated service to the EBS Pacific cod stock assessment and the GPTs, and for his invaluable contributions to advancing sustainable fisheries assessment and management practices in Alaska. Dr. Thompson's guidance, patience, and attention to detail will be missed.

Written public testimony was provided by the Freezer Longline Coalition (FLC) and oral public comment was provided by Chad See of the FLC. These comments did not support the use of the model ensemble, and suggested the SSC consider using the status quo model (19.12a) as the basis for 2022 harvest specification. In support of this preference for model 19.12a the FLC highlights the high scoring of this model relative to other ensemble members by the CIE reviewers, a potential preference for a single model rather than an ensemble from the perspective of the new assessment author in 2022, and the question of who would provide future scores for ensemble members given that the CIE review is complete. SSC responses to several of these concerns are detailed below. Public comment also expressed support for the risk table exercise and the authors' assertion that current levels of risk do not support a reduction from maxABC for 2022.

New data available in 2021 for the EBS Pacific cod stock assessment include: (1) updated fishery data through 2021 including catch and size compositions, (2) NMFS bottom trawl survey data for the EBS and NBS in the form of a VAST model-based abundance index; (3) EBS+NBS survey size compositions through 2021 expanded using design-based estimates; (4) EBS+NBS survey age compositions through 2019 expanded using VAST estimates; and (5) a VAST model-based CPUE index informing Model 21.2. The time series of the VAST model-based EBS+NBS biomass index changed in 2021 due to an increase in the specified number of knots (750 vs. 100) specified for the VAST model, and changes in the subset of survey hauls used to create the index. Following recommendations from the SSC in October 2021, the VAST model used to generate the fishery-dependent CPUE index for the EBS region (informing model 21.2) was updated to only extrapolate abundance across the range of observed fishing events, rather than extrapolating across the entire EBS shelf into areas with no fishing effort.

This assessment benefited from a thorough CIE Review in spring of 2021. Among other recommendations the CIE reviewers provided two specific pieces of guidance for the current assessment: (1) recommendation of a suite of five models for inclusion in an ensemble which incrementally build upon the base model by adding only a single new change to the assessment model structure or a single new data input, and (2) scoring for alternative ensemble member models based on an established set of criteria to be used as the basis for model weighting. It should be noted that the SSC removed from consideration one model from the CIE-recommended set of five in October 2021.

The EBS Pacific cod stock is assessed using age-structured single-sex models. For the 2021 assessment the authors recommend, and the BSAI GPT has endorsed, the use of an ensemble of four models, including:

- 19.12a – the current base model
- 19.12 – base model, with time-varying survey catchability
- 21.1 – base model, with dome-shaped survey selectivity
- 21.2 – base model, with VAST fishery CPUE index

While a model ensemble has been proposed in the past and the SSC has expressed interest in exploration of ensemble approaches during prior assessment cycles, it has always selected a single model for harvest specification. However, the SSC feels that the ensemble approach and the member models themselves have been refined with guidance from the CIE review to a point where they represent a valid basis for the assessment. **The SSC supports the use of the four model ensemble and associated model weights, as**

proposed by the authors and recommended by the BSAI GPT, as the basis for the 2021 assessment and 2022-23 harvest specification.

The SSC supports the use of the proposed model ensemble for the 2021 assessment for several reasons:

- The individual assessment models comprising the ensemble represent a tractable set of alternative model structures, or data inputs, each representing a clear incremental change from the base model.

- The scoring criteria for weighting members of the model ensemble is clear and reasonable, with transparent scoring criteria and scores provided by an independent review body as part of the 2021 CIE review.

- The model ensemble may provide stability over time in assessment estimates and management recommendations, as evidenced by the reduced retrospective pattern observed for the model ensemble.

The SSC highlights that this is not a blanket endorsement for ensemble approaches for this or other stocks. Clear and defensible justification for the approach and each member model will need to be provided for any assessment proposing a model ensemble approach in the future.

Under the proposed model ensemble (Models 19.12a, 19.12, 21.1, 21.2) the projected 2022 spawning biomass is above $B_{35\%}$ but below $B_{40\%}$, placing this stock in Tier 3b. The SSC supports this tier designation and the recommended OFL.

The risk table for EBS Pacific cod specifies a risk level of 1 (normal) for all categories with the exception of the environmental and ecosystem considerations, where a risk level of 2 (substantially increased concerns) is specified. The determination of increased risk under environmental and ecosystem considerations was based on the overall warm conditions and reduced prey availability in the NBS, however the authors' highlight that these concerns are tempered to some extent by closer to average temperature conditions in the EBS, near average sea ice extent, and a south-westward movement of the population in the recent bottom trawl survey. **The SSC concurs with the proposed risk scoring for this stock, and the authors' recommendation for no reduction from maxABC under Tier 3b.**

The projected 2022 OFL and maxABC represent a substantial increase. This change is due primarily to updated data inputs. A detailed data bridging analysis was conducted by the authors for the base model 19.12a to investigate what new information is driving the substantial (63%) increase in maxABC projections for 2022 from this model, between the 2020 and current 2021 assessments. Sequential addition of new data indicated that the 2021 NMFS bottom trawl survey size composition, new 2021 EBS+NBS abundance index, and updated historical survey index time series accounted for 85% of this change. The authors' note that the lack of a 2020 bottom trawl survey likely contributed to the large change with the addition of the 2021 data.

The SSC offers the following recommendations for this assessment:

- If model ensembles are brought forward in the future, the authors should work with the BSAI GPT to define a process whereby GPT members themselves assign model scores based on the same, or an updated set, of scoring criteria. This would allow for future development of ensemble member weightings based upon independent review, and the SSC believes this would address one of the concerns highlighted in public comment.

- The SSC has commented in the past on the exclusion of fishery age composition data as an input

to the assessment, which is fairly standard for other groundfish stock assessments throughout Alaska where these data are available. The SSC thanks Dr. Thompson for his review of the history and considerations for excluding these data in the current assessment and in the past, which centered on data availability and model performance issues when these data are included. The SSC recommends that inclusion of these data be fully explored in a later assessment cycle, either within a single model or multiple ensemble members, highlighting that it views this as a top priority for future research.

- Given that an ensemble model structure has been endorsed by the SSC in 2021, representing a fairly large change in the assessment process, if the new authors choose to propose an ensemble in the future it may be prudent to minimize changes to the suite of models comprising the ensemble so that the potential benefits of a stable ensemble can be realized.

There was additional discussion during the SSC meeting about what should constitute a model variant within an ensemble, and whether ensemble members should only include structural changes representing alternative assumptions about demographic or observation processes. The underlying question being whether models such as 21.2 which include a new data input should be treated as a separate ensemble member, or whether efforts should be made to include new or different data inputs within all ensemble members. While the SSC does not have a specific recommendation on this point, it encourages the authors to consider this question if an ensemble is brought forward in the future.

Aleutian Islands Pacific Cod

The SSC received an overview of the Aleutian Islands Pacific cod assessment from Dr. Grant Thompson (NOAA-AFSC). There were no public comments. This stock has been managed under Tier 5 using a random effects model since it was first assessed separately from the EBS in 2013. The authors presented four models similar to those shown at the October 2021 SSC meeting. The four models included the base Tier 5 random effects model (13.4), introducing new observer-collected macroscopic maturity data (19.0 and 19.0b), the previously used histological maturity data (19.0a) and an increase in the natural mortality value (19.0b). The authors recommended 19.0 during the BSAI GPT meeting, but later changed the recommendation to 19.0b when presented to the SSC.

The SSC appreciates the authors continuing to try to move forward with an age-structured model. There has not been a new survey data point since 2018, which makes both adopting a new model and Tier 5 estimates problematic and the SSC continues to stress the importance of a 2022 AI survey. There remains some concerns that the BSAI GPT and SSC had commented on in past meetings. Several alternatives for natural mortality were presented. Without a firm justification and resolution of the natural mortality value, the authors might choose the prior point estimate (M = 0.36) calculated using the multi-method barefoot ecologist tool, or using that prior and attempting to estimate it within the model.

In terms of maturity, the SSC previously requested the authors consider fitting the two maturity curves inside the model rather than one data source fit outside the model. The author responded that estimating the combined estimates in the model is confounded with ageing error. The SSC disagrees and notes that if this is true, a better explanation would be helpful. This method has been used successfully in Gulf of Alaska rockfish models. The SSC reiterates that fitting both data sets within the model would improve the perception of maturity uncertainty and use all the data available, as it is unknown whether the macroscopic scans of maturity are as accurate as histological at this time; nor is it known whether the large change in maturity is from the methods, spatial extent, or a temporal change.

The authors recommend moving to an age-structured model (19.0b) but using the risk table to highlight assessment uncertainties to reduce to the Tier 5 ABC. Rather than adopt a Tier 3 model only to use the Tier 5 ABC, the BSAI GPT recommended continuing with the Tier 5 model (13.4) and OFL and ABC calculations; the SSC agrees and further notes that it is prudent to wait until the 2022 AI survey is conducted to consider adopting an age-structured model. **Thus, the SSC recommends that Model 13.4 (Tier 5) should be used for setting ABC and OFL in 2022 and 2023.** The SSC agrees with the tier and resultant catch specifications. Risk table scores were assessment (2), population dynamics (1), environmental/ecosystem (2), and fishery performance (1). As the highest risk score (2) is greater than 1, a case could be made for additional reductions in ABC. The BSAI GPT noted that primary concerns were that the age-structured model was nascent and the lack of survey data were the rationale for a Tier 5 ABC and supported delaying implementation of the age-structured model. Because the recommendation continues to be Tier 5, **no additional reduction below maxABC was recommended; the SSC agrees.**

Specific comments and recommendations:

1) **The SSC recommends further examination of the AFSC longline survey for potential use in this assessment, particularly because there have now been multiple spans of four years between AI bottom trawl surveys.**

2) Ensure that figure values match table values in various places

3) In Figure 2A.22, ensure that the correction for stratified age samples is correct. The typical calculation would provide unbiased mean lengths-at-age, not corrected individual specimens. These figures look identical

4) The tables for MCMC and figures for MCMC estimates of biomass, recruitment, and total biomass are identical for both 19.0 and 19.0b

5) Recruitment graphs Figure 2A.42 and 2A.43 appear to be identical

6) Check projections for table for Model 19.0 as expected ABC/OFL values are different from summary table

7) This length-at-age (pp. 13 - 14) section could be re-written and more specific to how the length-age calculations are conducted

BSAI Flatfish

Yellowfin Sole

Yellowfin sole is assessed annually and therefore a full assessment was presented this year. The base model for this Tier 1 assessment (Model 18.2) was first developed in 2018, modified slightly in 2019 and remains unchanged for the current year. Two additional models that included VAST estimates for the EBS (Model 18.2a) and the EBS and NBS (Model 18.2b) were presented but ultimately not selected. Updated data included fishery age compositions for 2020; total catch for 2020; estimated catch for 2021; shelf trawl survey biomass estimates, standard errors, and survey length composition for 2021. Additionally, VAST estimates and standard errors for the EBS only (Model 18.2a) and the EBS and NBS (Model 18.2b) were included. There was no public testimony.

Yellowfin sole biomass continues a long, slow decline and was estimated to be 19% lower than in 2019. However, spawning biomass was estimated to be 1.8 times greater than Bmsy, which qualifies it for management under Tier 1a under the base model. Over the past decade, catch has been only approximately

50% of the ABC. Recruitment has generally been below average over the past two decades, but slightly above average for the past two years. Projections of female spawning biomass suggest a stable biomass into the future.

The risk assessment showed increased levels of concerns for the population dynamics and Environmental/Ecosystem considerations. The author originally increased concerns for assessment related considerations due to poor fits to the spawner-recruit curve, but upon further discussion during the BSAI GPT meeting the risk level was reduced from level 2 to 1. The population dynamics concerns centered around the long (30 year) decline in biomass along with generally less than average recruitment. Additional SSC discussion centered around similar declines for yellowfin sole in the GOA and AK plaice in the BS. A detailed description of the relatively poor condition of the ecosystem for yellowfin sole in addition to published work suggesting that temperatures were nearing their thermal tolerances (Yeung et al., 2021). While the author and the BSAI GPT thought a reduction from maxABC was warranted, the SSC disagreed that the concerns were large enough to warrant a reduction. The SSC discussion also noted that the NBS is not included in the preferred model and should these fish be considered part of the BS population, then the total biomass may be underestimated. In addition, the negative retrospective pattern suggests the stock size has been chronically underestimated.

The SSC supports the BSAI GPT's and authors' recommended model (18.2) and its associated OFL for 2022 and 2023. The SSC did not support the BSAI GPT's and author's recommendation for a reduction from max ABC and **recommended the maxABC from Model 18.2 for 2022 and 2023.**

The SSC commends the author for thoroughly addressing the majority of its previous comments, especially noting the much-improved retrospective patterns due to these updates. The SSC looks forward to continued work on previous recommendations, especially with bringing forward updated models that include VAST estimates and include NBS data (similar to models 18.2a and 18.2b) and incorporate NBS bottom temperatures into estimates of survey catchability (if appropriate). An important issue discussed by the SSC was the posterior probability distributions for key model parameters (Figure 4.31) still indicate the absence of the smooth probability distributions that are often associated with model convergence and efficient MCMC sampling. The SSC suggests that this could result from poor MCMC chain mixing, an insufficiently long chain, or high autocorrelation, that may be indicative of important estimation challenges within this complex assessment model. **The SSC requests the authors present standard MCMC convergence diagnostics including trace plots, autocorrelation, and potential scale reduction factors for model parameters and derived quantities.** The SSC also requests the authors investigate the negative values for recruitment in the lower confidence interval of Table 4.18.

Finally, the author and the BSAI GPT highlighted potential impacts associated with the implementation of Amendment 80, including an incentive to reduce discards of smaller fish and changes in observer coverage. The SSC encourages the author to seek input from the industry to explore these potential effects along with other factors (e.g. markets, tariffs) that may be impacting fishery catch compositions.

BSAI Greenland Turbot

A partial assessment was presented this year for BSAI Greenland Turbot. This stock is assessed on a biennial basis and is managed in Tier 3a. The next full assessment will be in 2022. There was no public testimony. New input data for the projection model included updated catch for 2020 and estimated catch for 2021–2023. Catch in 2021 was estimated as a product of the 2021 TAC and the average proportion of the TAC caught between 2016 and 2020 (54.925%). The catch in 2022, and presumably 2023, was set equal to the estimated 2021 catch.

The OFL and ABC recommendations for 2022 are slightly higher than those projected by the 2020 full

assessment model and there is a projected decrease in 2023. The catch-to-biomass ratio for this stock remains quite low in 2021 (0.04).

The SSC notes that total biomass from the 2020 assessment model shows a declining stock trend since the early 1970s and the projected 2021 biomass is the lowest in the time series. Exploitation on the stock has been low with catch far below the TAC and the TAC set below the ABC.

The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs and EBS/AI apportionments, with no reduction from maxABC.

The SSC appreciates the authors' responses to SSC comments in this partial assessment, and for updating the catch in projections to be less than the ABC since only a portion of the ABC is generally caught.

BSAI Arrowtooth Flounder

A partial assessment was presented this year for BSAI Arrowtooth flounder. This stock is assessed on a biennial basis and is managed in Tier 3a. The next full assessment will be in 2022. There was no public testimony. New input data for the projection model included updated catch for 2020 and estimated catch for 2021–2023. Catch in 2021 was estimated as the product of 1.07 and the official catch as of October 30th, where 0.07 represents the average fraction of catch taken after October 30th in the last five years (2016–2020). To estimate catches in 2022 and 2023, the authors used a product of the average ratio of catch to ABC for the last five complete catch years (2016–2020) and the projected ABCs for those years. The resulting OFL and ABC recommendations for 2022 are slightly higher than those projected by the 2020 full assessment model and there is a small projected increase in 2023. The catch-to-biomass ratios for this stock remain low in recent years (approximately 0.01).

The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs, with no reduction from max ABC.

BSAI Kamchatka Flounder

A partial assessment was presented this year for BSAI Kamchatka flounder. This stock is assessed on a biennial basis and is managed in Tier 3a. The next full assessment will be in 2022. There was no public testimony. New input data for the projection model included updated catch for 2020 and estimated catch for 2021–2023. Catch in 2021 was estimated as the product of 1.0493 and the official catch as of October 8, where 0.0493 represents the average fraction of catch taken after October 8th in the last five years (2016–2020). Catches in 2022 and 2023 were set equal to that of 2021. The resulting OFL and ABC recommendations for 2022 are slightly higher than those projected by the 2020 full assessment model and there is a small projected increase in 2023. The catch-to-biomass ratio for this stock remains low in 2021 (0.05).

The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs, with no reduction from max ABC.

BSAI Northern Rock Sole

A partial assessment was presented this year for BSAI northern rock sole. This stock is assessed on a biennial basis and is managed in Tier 1a. The next full assessment will be in 2022. There was no public testimony. New input data for the projection model included updated catch for 2020 and estimated catch for 2021–2023. Catches in 2021–2023 were estimated as the average catch over the most recent decade of final catches (2011–2020). The resulting OFL and ABC recommendations for 2022 (214,084 t and 206,896

t, respectively) are slightly higher than those projected by the 2020 full assessment model and a large increase from those of 2021 (145,180 t and 140,306 t, respectively) due to large incoming recruitment classes. There is another large projected increase for the 2023 OFL and ABC (280,621 t and 271,199 t, respectively). The catch-to-biomass ratios for this stock have been decreasing in recent years to a low in 2021 of approximately 0.01.

The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs, with no reduction from maxABC.

BSAI Flathead Sole

A partial assessment was presented this year for BSAI flathead sole. "Flathead sole" represents a two-species complex consisting of true flathead sole (*Hippoglossoides elassodon*) and Bering flounder (*H. robustus*) and is assessed on a biennial basis and managed in Tier 3a. The next full assessment will be in 2022. There was no public testimony. New input data for the projection model included updated catch for 2020 and estimated catch for 2021–2023. Catch in 2021 was estimated as the sum of the official catch as of October 28th and the average October 28–December 31 catches over the previous five years (2016–2020). The 2022 and 2023 projected catches were calculated as the average catch over the years 2016–2020. The resulting OFL and ABC recommendations for 2022 are nearly identical to those projected by the 2020 full assessment model and slight increases are projected for the 2023 OFL and ABC. The catch-to-biomass ratio for this stock is low in 2021 (approximately 0.015).

The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs, with no reduction from max ABC.

The estimated biomass of EBS Bering flounder in the EBS has decreased by an order of magnitude over the last four years and is at the lowest estimated biomass in the time series. The SSC requests the authors provide any available information in the full 2022 assessment as to possible reasons for the decline.

Alaska Plaice

A full assessment was conducted for Alaska plaice, which is on a biennial assessment cycle. The model has been unchanged since the 2011 assessment. Updated data included estimates of catch and discards for 2021; shelf trawl survey biomass estimates, standard errors, and survey length composition for 2021; survey age composition for 2019, and the 2019 and 2020 fishery length composition. There was no public testimony.

Alaska plaice is a non-target species, but biomass is slowly declining even though the catch is consistently well below the ABC. Survey biomass in the EBS decreased 9% from 2019 to 2021 and is the lowest value in the survey time series. However, catch was less than 50% of the ABC in 2021. Additionally, there appears to be above average recruitment over the last five years, resulting in projections that show an increase in biomass into the future. The stock is projected to be well above B40% at current levels of exploitation.

The risk assessment showed low levels of concerns for all categories. However, there was a discussion regarding the long, slow decline in biomass, similar to that in BSAI yellowfin sole. It was noted that the strong recruitment for Alaska plaice mitigates these concerns.

The SSC supports the BSAI GPT's and authors' recommended ABCs/OFLs for 2022 and 2023, under Tier 3a.

The author continued to investigate biomass in the NBS, noting that over 50% of the survey biomass currently resides in the NBS. While trawling is prohibited in the Northern Bering Sea Research Area, the spatial distribution of Alaska plaice does not suggest any stock separation. **The SSC appreciates the authors' investigation of this issue and recommends examining new models that include the use of the NBS data in a similar manner to many other BSAI stocks, perhaps through a combined EBS+NBS**

VAST index. The author should also consider the potential for differences in age-at-maturity and size-at-age between the EBS and the NBS as they move forward. Additionally, the SSC suggests that the author examine the utility of estimating catchability (q) within the model rather than relying on a fixed value (1.2).

BSAI Rockfish

Pacific Ocean Perch (POP)

The SSC received a partial assessment for BSAI Pacific ocean perch, as well as a short summary presentation from Dr. Thompson (NOAA-AFSC). There was no public testimony. The projection model was updated with final 2020 catch data, revised 2021 and 2022 catch estimates, and an estimate for 2023 catch. No changes were made to the Tier 3 assessment model, or the method used to estimate area apportionments. **The SSC accepts the projected ABCs and OFLs for 2022 and 2023, as recommended by the author and BSAI GPT. The SSC also supports the assessment authors' continued efforts to resolve the model's poor fit to the survey index in recent years, as summarized in previous SSC (Dec. 2020) and BSAI GPT (Nov. 2020) recommendations.**

Northern Rockfish

The SSC would like to commend the authors for their work on this assessment. There was no public testimony. This recommended model and the set of models brought forward was not seen at the September plan team meeting or by the SSC in October. The SSC reiterates the general policy to limit the number of models brought forward in December that have not had the full benefit of the fall assessment review process. The SSC appreciates the BSAI GPT reviewing their policy regarding this during their meeting.

The last full assessment of BSAI northern rockfish was in 2019. Changes in data inputs for this full assessment include updated catches through 2020, projected catches for 2021, and 2019 and 2020 fishery age compositions. Northern rockfish are primarily encountered in the Atka mackerel fishery. However, with restrictions on the Atka mackerel fishery in place, increased direct targeting of northern rockfish has been occurring in recent years. Discard rates have generally correspondingly declined as well. The SSC appreciates the detailed information from the observer program presented in the assessment document in support of this. Within the fishery, there has been inconsistent sampling of northern rockfish over the years and an area-specific age-length key has been used since 2019 to produce fishery age compositions from the length compositions.

The most recent AI survey was completed in 2018. There was no survey in 2020 due to COVID-19, but a survey is scheduled for next year (2022). **The SSC notes the critical importance of completing the 2022 AI bottom trawl survey for the most accurate assessment of the status of this stock and looks forward to updated survey information for the next full assessment.** Survey data show that the stock is more abundant in the western AI and overall, survey biomass estimates have declined from a peak in 2014. The SSC requests that the uncertainty for the survey biomass estimates be included in all of the figures with these data. Survey age compositions are also produced using area-specific age-length keys.

Stemming from a BSAI GPT recommendation in 2019, the authors' recommended model (Model 21) includes a change to a constraint on the survey selectivity curve relative to the 2019 accepted model (Model 16.1a). This change effectively fixes the survey selectivity at 1 for ages 30 or greater by using a tightly constraining prior, shifting the curve to the right from Model 16.1a and increasing the scale of the population. This recommendation was the focus for this year's assessment, and the authors brought forward an additional series of models that explored this change. The SSC notes that removing the constraint (Model 21b) did not result in a survey selectivity that was dome-shaped, providing support for the assumption of an asymptotic selectivity curve shape. Fits to the AI survey biomass estimates are similar across these series of models, but those models with constraints on survey selectivity have a slightly better fit in recent years,

mirroring a decline in biomass estimates. RMSE values for the age and length compositions are similar between the previously accepted assessment model and the author's recommended model, with a slight improvement in survey fit with Model 21. The author notes several times that the available data are not very informative with respect to selectivity and the scale of the population is still relatively uncertain. The additional flexibility in estimating selectivity prior to age 30 is the primary reason the author recommended Model 21 for harvest specifications. The BSAI PT agreed with this model choice.

The SSC concurs with the author's and BSAI PT's recommended model for setting harvest specifications. The assumption of an asymptotic selectivity shape is reasonable and aligns with how survey selectivity is modeled for other rockfish species. Results from this model place BSAI northern rockfish in Tier 3a.

This is the second consecutive assessment where the scale of the population has increased, somewhat surprisingly given the life history of this long-lived, slow-growing species. In the 2019 assessment, changes to selectivity and the age-length keys also produced an increase in the scale of the population. Harvest specifications have increased by roughly 50% since the 2018 assessment (e.g. 2019 OFL = 15,507 t vs 2022 recommended OFL = 23,420 t). However, this increase was not informed by new survey data during this time. Moreover, the ABC has increased nearly 300% since 2000 when the survey biomass was at approximately the same level and the SSC suggests the authors explore whether that is reasonable for this long-lived stock. The SSC also notes the retrospective Mohn's rho also increased somewhat to a moderate - 0.18. The SSC identifies these issues as potential cause for concern.

The author updated the risk table and, in response to a previous SSC recommendation, clarified the sources of uncertainty not included in the model or tier of this stock. A risk score of 2 was put forward for assessment related concerns, in part due to the retrospective pattern and to the need for restrictive priors to estimate selectivity. All other categories had a risk score of 1. The author noted the concerns regarding the potential inconsistency between the genetic spatial structure of the stock and the management area under the population dynamics risk category but suggests that this risk has not been realized as targeting of northern rockfish has only been occurring recently. The author and BSAI PT recommend no reduction from the maximum ABC permissible, due to the high stock abundance and low catch relative to the ABC. **The SSC appreciates the explanations provided in the risk table and agrees with the use of maxABC for this stock.** However, the SSC would like to refer to their general comment regarding the use of stock status as a source of information to inform reductions from maxABC, as the risk tables are intended to evaluate the risk of the ABC exceeding the true OFL.

There continue to be concerns regarding the need for highly restrictive priors to estimate a reasonable survey selectivity curve. The retrospective pattern is negative but persistent and the author indicates that he intends to investigate this further. Finally, as the SSC reiterates its request that the aging error matrix be updated with data from the BSAI, as the assessment author did not have time to complete the request this cycle.

The relative paucity of data available for this Tier 3 species is a primary issue with this assessment, and the SSC recommends the author review any potential sources of data in the AI, including ADF&G surveys. It would also be helpful to confirm the absence of northern rockfish in the EBS survey data, noting the increase in the portion of the AI survey that enters the southern Bering Sea in 2018, following the marine heatwave. With regard to readability, the SSC suggests the technical description of the model (e.g. equations etc.) be moved to an appendix in this assessment, and the main document contain a detailed text description of the model structure. A final concern that the SSC wishes to elevate is the potential for a mismatch in the spatial structure of this stock, as noted by the assessment author as well. A stock structure evaluation was completed as an appendix to the 2012 assessment. This included information on an area-specific evaluation of growth using AI survey data that indicated differences in growth among AI subareas, EBS and the GOA. Genetic data also supported stock structure at a smaller spatial scale than currently used for management.

Given the concerns described by the assessment author and the recent interest in directed targeting of northern rockfish, the SSC suggests updating the information presented in the stock structure appendix for the next full assessment in 2023, given that it will be more than 10 years old at that time and there may be new survey information available.

Blackspotted and Rougheye Rockfish Complex

The SSC received a partial assessment for BSAI rougheye/blackspotted rockfish complex, with a short summary presentation from Dr. Thompson (NOAA-AFSC). There was no public testimony. No changes were made to the 2020 assessment models. The projection model for the Tier 3, Aleutian Islands portion of the stock was updated with final 2020 catch data, revised 2021 and 2022 catch estimates, and a 2023 catch estimate based on an average of 2020 and 2021 F rates. No changes were made to the input data for the Tier 5, Eastern Bering Sea portion of the stock since no new EBS slope survey data have been available since 2016. **The SSC accepts the author and BSAI GPT recommended ABCs and OFLs estimated with the Tier 3 projection model, as well as the Tier 5 estimate of ABCs and OFLs for the EBS.** No changes to the area apportionments occurred, and **the SSC accepts the author recommended area allocations**. No changes were made to the methods of calculating the maximum subarea species catch (MSSC) for the Western and Central Aleutian Islands, and **the SSC accepts the author and BSAI GPT recommended MSSC for these subareas. The SSC supports the assessment authors' continued efforts to address previously identified SSC and BSAI GPT recommendations (December 2020) which pertain to the assessment model. Additionally, the SSC wishes to restate its October 2021 recommendation to develop a white paper which summarizes how the Spatial Management Policy can be used to address conservation and management concerns stemming from the disproportionate spatial harvesting of the BS/RE complex in the Western and Central AI.**

BSAI Atka Mackerel

BSAI Atka mackerel is a Tier 3 stock for which an annual assessment is produced. There was no public testimony. Since 2002, the BSAI Atka mackerel stock assessment has been conducted using the Assessment Model for Alaska (AMAK), customized for Atka mackerel and implemented in AD Model Builder. The stock assessment document describes the history of assessments, fisheries, historical management actions including mitigation actions associated with Steller sea lions, and the current stock assessment modeling approach. The biennial AI trawl survey is the only fishery-independent data source for this assessment and, because the 2020 survey was cancelled due to COVID-19, there has not been an AI trawl survey since 2018. The **SSC concurs with the BSAI GPT that conducting an AI bottom trawl survey in 2022 is a high priority and essential for management of fisheries in this region**.

This assessment presented results from the base model (16.0b) and there were no changes in the modelling methods. The 2020 catch estimate was updated and estimated total catch for 2021 was set equal to the TAC. Catches for 2022 and 2023 were estimated and the 2020 fishery age composition data were added. Time-dependent fishery selectivity is used in this assessment and the estimated average fishery selectivity for 2016–2020 was used for projections. Consistent with previous assessments, the authors assumed that approximately 85% of the BSAI-wide ABC is likely to be taken under the revised Steller Sea Lion Reasonable and Prudent Alternatives implemented in 2015. This percentage was applied to the 2022 and 2023 maximum permissible ABCs, and those reduced amounts were assumed to be caught in the estimation of the 2022 and 2023 ABCs and OFL values.

The authors' recommended 2022 ABC is a 7% increase from the 2021 ABC. This is due to (1) an increase in the projected female spawning biomass resulting from the 2012- and 2017-year classes being stronger in the fishery than expected last year, and (2) a shift in selectivity to older fish, leading to an increase in F_{ABC} and F_{OFL}. The current estimate of $maxF_{ABC} = F_{40\%adj} = 0.54$ is 25% higher relative to last year's estimate, due to changes in the fishery selectivity used for projections. Projected 2022 female spawning biomass at

$B_{39\%}$, placing BSAI Atka mackerel in Tier 3b.

Model fits were reasonable. The coefficient of variation about the 2021 biomass estimate was 23%. Recruitment variability was moderate with Sigma*R* estimated to be 0.48. The overall residual root-mean square error (RMSE) for the survey biomass data was estimated at 0.278.

Fishery and survey selectivity are both modeled with a smoothed non-parametric relationship and exhibit dome-shaped selectivities. Fishery selectivity is allowed to be time-varying, but survey selectivity is not. The dome-shaped patterns reflect the age compositions fairly well, but the mechanisms responsible for dome-shaped selectivity are uncertain and several factors likely contribute. Mature fish may be aggregated and unavailable to the summer surveys which can occur during the spawning season. Temperature may also affect recruitment of Atka mackerel and availability to the bottom trawl survey. **The BSAI GPT recommended, and the SSC supports, that the authors continue research into possible reasons for dome-shaped fishery and survey selectivity patterns, including senescence or differential distribution by age.** As the BSAI GPT acknowledged during the report on EBS pollock, the problem of projecting selectivity is common across a number of Tier 1-3 assessments. **The SSC highlighted the sensitivity of projections and F_{OFL} estimates to the assumed selectivity for future years in this assessment and recommended that BSAI Atka mackerel would be a good case study to examine when the GPTs develop guidance to assessment authors on what selectivity to use in projections for Tier 1-3 stocks (see General Stock Assessment Comments under C-3 BSAI and C-4 GOA specifications and SAFE Report).**

Previously the SSC noted that a "scale change" in the retrospective pattern appears after data from 2012–2014 are dropped from the model and requested the author report additional diagnostics including Woods Hole rho, RMSE, and Hanselman's phi. The current assessment reports Mohn's rho (0.067) and RMSE and the authors indicate that an analysis of additional diagnostics will be brought forward at the 2022 BSAI GPT meeting. The SSC appreciates the authors' responsiveness to the SSC's request.

The SSC commends the author for the thorough risk table discussion. The Team discussed the lack of Atka mackerel in Area 542 in the 2018 survey and whether this would be a reason for increasing the level of risk for the stock assessment to a level 2. The author indicated that the model adequately deals with this uncertainty and that an increase in risk level was not warranted. During discussion of possible alternative indices for this stock (e.g., AFSC longline survey), the author indicated that they had investigated a number of possible indices but none of those examined proved to be adequate for this species.

The SSC notes the increase in rockfish in the Aleutian Islands reported in the AI ESR. This was discussed by the BSAI GPT as a potential concern. The author agreed that there may be some competition for forage, but also noted that the overlap in the depth distributions of rockfishes and Atka mackerel is limited and thus direct competition is likely minimal.

The assessment author rated all categories of the risk table at level 1 and did not recommend a reduction from maximum ABC, and the BSAI GPT agreed. While the SSC noted that there is additional concern in the assessment due to no survey since 2018, the SSC agreed with the risk table scores for this assessment. The BSAI GPT accepted the author's model (16.0b), which places the stock in Tier 3b, and specifications of OFLs and ABCs for 2022 and 2023. The BSAI GPT also accepted the continued use of a four-survey weighted average for area apportionment. **The SSC concurs with author's and the BSAI GPT recommended model, Tier, specifications of OFL and ABC, and apportionments.**

BSAI Skates

The BSAI skate complex is assessed biennially. The last full assessment was in 2020 and a partial

assessment was presented this year. There was no public testimony.

The complex is separated into two components to generate harvest recommendations: Alaska skate (*Bathyraja parmifera*), which is the most abundant skate species in the BSAI, and the remaining species (i.e. "Other Skates"). Alaska skate harvest recommendations are based on an age-structured model and managed under Tier 3a, while Other Skates are managed under Tier 5. The Tier 3 and Tier 5 recommendations are combined to generate recommendations for the whole complex.

No changes were made to the assessment methods. New data for the Alaska skate projection model included updated 2020 catch data, preliminary 2021 catch estimates, estimated total catch for 2022 and 2023. The EBS shelf bottom trawl survey biomass estimate time-series, including 2021, was provided. The Tier 5 random effects model for the Other Skates component was not re-run.

While not included in the partial assessment calculations, the estimated survey biomass for the aggregate skate complex on the EBS shelf was shown to decrease slightly relative to 2019 (511,965 t vs. 528,826 t). There was no survey in 2020 due to COVID-19. Catches remain well below the ABC.

The SSC concurs with the author's and BSAI GPT's recommended OFL and ABC for the BSAI skate complex, with no reduction from maxABC. The SSC requests that the methods used for catch projections be detailed in future assessments.

BSAI Forage Species

The SSC commends the authors on an excellent report for the Status of Forage species in the BSAI. There was no public testimony.

Forage species include numerous forage fishes (BSAI FMP listed), juveniles of managed groundfish, Pacific herring, and salmon, Arctic cod, shrimps, and squid. The purpose of this biennial report is to monitor potential impacts of bycatch on forage fish by (1) investigating trends in forage fish abundance and distribution, and (2) describing interactions between federal fisheries and forage species. Additional information on forage species diet, predation (e.g., seabirds) and ecology is linked in the Ecosystem Status Report.

A number of research surveys provide data for the report, including the AFSC bottom trawl surveys on the EBS shelf and slope, and in the AI, the AFSC Ecosystem Monitoring and Assessment (EMA) program surface trawl, biennial acoustic surveys for pollock in the middle and outer domain of the EBS shelf. None are optimized for sampling forage fish and there were several spatial, temporal, and selectivity issues identified; therefore, the authors note that results from individual surveys (i.e., years) are less important than longer-term trends.

Noteworthy items from the 2021 report are provided below:

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

5) 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.
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.

Forage fish are sensitive to changes to the physical environment, which may result in shifts in their distribution in the water column and their survival. Understanding the impacts of the recent persistent warming of the EBS on interactions between fisheries and forage species will require additional acoustic surveys and improved estimates of survey selectivity. There is a need to examine how changes in forage fish abundance affects predator prey choice and predation on the juveniles of commercially important species. The SSC is supportive of these research directions, as well as other research topics identified in the report.

As forage fish are the linkage between the lower and upper trophic levels, understanding stock structure, trends in abundance, interactions between federal fisheries and forage species, and movement distribution is key to ecosystem-based fisheries management. **The SSC concurs with the BSAI GPT recommendation for a forage species workshop** to discuss (1) surveying and population estimation of forage species, (2) importance of forage to different managed species (e.g., evaluate the suite of current food web models), (3) questions about how climate change may impact forage biomass and exploitation rates, (4) how best to report on changing populations, scientific knowledge about forage species, and the dependence of other species on them; including timing, frequency, and scope of the report, and (5) potential resulting management measures from shift in bycatch or spatial distribution of the forage base. **The SSC also recommends that in light of the recent substantial increases in squid catch levels, this workshop focuses on identifying the threshold for placing squid back in the fishery.**

The BSAI GPT recommended coordination between editors of the ESR and the forage report to reduce redundancy. While the SSC supports efforts to reduce redundancy, there was hesitancy to support the initial suggestion of considering a combined forage species report for Alaska due to the significant differences in stock structure, ecosystem role, and dynamics across the GOA, BS and AI. **The SSC recommends that this topic would be a good discussion point for the proposed workshop.**

C-4 GOA SAFE and Harvest Specifications for 2022/2023

GOA Walleye Pollock

The SSC received a presentation on the GOA walleye pollock assessment from Cole Monnahan (NOAA-AFSC) and extended its welcome and thanks to the new lead author for quickly coming up to speed on this assessment. The SSC also thanks Martin Dorn for his many years as lead author on this assessment. No structural changes were proposed to the current base model (19.1) for the western portion of the stock (W/C/WYAK) or to the random effects approach for pollock in Southeast Alaska. There was no public testimony.

The age-structured model was updated with data from 2020 (total catch and catch at age in the fishery, age composition from ADF&G trawl survey) and new survey data from 2021, including a biomass index and age compositions from the winter Shelikof Strait acoustic survey and biomass indices and length compositions from the NMFS bottom trawl survey and the summer acoustic survey. Three of the surveys included in this assessment showed increases in biomass and only the summer acoustic survey showed a decrease. This relative consistency among surveys further alleviates concerns over conflicting trends between the Shelikof Strait survey index and other survey indices in 2016-2018, which previously resulted

in an increased level of concern and the adoption of a 10% buffer. Consistent with the observed increases in survey biomass, the model results suggest a slight increase in biomass from 2020.

Survey and model results also suggest that the strength of the 2018 year class is lower than initially estimated based on the number of age-3 fish observed in the surveys, although there are some mixed signals in the fishery data and the true strength of the year class remains unresolved. In addition, there are some promising indications of a strong 2020 year class based on the number of age-1 fish in the Shelikof survey and other observations. The fishery is no longer dominated by the 2012 year class, resulting in a higher age diversity compared to recent years. The assessment has a fairly stable retrospective pattern (Mohn's rho = 0.056).

The ESP was updated with new data for 2021 and the SSC thanks the authors for an informative summary and update of trends in ecosystem conditions, which suggested average to above average conditions for walleye pollock in 2021.

While the authors and GOA GPT identified some concerns with patterns in weight-at-age and the absolute scale of the population estimates, the **SSC concurs with their recommendation to use model 19.1 for setting 2022 and 2023 OFLs and ABCs for the western portion of the pollock stock (W/C/ WYAK areas), placing the stock above $B_{40\%}$ (Tier 3a) with a negligible probability of falling below $B_{20\%}$ over the next 5 years. The SSC also agrees with the authors and GOA GPT to use the random effects model fit to 1990-2021 survey biomass east of 140 °W to specify OFLs and ABCs for the Southeast Outside management area under Tier 5.** Finally, the SSC agrees with the previously accepted methodology for apportioning the ABC between areas and between the new A (formerly A&B) and B (formerly C&D) seasons.

Based on the risk table, the authors and GOA GPT identified no elevated concerns this year; hence, no reduction from the maximum ABC is recommended. **The SSC appreciates the thorough discussion of risk table considerations and with setting ABC equal to the maximum permissible ABC.**

The SSC discussed some of the current concerns with this assessment and generally supports the proposed research priorities for improving the assessment. **The SSC suggests prioritizing research on any model components that affect the scale of the population estimates**, including in particular catchability and survey selectivity in the Shelikof Strait and bottom trawl surveys, as well as data weighting issues:

- The SSC suggests that an initial step in addressing concerns over the prior on q in the bottom trawl survey would be to fit a model that uses an uninformative prior, at least as a sensitivity run. The author indicated this sensitivity test had already been completed, and the SSC looks forward to reviewing the results of this and other sensitivity tests in October 2022.

- Regarding the Shelikof Survey, the authors explored an alternative parameterization of time-varying catchability (q) using a logit transformation to constrain q to be less than 1. This resulted in an improved fit to the survey data due to greater variability in q, as well as a lower mean value for q and substantially higher spawning biomass estimates. The SSC encourages further exploration of an appropriate parameterization for q (see also SSC minutes from October 2021) to determine whether the resulting q is realistic or whether the parameterization may artificially constrain q to be well below 1 based on influence of the prior and the logit distribution.

- The SSC supports future research to identify the optimal level of constraint on among-year variation in Shelikof Survey catchability (q), including the potential to estimate the process error variance internally within the assessment model.

- The SSC reiterates its recommendation from December 2020 to explore the use of covariates related to the timing of the survey to inform survey catchability in the Shelikof Strait survey. For example, the difference in timing between peak spawning and mean survey date or, alternatively, the proportion of mature fish in the survey, are likely to inform time-varying catchability in the survey.

- The SSC supports assessing the sensitivity of the absolute population scale to data weighting, and future research to identify optimal weighting schemes.

The SSC further supports GOA GPT recommendations to investigate alternative methodologies for projecting weight-at-age, for example using a random-effects model rather than simple averages over recent years. The SSC notes that this is a general issue across all age-structured assessments that could benefit from additional guidance for stock assessment authors. The SSC also encourages considerations of temperature-dependent growth and its effects on weight-at-age, perhaps in the context of the multi-species model that is being developed for the GOA or as a separate research project.

The authors assessed the influence of different data sources by iteratively removing different survey indices, and associated length and weight composition data, quantifying the resulting impact on biomass estimates and associated uncertainty. This leave-one-out experiment showed that the NMFS bottom trawl survey had by far the strongest influence on population estimates, whereas the summer acoustic survey had a minimal impact. The SSC appreciates these analyses and suggests that they should become a regular component of the assessment.

The SSC noted that recruitment deviations in the GOA pollock assessment are unconstrained except for the terminal two years, and suggests that exploring a moderate constraint on recruitment deviations in all years, as is commonly applied in other assessments, may be warranted. At a minimum, this would allow an assessment of the sensitivity of results to only constraining the last two years.

Regarding area apportionments (Appendix 1D), the SSC suggests simplifying the computations in the Appendix to reflect the new season structure to the extent possible, without changing the underlying methodology. For example, it appears that seasons B1 & B2 (formerly C & D) could be combined as they use the same apportionment scheme. The SSC notes that the model predictions for age 2+ spawning biomass used in the calculation of winter biomass by area were from the 2020 version of the model instead of the 2021 version. The author updated these values in response to questions during the SSC meeting to the accepted 2021 model output, resulting in minor changes to the A season apportionment among 610, 620, and 630 (< 15 mt). There were no changes to A season area 640 nor the B season.

Finally, the SSC encourages the authors and GOA GPT to re-evaluate whether assessing Southeast Alaska walleye pollock as a separate stock is justified or whether the available data support a single, gulf-wide stock assessment. This evaluation may also benefit from considering recent studies on the genetic structure of walleye pollock across Alaska and the North Pacific.

GOA Pacific cod

The SSC received a presentation from Steve Barbeaux (NOAA-AFSC) on the assessment of GOA Pacific cod. The SSC thanks Dr. Barbeaux and the other authors for their detailed assessment, presentation, and willingness to explore new environmental linkages. Clearly, assessments should be striving to explain model processes with environmental and ecosystem processes when possible and this assessment has made significant progress in that regard. There was no public testimony. The authors presented three models, the base model (19.1), a new model with a change in the heat wave natural mortality block (21.1) and a third model with new environmental linkages to growth and recruitment and natural mortality (21.2). All three models show some degree of recovery of the stock.

Model 19.1 had several environmental linkages already; the recent marine heatwave related natural mortality (M) block and temperature-dependent catchability on the AFSC longline survey. These linkages seemed to be well vetted over the last several years. Model 20.1 uses a different set of years for the M block (2015 - 2017 instead of 2014 - 2016), but the rationale for that is less clear as it was based on statistical fit rather than a mechanistic hypothesis. The additional linkages and addition of the beach seine index presented in Model 21.2 degrade some of the model fits to the most important indices and some compositional data (ages). It was unclear to the SSC which model deficiencies were being addressed with this full suite of changes.

The addition of the age-0 beach seine index, after allowing for additional variance to be estimated, degraded fits to the other indices, and did not clearly improve the estimation of recruitment because the estimated variance of the index is larger than the assumed recruitment variability (CV = 0.44). Additionally, the index represents a limited portion of the GOA Pacific cod distribution, and the back-calculation of the full spatial grid for the early years of the beach seine index could be problematic with few years of full spatial coverage, as the earlier years have very narrow spatial coverage. The SSC looks forward to seeing the publication describing the methodology.

The SSC appreciates the inclusion of jitter results for the three possible models. While lack of convergence for some iterations is not a bad property of jitter results, as it indicates a broad search over the parameter space, the relative high number of jitters that did not converge (24%) for Model 21.2 relative to 19.1 and 21.1 may indicate it is less stable due to greater complexity.

The environmentally linked growth formulation is interesting but leaves some questions and resulted in only modest improvements to the conditional length-at-age data with the new six-parameter form. In addition to accounting for environmental variation, the shape of the new curve differs from the previous growth model, as evidenced by the strong monotonic change in length-at-age for the 10+ group predictions. The SSC appreciates the model evaluation assessing the significance of the environmental growth relationships, which showed that the environmental links for some growth parameters either were not significant (K), or were marginally significant (L2 and R0), based on both the Hessian and MCMC approaches. The SSC suggests that if these links are considered in future years, that a similar evaluation be conducted and marginally significant links be omitted.

In summary, the SSC concluded that the additional complexity included in Model 21.2 is premature at this time without further explanation and exploration of the individual changes. Each change should be supported with a sufficient rationale and an assessment of model improvement. The SSC in October was interested in examining models with only one change for this meeting, particularly a model that excluded the beach seine survey. The rationale for changing the M block in Model 21.1 was not fully justified beyond a better fit to the data and opens up the need for more rigorous lines of inquiry, such as fully time-varying natural mortality or a multi-stage fitting of the M block including both location and length of the block. The SSC appreciated receiving the ESP report card and notes that it may be beneficial if some of these potential linkages and research models could be tracked and evaluated in the ESP. In this way, specific hypotheses about environmental correlates could be evaluated and examined before being considered or recommended as operational models. The SSC suggests that generally the addition of covariates should clearly improve model performance to warrant inclusion in a model used for management purposes.

Based on recent tagging and genetic studies, the SSC encourages further development of the movement hypothesis as an important contributor to the rapid population changes in GOA Pacific cod. Movement should be considered in concert with high natural mortality events for future models, and specifically consideration should be given to an Alaska-wide stock or one that includes WGOA within the EBS stock assessment.

The SSC again recommends the use of Model 19.1 as the basis for 2022 and 2023 harvest specification. Under Model 19.1, the 2021 spawning stock biomass remains below B40%; however, the stronger 2018 recruitment and limited fishing mortality in 2020 - 2021 are projected to result in increased spawning

biomass in 2022 and 2023, with both years projected to be above B20%. With spawning biomass projected to remain below B40% in 2022, this stock falls under Tier 3b.

In the risk table for the 2021 assessment, the authors identify that all risk levels have now returned to level 1, therefore the authors assert that setting ABC below the maximum permissible level is not warranted. **While the choice of Model 19.1 results in a higher ABC than the author and GOA GPT recommended model, the SSC supports the authors' and GOA GPT's recommendation to set ABC and OFL for 2022 and 2023 at the maximum permissible level under Tier 3b.** ABC apportionment based on the addition of the 2021 GOA bottom trawl survey resulted in a similar distribution to the previous assessment with slightly more allocated to the WGOA. **For 2021, the authors and GOA GPT are again recommending the random effects apportionment scheme and the SSC agrees, noting the stair step employed in 2020 is no longer necessary.** The SSC reiterates their encouragement for the authors to consider whether information from the IPHC setline survey and NMFS longline survey, alongside the NMFS bottom trawl survey, may provide a superior basis for apportionment recommendations, perhaps through the use of an integrated spatiotemporal model or a multi-survey random effects model.

Despite not utilizing Model 21.2 this year, the SSC thanks the authors for their diligence in exploring the ecosystem-linked model structure and thoughtful approach to incorporating temperature-dependent larval growth and mortality and exploring new indices. The SSC supports future exploration and development of assessment models that inform mortality, growth and recruitment based on temperature or other relevant mechanistic covariates, to the extent the authors believe this effort will help better explain the population dynamics of this stock now and in the future.

Specific additional recommendations include:

- Provide a discussion of whether the period of elevated M estimated in recent models, and other environmentally-driven dynamics should be included in the calculation of reference points and/or stock status
- Provide an explanation as to whether all age-classes should be expected to be affected equally by marine heat waves, and over which time periods and by what mechanism they may be affected
- Please elaborate on how the Dirichet-multinomial method verified that the current weights are "correct"
- Address implausibly large standardized residuals observed for smaller fish in the fit to NMFS bottom trawl length frequency data
- Provide more details about the spatial-temporal correlation that informs the historical beach-seine index where no historical data exist
- Include standard MCMC diagnostics for all model parameters and derived quantities if posterior distributions are to be evaluated as part of the model results. These should include tests for burn-in, auto-correlation and mixing of the MCMC chain(s).
- Explore the potential for hook-competition in the IPHC index if it is to be incorporated

GOA Flatfish

Shallow-water Flatfish Complex

A full assessment for the shallow-water flatfish complex was presented. The shallow-water complex is composed of northern rock sole, southern rock sole, yellowfin sole, butter sole, starry flounder, English sole, sand sole and Alaska plaice. The two rock sole species are assessed by age-structured assessment

models under a Tier 3 assessment, whereas a random effects model is used for the other species in the shallow-water flatfish complex under a Tier 5 assessment.

Northern/Southern Rock Sole

The SSC thanks the assessment author for their work on this assessment and the GOA GPT for their comments and presentation. There was no public testimony. The GOA northern and southern rock sole assessment is on a four-year cycle and was last assessed in 2017. This 2021 assessment represents a full assessment for these two species. The OFLs and ABCs for these species are combined with the shallow-water flatfish complex. New data inputs include:

- Updated catches from 2017 – 2020 and estimated total catch for 2021
- 2019 and 2021 GOA trawl survey biomass estimates and length compositions
- 2018 – 2021 fishery lengths
- 2017 survey conditional age at length (CAAL) for northern rock sole, and 2017 and 2019 survey CAAL data for southern rock sole were added

The SSC notes that there were no southern rock sole samples collected in 2019 and recommend these samples be collected in the future. This assessment also underwent a CIE review in 2021. One of the key recommendations from this review is that an improved approach to modeling of growth was necessary. At the September plan team meeting, the author presented information that demonstrated differences in growth patterns between the central and western GOA. The author noted that the observed differences in growth patterns were less pronounced for southern rock sole than northern rock sole. At the SSC October 2021 meeting, it was noted by the GOA PT that a two-area model had been attempted by the author and was not considered a viable approach at that time. The SSC then requested that the author bring forward a series of single-area models in December that included an update to the aging error matrix and a VAST survey biomass time series. Following the October SSC meeting, the assessment author diagnosed and corrected the issue with the two-area models. For this assessment, the SSC was presented with two series of models for each species that are both single area and two-area models, but without the SSC recommended model aspects from the October meeting, which included an updated aging error matrix and an application of VAST to the GOA bottom trawl survey data. There is no mention of the new aging error matrix or the VAST survey estimates in the assessment document or in the GOA PT minutes. Upon questioning during the SSC meeting, the assessment author confirmed the updated aging error matrix was used in their recommended model and the SSC requests that the author update the assessment document to reflect this.

From a process standpoint, it has been the policy of the SSC and the Plan Teams to limit the number of models brought forward in December that have not had the full benefit of the annual groundfish assessment review process. Models that are brought forward in this manner are subject to a somewhat higher bar of review. **The SSC found this deviation from the typical review process concerning and reiterates its commitment to this policy as a matter of transparency and consistency in assessment review.** However, the SSC appreciates the author's extraordinary work on model development and diagnostics. This allowed the SSC to move forward in evaluating the new models.

For northern rock sole, the eight models presented include:

- 17.1 (base model with data updated though 2021)
- 17.1a (17.1 with fishery selectivity fixed to be asymptotic)

- 17.1b (17.1 with CV at maximum age fixed)
- 17.1c (combines 17.1a and 17.1b)
- 21.0 (a two-area model version of 17.1)
- 21.1 (21.0 with the fixed CV at maximum age)
- 21.2 (21.0 with asymptotic fishery selectivity)
- 21.3 (21.0 but with fixed growth parameters)

Results from these models indicate similar fits among the models to the CAAL data, fishery length compositions and survey length compositions. Within the two area models, growth appears to be estimated adequately when compared to the model with fixed growth parameters (Model 21.3), though growth in the western GOA was not estimated as well as in the central GOA area. All models consistently underestimate survey biomass from 2005 – 2013, and then overestimate from 2015 – 2021, though the two-area model fit was better during this later period. The authors recommend Model 21.2 be used for northern rock sole management advice, as it allows for separate estimation of growth by area, improvement to the fit to recent survey data, and given the distributions of the fishery length compositions, an asymptotic selectivity seems reasonable. Retrospective analyses on all the northern rock sole models indicate a strong positive retrospective pattern. Looking at the total likelihood and likelihood components (Table 4.13), Model 21.2 has a lower total likelihood than the other two-area models. The age composition and the length composition likelihood components from Model 21.2 are also lower than those from Model 21.3. While the retrospective pattern for Model 21.3 was slightly worse than Model 21.2, the overall fit was slightly better, and the two-area model appears to be biologically plausible.

The model series for southern rock sole was similar but excluded models where the CV at maximum age was fixed. These included:

- 17.1 (base model with data updated though 2021)
- 17.1a (base with fishery selectivity fixed to be asymptotic)
- 21.0 (a two-area model version of 17.1)
- 21.1 (21.0 with fishery selectivity fixed to be asymptotic)
- 21.2 (21.0 but with fixed growth parameters)

Results show that fits to the CAAL, the fishery length composition data and survey length compositions are similar across models. Fits to survey biomass show similar residual patterns across models, as seen in the northern rock sole models – a period of underestimation followed by a shorter period of overestimation in recent years. Model 21.2 with the fixed growth parameters did not fit the survey length compositions as well at the other two area models, though it fits the CAAL data better. This model also estimates a lower spawning biomass and higher fishing mortality, and was outside the uncertainty associated with the other models. The author recommends Model 21.1 for harvest specifications, as it better accounts for differences in growth between the western and central GOA. This model also has a relatively small positive retrospective bias. The GOA GPT agreed with the author's recommended models for both species.

The SSC concurs with the author and GOA GPT recommended models for each species (Model 21.2 for northern rock sole and Model 21.1 for southern rock sole). As noted by the author and GOA GPT, these models better represent the observed differences in growth for both species and there are improvements in the model's fit to the survey data. The SSC appreciated the extensive documentation on the new recommended models in the tables/figure and the appendices, which was necessary given the abbreviated review process. The results from these models would place both species in Tier 3a. **The SSC also concurs with the use of the maximum ABC for harvest specifications.**

The SSC supports the author's list of future work presented in the assessment. As mentioned in the October 2021 SSC report, the next assessment should attempt to address the large positive retrospective pattern seen in the northern rock sole model, which continues to be a concern in the current recommended model. The author's planned investigation into the non-stationary residual pattern of the bottom trawl survey fits with time-varying catchability may be informative. Breaking the retrospective analysis out by area might also be a good diagnostic method to help isolate potential mechanisms**. In addition, the SSC recommends the author investigate using observer data to evaluate the current 50/50 split assumption between northern and southern rock sole catch.** Finally, the SSC requests that investigations into the use of VAST to estimate survey biomass continue to move forward as a part of this effort.

The SSC also has several new recommendations not addressed by the author's planned work:

- The assessment would benefit from a more comprehensive overview of available biological information and specifically information on movement, mechanisms of spatially defined differential growth, and how recruitment may settle between the areas. The assessment would also benefit from a table showing area-specific fishing mortality and whether this may influence interpretation of growth.

- The SSC forwards a past recommendation that data weighting continue to be explored.

- The SSC thanks the author for the development of a risk table for these species. In the future, the SSC would request a reference be provided if a complex-level risk table is located in a separate assessment document.

Finally, the SSC notes that several flatfish stocks appear to have area-specific growth and demographic characteristics. Future research should take a comprehensive view, across species, on demographic and biological mechanisms for differential growth, migration, and potential spatial patterns in recruitment.

Other Shallow-water Flatfish Species

Biomass of species other than northern and southern rock sole were estimated using the same random effects model used in the 2015 and 2017 assessments. Catch data were updated and the model was fit to survey biomass for 1984 to 2021.

While there has been a decline in biomass of the six Tier 5 species since 2001, there was a 1% increase between 2019 and 2021. Trends in biomass vary among the six Tier 5 species, with declines in Alaska plaice (-53%), butter sole (-28%), starry flounder (-34%), and yellowfin sole (-1%), but increases in biomass for English sole (101%) and sand sole (16%). The SSC noted that English sole, a generally more southern species, is showing an increasing trend in abundance and catch, while yellowfin sole, a more northern species, is showing the opposite trend. It was noted that the incidental catch trends tend to match survey biomass trends. The SSC requests comparing available data for shared species from Canada and the U.S. West Coast to see if trends are a result of climate-induced movement, or increases across all areas.

Shallow-water Flatfish Complex combined specifications

Area-specific apportionment of ABC for the shallow water flatfish complex (including northern and southern rock sole) was calculated by fitting the random effects model to the survey biomass summed for all species by area and estimating the percent biomass in 2021 by area. This was the same method used in the 2017 assessment.

A risk table was produced for the combined Tier 3 (northern and southern rock sole) and Tier 5 (other shallow-water flatfish species). A level 1 (normal) was assigned to all areas of consideration other than assessment-related considerations, which was given a level 2 (substantially increased concerns) because the northern rock sole model fit to the bottom trawl biomass exhibits a pattern of autocorrelation indicating potential non-stationarity and exhibits a strong retrospective pattern. In addition, the GOA GPT indicated that a level 2 was warranted for assessment-related considerations because yellowfin sole survey estimates have shown a steady decline for a number of years. **The SSC concurs with the authors' and Plan Team's recommendation not to reduce ABC from maxABC.** The SSC appreciates that the authors looked at multiple species when constructing the risk table for a well-rounded evaluation for this stock complex.

The SSC supports the authors' and GOA GPT's recommendations for ABC and OFL in 2022 and 2023, and associated area apportionments, using combined Tier 3 (northern and southern rock sole) and Tier 5 (other shallow-water flatfish species) calculations for this stock complex.

Deepwater Flatfish Complex

The SSC was presented with a partial assessment of the GOA deepwater flatfish complex, along with a short summary presentation from Dr. Jim Ianelli (NOAA-AFSC). This stock complex is assessed on a four year cycle and was last fully assessed in 2019. The deepwater flatfish complex is composed of Dover sole, Greenland turbot, deepsea sole, and Kamchatka flounder (a new addition to the complex). Dover sole is assessed using Tier 3 methods and no updates were made to the assessment model. The projection model for Dover sole was updated with final catch data for 2019-2020, revised catch estimates for 2021, and projected 2022 and 2023 catches, and provided species-level estimates of ABCs and OFLs for 2022 and 2023. Greenland turbot and deepsea sole are Tier 6 stocks, with OFLs set equal to the average catch from 1989-1995 for each respective species.

Kamchatka flounder is also considered a Tier 6 stock, with an OFL set equal to the maximum catch in the historical time series (69 tons), as previously recommended by the SSC in December 2019. In November 2021, the GOA GPT noted a large discrepancy between the 2021 estimated survey biomass of 6 tons and the species-level ABC of 52 tons. The SSC briefly discussed the rationale for selecting the maximum value rather than an average of the catch time series, which only dates back to 2011, and did not identify a need to change the OFL determination.

The SSC accepts the complex-level ABCs and OFLs for 2022 and 2023 for GOA deepwater flatfish, which constitute the sum of the species-level ABCs and OFLs for those years. The methods for apportioning the GOA-wide ABCs and OFLs for the deepwater flatfish complex in each management area are based on the proportion of survey biomass found within each management area between 2001-2021 for the Tier 6 species. Dover sole is apportioned using a random effects model to produce estimates of survey biomass within each management area in 2022 and 2023. **The SSC accepts the apportioned ABCs for each management region for the GOA deepwater flatfish complex for 2022 and 2023.**

Rex Sole

GOA rex sole is assessed every four years with an age-structured model in two distinct areas (Western-Central GOA and Eastern GOA) and is managed in Tier 3a. The last full assessment was in 2017. This year, a full assessment was done. Updates to the model included using Francis data weighting methods and estimating survey catchability with a normal prior based on previous survey efficiency studies. In addition to updating the data sets to include the most recent data since the last full assessment, the authors omitted the 1984 and 1987 bottom trawl survey data. These data are not comparable to the rest of the survey time series because of differences in survey timing and methodology in those years. A mini bridging analysis to examine the effect of these changes indicated that:

- Francis reweighting method provided better fits to survey biomass than the McAllister-Ianelli approach, which was used in the last assessment. The Francis method puts more emphasis on the survey biomass data than composition data, unlike the McAllister-Ianelli approach, which emphasizes composition data in its weighting scheme. This was relevant because of several recent large year classes seen in the fishery that have high uncertainty at this time.
- Estimating catchability led to better objective function values compared to fixing catchability at 1.
- Removing the 1984 and 1987 survey data had little effect on model performance.

The SSC agrees with the changes made to the model and concurs with the authors' and GOA GPT's recommendation to accept Model 21.0 for this assessment.

Model results indicated that there may be some mismatch in growth occurring in the data based on model fits to the fishery data. For example, a larger proportion of fish ~20-30 cm in length was estimated by the model compared to what has been observed in the fishery. There is the potential that the model is not tracking time-varying growth as evidenced in the fits to conditional age-at-length data, which was also observed in the last assessment. The SSC suggests that the authors remain cognizant of these temporal patterns between the growth morphs in future assessments. There was a minor retrospective pattern in Model 21.0 that was within acceptable limits (indicated by a small value for Mohn's rho).

A risk table was completed for this stock with a level 2 (substantially increased concerns) for assessment-related considerations and population dynamics considerations. Environmental/ecosystem considerations and fishery performance considerations were both assigned level 1 (normal). **The SSC concurs with the authors' and GOA GPT's recommendation not to reduce ABC from maxABC.**

The SSC concurs with the authors' and GOA GPT's recommended OFL and ABC for GOA rex sole for 2022 and 2023, as well as the associated area apportionments of ABC based on a random effects model applied to GOA bottom trawl survey biomass in each area.

The authors discussed several research priorities, including development of an aging error matrix (SSC recommendation in 2017), exploration of natural mortality rates, updated information on maturity-at-age, and research into mechanisms behind the different growth patterns between Western-Central GOA and Eastern GOA (e.g., genetic and/or environmental). The SSC supports these areas of future work. The SSC notes that differences in growth patterns between these areas are also observed in other species and suggests that exploration into this phenomenon be done within a broader context that includes other flatfish species that may, or may not, display a similar pattern.

Arrowtooth Flounder

A full assessment was conducted this year using the same assessment methodology as the 2019 assessment (Model 19.0 for this assessment). The authors updated data inputs including estimates of total catch; trawl survey biomass estimates, standard errors, and age compositions from the GOA bottom trawl survey; and sex-specific trawl survey age and fishery length-frequencies from observer samples. An updated risk table showed all scores to be Level 1, suggesting the stock was at normal levels of concern for the risk categories.

The SSC thanks the authors for their responsiveness to previous comments by the GOA GPT and SSC. Two requests by the SSC and GOA GPT were investigated in this assessment:

- Evaluation of opportunistically collected trawl survey lengths from 1985, 1986, and 1989: Results showed that removing these data had very small impacts to model fits and outputs. **The SSC appreciates the author's responsiveness and concurs with their decision to remove these data from model inputs.**

- Whether age composition data are available from the trawl fishery: As noted by the authors, since the onset of the Observer Program in 1990, there are very few years with adequate sample sizes for inclusion in this assessment and sampling has been sporadic. **Thus, historical samples are severely limited and new collections would be required to provide this information for the future, which the SSC does not recommend at this time.**

Trends in female spawning stock biomass have shown a general decline since the high levels that occurred during the mid-2000s, but remains well above B35%. Bottom trawl survey biomass has been stable since 2017, with the 2021 estimate being 26% below the long-term average. Both the IPHC and AFSC longline survey indices have generally shown recent increases, but are also below long-term averages. The longline surveys are not used in the assessment model. Arrowtooth flounder are lightly exploited in fisheries, with the 2021 TAC for arrowtooth flounder set below ABC and projected catch likely less than 10% of the ABC.

The 2022 estimate of SSB is well above the estimate of B40%, placing this stock in Tier 3a. The SSC agrees with the authors' and GOA GPT's recommended OFL and ABC. The SSC appreciates the application of the risk table in this assessment and agrees that no reduction from the maximum ABC is necessary.

The SSC also endorses the authors' and GOA GPT's recommendations for future work that includes:

- Investigating the lack of fit in female survey age and fishery length compositions, including interactions between female natural mortality and selectivity.

- Consider incorporating estimates of predation mortality from the GOA CEATTLE model.

- Re-examine growth assumptions, update age-length conversion matrices, and consider alternative surveys and VAST estimates.

- Further investigation of incorporating the AFSC and the IPHC longline surveys into the assessment. The SSC notes that hook competition corrections may be appropriate and should be considered in these investigations.

The SSC notes that the arrowtooth flounder assessment extrapolates current year catch in October using the average of catch taken between October 17 and December 31 in the last five complete catch years (e.g.

2016-2020). Given changes in arrowtooth harvest due to fluctuations in markets and "top-off" fisheries, the SSC requests the authors consider whether other projection methods would better reflect fishery changes.

Finally, the last CIE for arrowtooth flounder was done in 2017 and was focused on the BSAI arrowtooth stock. It is unclear whether the BSAI CIE is applicable to the GOA assessment, which has not had a specific CIE review in over five years. The SSC encourages consideration of whether a CIE is appropriate for this stock.

Flathead Sole

The SSC was presented with a partial assessment for GOA flathead sole, along with a short summary presentation from Dr. Jim Ianelli (NOAA-AFSC). The last full assessment was in 2017 and is typically assessed on a four year cycle, although this year's full assessment was delayed until 2022 (due to staffing limitations). This stock is assessed using Tier 3 methods, and there were no changes to the assessment model. The projection model was updated with catch data from 2017-2020, and projected catch from 2021-2023. **The SSC accepts the region-wide projected ABCs and OFLs for 2022 and 2023 for flathead sole.** The area apportionments were updated this year based on the projected proportions of survey biomass in each area in 2021 and 2022 from the random effects model. T**he SSC accepts the GOA GPT and author recommended apportionments for 2022 and 2023 but agrees with the GOA GPT's recommendation to update apportionments only in full assessment years in the future.**

GOA Rockfish

Pacific Ocean Perch

The SSC received a presentation on the 2021 GOA Pacific ocean perch (POP) stock assessment. There was no public testimony.

Pacific ocean perch in the GOA are assessed on a biennial stock assessment schedule. However, an off-cycle full assessment was conducted in 2020 in anticipation of a CIE review that occurred in 2021. The SSC reviewed several model changes in December 2020 and accepted an updated model. The 2020 model 20.1 includes a revised aging error matrix, updated fishery age compositions and a prior on trawl survey catchability and natural mortality. In 2021, the authors did not plan any substantial changes to the assessment. **Therefore, the SSC supports, in agreement with the authors and the GOA GPT, the recommended Model 20.1 for the 2021 assessment**. The POP stock is currently in Tier 3a and rankings in two risk table categories were Level 2, substantially increased concerns, and environmental and ecosystem considerations were Level 1, normal.

The SSC notes that there is a substantial retrospective pattern in the assessment that shows consistent underestimation of the biomass (even with substantial increases in trawl estimates). This retrospective pattern should be addressed; however, with the consistent underestimation there is no need to reduce the ABC below the maximum permissible level. **The SSC agrees with the author and the GOA GPT recommendations for area apportionments based on the random effects model.**

The SSC further notes that the estimate of q is much greater than 1 (q=1.82) (when the prior is set at 1.15 based on evidence of higher density in trawlable areas). The authors should update the section on catchability as the new prior is only mentioned in the responses to SSC comments section of the report. These concerns regarding q and the retrospective pattern suggest potential underestimation of biomass/OFL/ABC.

The SSC learned that the authors considered the 2020 model as an intermediate step to additional changes resulting from the CIE review. The authors provided a summary of the CIE reviewer recommendations and responded with a timeline for addressing each recommendation as follows:

1) Examine the feasibility of incorporating hydroacoustic information into the assessment.

   - Assessment scientists will continue to work with MACE in 2022 and 2023 to investigate the utility of this survey in the POP assessment.

2) Examine the sensitivity of the model to changes in catchability and selectivity.

   - Assessment scientists will perform this request as a sensitivity run in the summer of 2023.

3) Examine the quality and utility of the VAST model for POP abundance and apportionment.

   - Assessment scientists will work with the Groundfish Assessment Program (GAP) to evaluate the VAST model for POP in the spring of 2022.

4) Examine data weighting for compositional data.

   - This has continually been evaluated since 2017 and the model results are very sensitive to the weight used on the biomass index. Assessment scientists will present updated results in September 2022.

5) Reevaluate the plus age group.

   - Assessment scientists have explored this in previous assessments, but will update this analysis in the summer of 2022.

6) Examine how fishery-dependent ages are being collected.

   - Assessment scientists have previously evaluated time dependent weight-at-age and have made comparisons between the survey and fishery. Assessment scientists will update this analysis in the spring of 2023, in particular with the different groups of ages, as well as new methods of length stratified sampling.

The assessment authors intend to evaluate the majority of the CIE recommendations before the next full assessment in 2023. **The SSC appreciates the author's compilation of CIE recommendations and requests that the authors develop responses to these recommendations as they address them.** The SSC looks forward to the opportunity to review proposed model changes prior to the next full assessment in 2023. **The SSC also reiterates its request from December 2020 that the author explore whether the prior on M is still constraining.**,

Northern Rockfish

The SSC was presented with a partial assessment for northern rockfish. The GOA northern rockfish stock is assessed on a biennial cycle using Tier 3 methods (Tier 3a), with the next full assessment scheduled for 2022. No changes were made to the most recent (2020) assessment methodology. The projection model was updated with final catch data for 2020, revised catch estimates for 2021, and projected catches for 2022 and 2023. The SSC was also presented with both the updated VAST and design-based estimates of survey biomass for information purposes, which show a large decrease in the 2021 biomass estimate - although

the author noted the time series is highly variable.

The SSC accepts the author and GOA GPT recommended GOA-wide ABCs and OFLs for 2022 and 2023, and the regionally apportioned ABCs for 2022 and 2023. Apportionment was based on the random effects model applied to GOA bottom trawl survey biomass estimates through 2019. The SSC also supports the authors' efforts to address previous GOA GPT and SSC recommendations to explore alternative length and age composition bin structures, and alternative data weighting methods in the next full assessment.

Shortraker Rockfish

A full assessment of GOA shortraker rockfish was presented this year. This Tier 5 assessment included no changes to the assessment methodology. There was no public testimony. The SSC thanks the authors for their work on this assessment and for their responses to previous SSC recommendations.

The assessment was a straightforward update of the random effects model that incorporates both the GOA bottom trawl and longline surveys to estimate biomass. Data were updated to include: 1) 2021 bottom trawl survey biomass and length compositions; 2) 1992-2021 longline survey length compositions; 3) 2020 and 2021 longline survey Relative Population Numbers (RPNs), Relative Population Weights (RPWs), and length compositions; 4) 2020 and 2021 longline and trawl fishery length composition; and 5) updated catch from trawl and longline fisheries (total catch through 2020 and partial catch for 2021).

Neither of the surveys sample the shortraker population well. The longline survey is conducted annually and likely surveys in more appropriate habitat than the bottom trawl survey, which is not able to sample the upper slope well due to a predominance of untrawlable habitat. The SSC encourages the authors to consider studies of hook competition with sablefish as this could be a factor with the large incoming year classes of sablefish. In 2021, relative population weights (RPW) from the longline survey increased by 29% from 2020 and estimated biomass from the trawl survey decreased 39% from 2019. Estimates in 2021 from both surveys were within the range of estimates in the last decade. The use of the longline survey in addition to the trawl survey stabilizes the model-estimated biomass. This stability is generally consistent with the population dynamics and biological characteristics of this long-lived species. Estimating the regional catchability coefficients further improves model fit and suggests that there are some regional dynamics related to availability of shortraker rockfish to survey gear. Biomass estimates from the random effects model for the EGOA, CGOA, and WGOA in 2021 changed very little with respect to recent years, as did the estimates of OFL, ABC, and area apportionments.

Applying the random effects model to trawl survey data from 1984–2021 and the longline survey RPW indices resulted in a 2022 biomass estimate of 31,331 t for shortraker rockfish, almost equivalent to the previous estimate (31,465 t). **The SSC concurs with the authors' and GOA GPT's recommended 2022 and 2023 OFLs and ABCs. The SSC concurs with the GOA GPT and author that no reduction from the Tier 5 maximum ABC is necessary**. **The SSC also supports the area apportionments** estimated with the random effects model fit to area-specific survey indices.

The majority of the shortraker catch occurs in the EGOA and catch in all areas has been decreasing since 2018. The HAL fishery catch of shortraker rockfish has decreased to low levels due to the transition to pot gear in the sablefish IFQ fishery. **Discard rates for fixed gear under full retention mandates remain high, particularly in sablefish fleet, and an overall review is pending to determine how well this new regulation has been implemented and communicated with industry. The SSC looks forward to the results of this review.**

SSC appreciates the authors' response to the previous SSC question regarding why the trawl and longline surveys were equally weighted even though the uncertainty in the longline survey RPW index is consistently smaller than that of the bottom trawl survey biomass and supports the use of weighting each by 0.5 again in this assessment. **The SSC suggests that GOA shortraker rockfish is a good candidate to examine for the working group the SSC requested to develop standard practices for data weighting**

(see October 2021 SSC Report).

The SSC noted study by Rodgveller *et al.* (2011) that compared longline survey catch rates of shortraker and rougheye rockfish with observed densities of fish around the longline from a manned submersible that showed a catchability coefficient of 0.91, and requests the authors consider whether or not this would be appropriate for inclusion in assessment.

The SSC supports the GOA GPT recommendation that the authors reexamine natural mortality, as this is critical for setting the fishing mortality rate for this long-lived species. The SSC also asks the authors to consider the confidence in the estimates of M, compared to other species without reliable age estimates and with consideration of the longevity of this species, when they evaluate risk levels in the risk tables in the next full assessment.

The SSC is looking forward to seeing the results of research into untrawlable habitat for GOA POP rockfish and encourages the authors to consider whether results are useful for shortraker as well.

The SSC noted that the authors' justification for a level 1 ranking of assessment considerations in the Risk Table was that the CVs of the surveys have remained low and encourages the authors to consider potential bias, in addition to estimated uncertainty. For instance, as untrawlable habitat is preferred by shortraker, perhaps the trawl survey index is biased low. Similarly, if there is hook competition (this would certainly vary over time), the longline survey index might also be biased low. Finally, a submersible study (Rodgveller *et al.* 2011) showed that the catchability of shortraker and rougheye to the longline was 0.91. While a negative bias may not be justification for a reduction from max ABC, the SSC suggests the authors consider such factors in the risk table rankings.

The SSC requests clarification on why Figure 11-1 which shows no trawl harvest in 2019 and 2020 in the EGOA butFigure 11-2 does.

Dusky Rockfish

The SSC was presented with a partial assessment for Dusky rockfish. There was no public testimony. This is a Tier 3 stock, which is assessed on a biennial cycle, with the most recent full assessment conducted in 2020. No changes were made to the 2020 assessment model nor the area apportionment percentages (based on the random effects model applied to the GOA trawl survey biomass estimates). The projection model was updated with final catch data from 2020, a revised catch estimate for 2021, and projected catch estimates for 2022-2023. Given the large increase in the retrospective pattern in the 2020 assessment, a reduction from maxABC (stair-step approach) was recommended by the SSC in 2020, whereby the 2021 and 2022 ABC would be reduced to the mid-point between the projected maxABC for each respective year and the 2020 ABC. **This year the authors and GOA GPT updated that stair-step for the 2022 and 2023 ABCs (each reduced from maxABC to the mid-point between the projected maxABC for each respective year and the 2020 ABC). The SSC accepts the projected OFLs for 2022 and 2023, the adjusted GOA-wide ABCs for 2022 and 2023 (approximately 23% reduction from maxABC for each year), and the apportioned area-specific ABCs for 2022 and 2023.** The SSC notes that the maxABC values listed in the assessment for 2021 and 2022 were typos and that they should be 7,101 and 6,913 tons, respectively, rather than equal to the ABCs for each year.

Rougheye and Blackspotted Rockfish

GOA rougheye and blackspotted (RE/BS) rockfish complex is managed as a "bycatch" only species complex with most of the catch in the rockfish and sablefish fisheries, with some in the flatfish fisheries. The complex is assessed every two years with an age-structured assessment model and is managed in Tier 3. The last full assessment was in 2019. This year, a full assessment was completed with area-specific ABCs and GOA-wide OFL. There was no public testimony.

New and updated data added to this model include:

1) Updated catch estimate for 2020, new catch projections for 2021-2023.
2) New fishery lengths for 2019
3) New fishery ages for 2018 and 2020 - the 2019 trawl survey ages are still being processed and will be included in the next full assessment in 2023.
4) New bottom trawl survey biomass for 2021.
5) New longline survey relative population numbers (RPN) for 2020 and 2021, and new longline survey RPN-weighted length frequencies for 2020 and 2021.

Further, this assessment included updated geographic area sizes and variance calculations for the longline database in 2021, which resulted in small changes to the longline survey data.

There were no changes in the assessment methodology and the authors continue to use the 2015 assessment model (15.4) that was used in the 2019 full assessment. There has been no change in the area-apportionment method, which uses a two-survey version of the random effects model and equally weights the longline and trawl survey relative abundance indices.

The SSC agrees with the GOA GPT in commending the authors efforts to respond to GOA GPT and SSC comments including comparing species trends at similar depth strata between the longline and trawl surveys. This work revealed that the surveys rarely tracked each other when split by area and depth strata, and that the surveys partition biomass differently among regions.

The author recommended the maxABC from the updated projection model, which is 35% lower than the 2022 projected ABC from the 2020 partial assessment. The proposed reduction in the ABC is not surprising given that the 2021 trawl survey biomass estimate decreased 56% from the 2019 estimate (the lowest in the time series) and the 2021 longline survey abundance estimate decreased 36% relative to 2019, and 2020 was the lowest in the time series.

These declines had significant impacts on the parameters that govern the scale of the population. In particular, estimates of trawl survey catchability increased from 1.7 to 2.2, longline survey catchability increased from 1.2 to nearly 1.7, and mean recruitment decreased from approximately 1.6 to 1.2 million fish. The GOA GPT noted that the large changes in survey catchability estimates resulted in a downward shift in the long-term biomass trajectory for this stock. However, because the surveys exhibit inconsistent trends and partition biomass differently among areas, it is unclear if these signals reflect a genuine conservation concern or are the byproduct of survey data conflicts. **The SSC concurs with the author and the GOA GPT that it would be prudent to estimate survey indices using the same depth strata definitions and to examine weighting CPUE by a variable other than total geographic area that may be more relevant to this complex (e.g., Essential Fish Habitat within a stratum).**

Relative to past assessments, the 2021 assessment model exhibited a strong positive retrospective pattern (Mohn's rho = 0.611). It is also notable that there has been an increase in Mohn's rho in each of the last three assessments (2017 = 0.009, 2019 = 0.167, 2021 = 0.611). **This "one-way" retrospective pattern is a cause for concern and is likely due to the recent sudden declines in both population indices that are used in the assessment.** The relatively noninformative priors used for catchabilities within this model result in some shifts in scale being accentuated with sudden changes in these indices. The authors recognized this and stated their intent to investigate catchability in future assessments and explore how that relates to this progressive retrospective pattern.

The dome-shaped trawl survey selectivity for this complex is expected given that adult habitat is typically in rocky areas along the shelf break where the trawl survey gear's sampling is limited. However, estimates in this assessment suggest that selectivity is changing considerably for older fish in the survey, which is unexpected given occupied habitat should not change above a certain age. For example, the GOA GPT noted it was unclear why 40-year-old fish would be so much less selected than a 30-year-old fish. **Future research could consider alternative parameterizations that would allow for more constrained estimates of selectivity at older ages.**

In response to SSC and GOA GPT comments the authors reported that a recent study used otolith morphometrics, weight, and age to accurately identify RE/BS rockfish 86% and 97% of the time, respectively. This is an improvement over field-based identification performance and demonstrates that otolith morphometrics can be used to improve species identification rates, especially for rougheye rockfish. The SSC agrees that this would likely be time consuming and potentially costly to implement, but that reliably identifying archived otoliths from the past 20-30 years would be of great value.

All categories in the risk table were rated level 1 except the assessment-related concern, which was a Level 2, due to the large changes in catchability estimates and the strong retrospective bias. The authors' ranking of Level 2 in the assessment versus population dynamics category is reflective of their concern that the trawl and longline surveys rarely tracked each other when split by area and depth strata, and that the surveys partition biomass differently among regions. They also note that this assessment is currently transitioning authors, and consequently no model updates were recommended in this cycle. Plans to address model and data concerns for this assessment were outlined in the Data Gaps and Research Priorities section. The authors noted the multiple layers of precaution instituted for this complex including relatively low Maximum Retained Allowance percentages, a bycatch only fishery status, subarea ABCs and TACs, and the generally low area-specific harvest rates.

The SSC concurs with the authors' and GOA GPT's continued use of Model 15.4, which places RE/BS in Tier 3a. The SSC also supports the authors' and GOA GPT's recommended OFLs and ABCs for 2022 and 2023 and no reduction from maxABC. In addition, the SSC concurs and supports the GOA GPT and the authors' recommendations regarding future exploration of data and model issues including data weighting, trawl survey length data, survey index refinements, and parameterizations for survey catchabilities and selectivities. The SSC appreciates the new authors' efforts given the on-going challenges of doing a data limited, multi-species stock assessment for long-lived and cryptic rockfish species and agrees with the GOA GPT that a high priority be placed on developing robust species identification methods and in estimating composition data. **Finally, the SSC notes that if the current trend in retrospective bias continues after model and data issues (catchability in particular) are addressed, the author will need to revisit risk table ranks and reassess whether a reduction from maxABC is necessary.**

Demersal Shelf Rockfish

The SSC received a presentation on the 2021 GOA demersal shelf rockfish (DSR) stock assessment. There was no public testimony.

The SSC notes that DSR biomass estimates in recent years are much lower than in the 1990s and that directed fisheries have been closed for the last two years. Yelloweye rockfish comprise the largest component of the DSR complex and are managed under Tier 4. The ABC and OFL for non-yelloweye DSR (canary, China, copper, quillback, rosethorn, and tiger rockfish) are calculated using the Tier 6 harvest control rule. The Tier 6 ABC and OFL are added to the Tier 4 values for yelloweye rockfish to determine the ABC and OFL for the DSR complex.

The SSC notes that the lower end of the 90% confidence interval on yelloweye biomass estimates, from the ROV density area-expansion assessment, have long been used for setting the OFL and ABC. However, as outlined in previous SSC reports, the SSC believes that this method for setting the OFL and ABC is inconsistent with the current use of risk tables and has requested that authors use point estimates instead of lower 90% confidence intervals for setting the OFLs and maxABCs, and using the risk table to recommend reductions from max ABC rather than incorporating reductions in the biomass estimates. The SSC further notes that the assessment has included additional conservation by using $F_{ABC} = M = 0.02$ rather than the Tier-based calculation of $F_{ABC} = F_{40\%}$, which in this case is 0.026. The combination of these two components would have resulted in a large (43%) reduction from the Tier 4 calculations of OFL and ABC for 2022-2023. **Therefore, SSC recommends that the OFL and maxABC be estimated using the standard Tier 4 values of $F_{35\%}$ and $F_{40\%}$, applied to the point estimate of biomass, for this year and future years.** The SSC recognizes that applying the standard Tier 4 calculations results in a large increase from previous maxABCs, and also that precautionary adjustments for this fishery continue to be warranted given the unproductive life history of yelloweye rockfish and uncertainty in the expansion of area-based density estimates to total biomass. **Therefore, the SSC recommends a reduction from maxABC equal to the difference between $F_{40\%}$ (0.026) and F = M = 0.02 calculation for the ABC, which represents a 22% reduction from the maximum permissible ABC.** Despite a full assessment being conducted this year, another full DSR assessment is planned in 2022, after which DSR will be on a two-year cycle in even years.

The SSC appreciates the work conducted by the assessment authors in providing the estimates of yelloweye abundance from which stock status on this stock and the associated shelf rockfish complex might be determined. **The SSC requests more detailed documentation on the statistical methods used for the area-specific density and biomass estimates based on the ROV counts.** This should include the alternative models used (and potentially combined) for the distance weighting, the design-based or model-based estimate of the mean density, and the methods used for estimating suitable habitat as is used for the area expansion. **Further, the SSC requests clarification regarding how the area-specific estimates are combined, given the unbalanced design, and the year for which stock-wide biomass estimates are reported relative to the years in which survey and other data have been collected.**

The SSC recommends a careful review of the risk table for the next assessment, noting that risk should be quantified relative to the Tier in which the stock is classified (for assessment considerations).

The SSC also acknowledges and supports the research priorities outlined by the authors in the assessment document. The SSC acknowledges, along with the authors, that there is limited information on yelloweye rockfish fecundity and maturity. Little is known about the timing of parturition for yelloweye rockfish recruitment or post-larval survival. The authors further note that a fecundity and maturity project is currently underway to provide updated life history parameter estimates for yelloweye rockfish for each management area. A recruitment index for yelloweye rockfish would improve modeling estimates for total yelloweye rockfish biomass. Finally, the SSC continues to support the development of a yelloweye rockfish age-structured assessment.

Other Rockfish

The Other Rockfish report was presented by Dr. Jim Ianelli (NOAA-AFSC) with Dr. Cindy Tribuzio (NOAA-AFSC) responding to questions about the assessment. Public testimony was provided by Julie Bonney (Alaska Groundfish Databank), who highlighted the incidental nature of 'other rockfish' catches and the stable incidental catch rates in the fishery that contrast with large fluctuations in survey biomass and a considerable drop in the area-specific apportionment for the Western and Central GOA.

The other rockfish complex comprises 27 species that are divided into two sub-groups within the complex

based on life history, spatial distribution, and fishery and survey characteristics. The two sub-groups are slope rockfish (20 species) and demersal shelf rockfish (7 species). The assessment of the other rockfish complex is composed of Tier 4 (sharpchin rockfish), Tier 5 (17 species) and Tier 6 (9 species) and is updated biennially. Updates were provided for catch, trawl survey data, random effects weighted mortality estimates (Tier 5 species), and the survey fractional biomass for separating Eastern GOA between Western Yakutat and Eastern Yakutat/Southeast. There were no changes to the assessment methods. The Tier 4 and Tier 5 species are assessed using a random effects model and Tier 6 species are assessed using the maximum harvest for the years 2013-2016. Biological reference points are calculated separately for Tier 4, Tier 5, and Tier 6 species and summed to set the reference points for the complex. These species exhibit different longevity and maturation schedules.

In 2021, the catch of the other rockfish complex exceeded the area-specific ABC for the Western-Central GOA but was well below the area-specific ABC in the Eastern GOA and total catch was well below the gulf-wide OFL. Catch discards increased and were higher than would be expected given the full retention mandate of rockfish implemented in 2020. The SSC will be interested in future updates. The 2021 trawl survey biomass declined slightly from the 2019 survey and shifted to the Eastern GOA. Six species are the primary species observed in the survey and the catch: harlequin, redbanded, redstripe, sharpchin, silvergray and yelloweye rockfish. The 2021 biomass estimates declined for harlequin (-94%), redstripe (-85%). and sharpchin rockfish (-26%), but increased for yelloweye (109%), redbanded (87%), and silvergray rockfish (48%). It was noted that the large changes that were observed are likely due to patchiness of the various species.

The authors updated the random effects weighted natural mortality estimates (weighted M) for the Tier 5 species. The weighted M is calculated so that it is responsive to the proportional biomass of Tier 5 species estimated from the random effects models. The updated weighted M estimates decreased from the previous assessment year because the biomass of high M species decreased compared to the lower M species. The GOA GPT discussed the discrepancy in catch and survey biomass due to survey catchability issues of higher M species and the resulting impact on weighted M for Tier 5. In discussions, it was suggested that the observed variability in species composition in the surveys was too extreme and likely due to sampling variability in the survey. Further, there is limited evidence that the survey is accurately tracking the species biomass and mix of species. Therefore, the GOA GPT recommended rolling over the harvest recommendations from last year. **The SSC concurs with the GOA GPT's recommendation to roll over OFL and ABC recommendations from 2021** because of the discrepancy between catch and survey biomass and the estimation of weighted M being influenced by a few species that have patchy distributions and survey catchability/availability issues. At this point, the SSC does not have any indication that the harvest recommendations from 2021 are not sufficiently precautionary. Recent catches have been stable, there is no indication of stock structure, and given the current level of knowledge, there is no indication that a conservation concern exists (although that does not mean one does not exist).

The SSC recommends that the authors:

- Revisit the tier level assignments for the species included in the other rockfish complex. (Are they appropriate given survey catchability/availability issues?)
- Consider fitting a random effects model to the aggregate complex, rather than subcomponents
- Re-examine the need for area-specific apportionments of ABC.
- Incorporate, as appropriate, results from the pilot 2022 untrawlable grounds cooperative work, recognizing that full results will not be available for some time.
- For Tier 5 stocks, evaluate the random effects weighted mortality methodology and consider

alternatives such as the long-term average.

- Evaluate past research and investigate estimating catchability in the next assessment, with a focus on key components such as harlequin, sharpchin and redstripe rockfish. See Jones et. al (2012, 2021) and Zimmermann (2003) for relative "trawlability"of rockfish species.

The SSC notes that there are several other outstanding issues and recommendations that will likely affect future assessments of the other rockfish stock complex including a Council-directed analysis on spatial management implications of separating DSR from the other rockfish complex gulf-wide, investigations into elevating some of the species (harlequin and yelloweye rockfish) into different tiers, and if there is evidence of range expansion of species from the south. The SSC looks forward to updates on these issues and to a timeline for the spatial management analysis.

GOA Skates

This was a full assessment for the GOA skate complex, which is assessed biennially. There was no public testimony. There are three stock components to the skate complex: big skate, longnose skate and other skates. The first two have GOA wide OFLs with area-apportioned ABCs. The third component includes multiple species, but consists primarily of Aleutian skate, Bering skate and the Alaskan skate, for which harvest specifications are set at the GOA-wide level.

As a Tier 5 complex, harvest specifications are assessed using survey biomass and a natural mortality rate. For GOA skates, random effects models are run both GOA wide and for each of the three regulatory areas for big and longnose skates, and GOA-wide for other skates using the bottom trawl survey data. A natural mortality rate of 0.1 is used. The assessment also presents data from four additional surveys to provide context to the bottom trawl survey for these species. There is also extensive biological information included in the assessment.

Big skate biomass has declined in the bottom trawl survey and longnose skate has increased when compared with 2019. Both species seem to have a relatively steady trend over time. Other skates biomass in the bottom trawl survey biomass increased from 2019 but has declined generally over approximately the last decade. **The SSC concurs with the author and GOA GPT recommended harvest specifications under Tier 5, including the GOA-wide OFLs for all three components, the GOA-wide ABC for other skates, and the area apportioned ABCs for big and longnose skates.**

The SSC notes the inclusion of the risk table. The assessment author was very clear about where information was lacking to make a strong recommendation. There has been recent big skate tagging work to evaluate connectivity among areas within the GOA and between the GOA and BSAI, suggesting some potential for a spatial shift in the center of distribution for this complex. The SSC encourages the authors to review this information as it may inform future considerations of management units for these stocks. Finally, the SSC supports the investigations into updating the natural mortality rates used in this assessment, in agreement with the GOA PT, and encourages explorations using Jason Cope's Barefoot Ecologist tool (http://barefootecologist.com.au/shiny_m.html).

GOA Atka Mackerel

The SSC was presented with a full assessment for GOA Atka mackerel, which is a Tier 6 stock on a biennial schedule. Atka mackerel have been a non-target fishery in the GOA since 1996, with OFLs and ABCs estimated to provide for the anticipated bycatch needs of several GOA fisheries. Catches have been well below the ABC for several decades. Data for this species are quite limited, and consequently it is categorized as a Tier 6 stock. Sparse length composition data are available from the most recent time there

was a directed fishery in the early 1990's, and fishery dependent age composition data are also very limited.

The GOA bottom trawl survey, which has been conducted since 1984, encounters Atka mackerel but the resulting survey biomass estimate produces very large CV's and is not considered a reliable index of abundance for this species. The author cites the patchy distribution of the species, as well as their association with untrawlable habitat as the primary reasons and noted that 98% of the Atka mackerel in the 2021 survey were captured in a single tow. Some age composition data are collected on the trawl survey and the author also noted that several of the large age classes observed appeared to correspond to strong year-classes in the AI stock. **Given the limited available information, the SSC continues to support the Tier 6 determination for GOA Atka mackerel.**

Under tier 6 specifications, the OFL is set equal to the average historical catch from 1978-1995 and the ABC is set equal to 75% of that value. **The SSC accepts the authors' and GOA GPT's recommended OFLs and ABCs for 2022 and 2023, with no reduction from maxABC.** A risk table was presented, which did not contain evidence for increased risk in any of the four categories and the author expressed interest in discontinuing the use of a risk table in future assessments, on the basis of the lack of information to inform a risk based reduction in ABC. The SSC notes that uncertainty in the ABC is intended to be accounted for in the assessment, Tier system and risk table. **Therefore, while the SSC recognizes that data for a Tier 6 stock provide little information to inform the risk table, due to authors' concerns about uncertainty in the ABC, the SSC requested that a risk table continue to be included in the next full assessment and requests the authors consider whether they recommend any changes to the assessment or risk table.**

GOA Octopus

The SSC received a full Tier 6 assessment (biennial schedule) of GOA octopus this year. All seven octopus species are grouped into a single complex for management. Octopuses are taken incidentally in trawl, longline and pot fisheries throughout the GOA. Most of the octopus survey biomass and catches are in the Central and Western GOA. The main species is *Enteroctopus dofleini,* which is also the most abundant octopus species in shelf waters, makes up the bulk of octopus catches in commercial fisheries. Trawl survey biomass estimates are poor for this complex and the size of octopus caught in the survey is generally smaller than that caught as bycatch in the fishery. The 2021 trawl survey biomass estimate is an order of magnitude smaller than the 2019 estimate, which underscores that trawl surveys do not provide reliable biomass estimates for the octopus complex.

In 2017, the SSC recommended moving octopus to a Tier 6 assessment and using maximum historical catch to set harvest specifications. In 2019, the SSC adopted the GOA GPT recommendation of fixing the time period from which to take the maximum catch as 2003 – 2019, with maximum catch occurring in 2014. **The SSC supports the authors' and GOA GPT's recommended Tier 6 OFLs and ABCs for 2022 and 2023.** The SSC appreciated the justification the author provided for not using a risk table for this assessment.

In contrast to the time period specified in 2019, the author and GOA GPT recommended in this 2021 assessment to use the period 2003-2018. It is unclear if the change to 2018 was intentional or a typographical error. Because the 2019 catch is close to that of 2018 and the SSC previously approved of the time-period 2003–2019, the SSC chose to maintain the time period as 2003–2019 for this assessment. The authors may review and justify a reason for a change in the next full assessment if they wish. The choice of end year (2018 or 2019) has no impact on the specifications.

There was some confusion in the chapter as to what was the maximum historical catch value in 2014. In the Summary of Results and Tables 3, 4, and 6, the 2014 catch value was 1,295 t, however the text of Analytical Approach section, Results section, and the specifications tables indicate 1,307 t. The SSC noted that the difference between the two values is small and chose to use the same value for maximum catch and OFL as used in 2019 (1,307 t) but asks the author to resolve the true maximum catch value in the next full assessment.

SSC Member Agenda Associations

At the beginning of each meeting, members of the SSC publicly acknowledge any direct associations with SSC agenda items. If an SSC member has a financial conflict of interest (defined in the 2003 Policy of the National Academies and discussed in Section 3) with an SSC agenda item, the member should recuse themselves from participating in SSC discussions on that subject, and such recusal should be documented in the SSC report. In cases where an SSC member is an author or coauthor of a report considered by the SSC, that individual should recuse themselves from discussion about SSC recommendations on this agenda item. However, that SSC member may provide clarifications about the report to the SSC as necessary. If, on the other hand, a report is prepared by individuals under the line of supervision by an SSC member, then that SSC member should recuse themselves from leading the SSC recommendations for that agenda item, though they may otherwise participate fully in the SSC discussion after disclosing their affiliations with the authors. The SSC notes that there are no financial conflicts of interest between any SSC members and items on this meeting's agenda.

At the December 2021 meeting, multiple SSC members declared an association with various agenda items. Anne Hollowed supervises Steve Barbeaux, Martin Dorn, Jim Ianelli, Sandra Lowe, Paul Spencer, and Grant Thompson, who are all lead authors or co-authors of SAFE chapters. Grant Thompson is the co-chair of the BSAI Plan Team and Jim Ianelli is the co-chair of the GOA Plan Team. Dr. Hollowed is second level supervisor of Meagan Bryan, Maia Sosa Kapur, Carey McGilliard, Cole Monnahan, Olav Ormseth, Kalei Shotwell and Ingrid Spies, who were all lead authors of SAFE chapters. Dana Hanselman supervises Chris Lunsford (co-chair of GOA Plan Team), Pete Olson, Cara Rodgveller, and is a second level supervisor for Elizabeth Siddon, Pat Malecha, Kevin Siwicke and Cindy Tribuzio. Dr. Hanselman is also married to Kalei Shotwell. Brad Harris is a co-supervisor of Madison Hall, who is a co-author of the POP assessment. Curry Cunningham supervises a graduate student that contributed to the sablefish ESP. Chris Siddon is married to Elizabeth Siddon, co-author of the BSAI ESR. George Hunt commented on an internal review draft of the ESRs. Jason Gasper is married to Cindy Tribuzio. Finally, Sherri Dressel was a co-author of multiple ESR contributions.