SCIENTIFIC AND STATISTICAL COMMITTEE
FINAL REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
December 5th – 7th, 2022

The SSC met from December 5th – 7th, 2022 in Anchorage, AK. Members present in Anchorage were:

Sherri Dressel, Co-Chair *Alaska Dept. of Fish and Game*	Franz Mueter, Co-Chair *University of Alaska Fairbanks*	Alison Whitman, Vice Chair *Oregon Dept. of Fish and Wildlife*
Chris Anderson *University of Washington*	Amy Bishop *University of Alaska Fairbanks*	Curry Cunningham *University of Alaska Fairbanks*
Mike Downs *Wislow Research*	Robert Foy *NOAA Fisheries—AFSC*	Jason Gasper *NOAA Fisheries–Alaska Regional Office*
Dana Hanselman *NOAA Fisheries—AFSC*	Brad Harris *Alaska Pacific University*	George Hunt *University of Washington*
Kailin Kroetz *Arizona State University*	Kathryn Meyer *Washington Dept. of Fish and Wildlife*	Andrew Munro *Alaska Dept. of Fish and Game*
Chris Siddon *Alaska Dept. of Fish and Game*	Ian Stewart *Intl. Pacific Halibut Commission*	Patrick Sullivan *Cornell University*

SSC Administrative Discussion

The SSC received administrative updates from Diana Evans (NPFMC). In addition to describing protocols and other announcements for the meeting, Ms. Evans provided a brief overview of the February 2023 SSC workshop and highlighted a flier that provides questions for discussion at the workshop that can be used to guide written testimony for the workshop. Written testimony submission will be available until the February meeting deadline on a workshop E-agenda.

SSC General Comments

The SSC recognizes the outstanding service of George Hunt on the SSC. Dr. Hunt served as a member of the SSC from 2001 – 2022. In his lifetime of work and through his contributions to the SSC, Dr. Hunt has greatly advanced system-level thinking about Alaska's marine ecosystems, particularly for the Bering Sea and Aleutian Islands (BSAI). He has been committed to conducting collaborative, interdisciplinary studies of Alaska's marine ecosystems and has brought a broad vision to the SSC that is critical for the continued development of ecosystem-based fisheries management in the North Pacific. The SSC will miss not only Dr. Hunt's extensive knowledge of ecosystem drivers and processes but also the camaraderie he has fostered among SSC members. The SSC is extremely grateful for his service and contributions to ecosystem research and to the management of Alaska's fisheries.

B1 Plan Team Nominations

The SSC reviewed the nomination of Dr. Skylar Bayer to the Scallop Plan Team. The SSC finds this nominee to be well-qualified and recommends the Council approve their nomination.

C2 Snow Crab Rebuilding - Initial Review

The SSC received a presentation from Sarah Rheinsmith (NPFMC), Jon McCracken (NPFMC) and Cody Szuwalski (NOAA-AFSC) on the draft initial review analysis of the rebuilding plan for Eastern Bering Sea (EBS) snow crab. The SSC thanks the authors for their work on this analysis and responsiveness to previous SSC comments. The SSC notes that the analysis has benefitted from earlier review during recent NPFMC meetings and the associated work by the analysts and Crab Plan Team (CPT).

Written public testimony was provided by Scott Goodman (Bering Sea Fisheries Research Foundation; BSFRF), Jamie Goen (Alaska Bering Sea Crabbers; ABSC), Oystein Lone and Mateo Paz-Soldan (City of St. Paul). Oral testimony was provided by Jamie Goen and Cory Lescher (ABSC), Mateo Paz-Soldan (City of St. Paul), Scott Goodman (BSFRF) and Lauren Divine (Aleut Community of St. Paul Island). The written and oral public testimony at this meeting (and provided at the October meeting) highlighted the importance of this crab stock and rebuilding plan to all those that rely on the fishery. The testimony was considered as part of the SSC's deliberations on the rebuilding analysis initial review draft. **In particular, the SSC recognizes that the overfished determination and associated rebuilding plan for this fishery, with or without a small TAC, is likely to result in extreme socio-economic hardships.**

The SSC supports the proposed rebuilding parameters of Tmin = 6 and Tmax = 10. However, the SSC highlights that the actual time to rebuilding may be much longer depending on ecosystem conditions and actual recruitment.

The SSC finds the draft analysis adequate to advance to final action pending some revisions and expansions of the draft document, as outlined below.

The SSC noted several improvements to the analysis since the October draft, including the use of the maximum likelihood estimate from the assessment model as the basis for rebuilding projections. The authors clarified that the closure of the snow crab fishery in 2022/23 was not included in the projections; however, they deemed this to have little impact on the rebuilding trajectory.

The SSC noted the discrepancy between the Essential Fish Habitat map and the stock definition for the snow crab assessment, which does not currently include the Northern Bering Sea (NBS). **The SSC recommended that the final draft include a calculation of habitat disturbance that attempts to exclude the area in the NBS, or at least provides an approximation of the disturbance within the assessed stock area. In addition, the SSC recommends a map or other means to evaluate the overlap between areas with identified higher abundance of the smallest snow crab size classes and habitat disturbance.** This is intended to provide insight into whether local disturbance of critical juvenile areas might be occurring at a higher level than the average across the entire stock.

The SSC supports the CPT recommendation to provide the projected catch series during the rebuilding period and to use these catches as the basis for evaluation of the potential magnitude of the fishery and potential economic effects. The SSC suggests that estimates of the total allowable catch (TAC), including information on the range of potential TACs, could be shown in a figure similar to Figure 2.2. The SSC recognizes that it may be difficult to provide a direct analog to the state harvest control rule (the currently employed 40% x ABC approximation may not be appropriate for small potential harvests under rebuilding and may therefore not be representative of current conditions) and is open to other options that could better approximate the potential TAC for assessing potential economic effects, especially in the early years of the rebuilding period. The SSC suggests it may be helpful to describe how a fishery might be

structured with a very small TAC, and what benefits could be captured by catchers and processors. While the SSC acknowledges there will be considerable uncertainty in predictions of future TACs, this represents the best available science on the likelihood a fishery may occur in the medium term and the relative size of that fishery. Because the production function is close to linear, it will also give a sense of how much effort is needed, and potential revenues and taxes. Estimates of the TAC could be compared to the 2021 TAC. It is likely that the 2021 experience can offer insight into how individual short-run adaptation strategies will lead to consolidation in the harvest and processing sectors, affect season length, and impact communities. Clearly, longer periods of low or no fishing will have long-term impacts that will be harder to forecast. To help inform potential impacts of an opening with a low TAC, public testimony suggested it would be helpful to have stakeholders together to discuss.

Relatedly, the SSC had a substantial discussion regarding the difference in reference points used by ADF&G as a basis for setting the TAC and federal analyses that serve as the basis for the OFL and ABC (e.g., B_{MSY} including males and females vs. only males). **The SSC requests additional description of the terms used, and the differences between the processes, recognizing that it is not clear how consideration of State actions fits into a federal rebuilding plan.** The SSC asks for further clarification of how crab rationalization could affect the viability of a limited fishery under rebuilding both for vessels as well as processors and those that rely on each.

The SSC acknowledges the development of a robust social impact assessment as part of this rebuilding plan, noting that this includes the first use of the Local Knowledge, Traditional Knowledge, and Subsistence (LKTKS) search engine. **The SSC requests a clarification of the next steps that would be appropriate to take when such a search does not produce any specific results in one or more of the search engine information areas.** The SSC also acknowledges the utility of the inclusion of LK information developed by industry and the innovation shown in the development of new table pairs for participating catcher vessels and processors that highlight snow crab dependency in the context of co-occurring changes in other crab fisheries and associated changes in fishery participant distribution across revenue percentile categories.

The SSC requests inclusion of additional information on the status of fishing communities, **especially with regard to the 2021/22 fishing season**, noting that additional economic information may now be available that was not available for earlier drafts. For example, for the communities the authors identified in the analysis, it could be helpful to provide time series as stacked bar chart figures (not tables), showing revenue by main species. This could be done for both catch and processing. This would highlight heterogeneity across communities in (1) diversification/dependence across species/fisheries, including snow crab, Bristol Bay red king crab, and other species/fisheries; and (2) the extent to which fishing or processing activity overall has decreased (or increased). Figures like this showing the overall trend in socioeconomic outcomes would complement the compelling figures shown in the first section of the report highlighting the stock collapse and the social impact assessment tables showing annual average dependency.

General Stock Assessment Comments

Ecosystem and Socioeconomic Profiles

The SSC commends the analysts on their continued efforts to develop and improve the Ecosystem and Socioeconomic Profiles (ESPs) in stock assessments. The suite of socioeconomic indicators will contextualize the fisheries with the combination of scale (e.g., number of vessels, number of processors, level of landings and revenue), structure (e.g., harvest and processing technology, major product forms and markets), and dependence (e.g., share of vessel or processing activity associated with the fishery for substantially engaged and or dependent communities). While these indicators only factor directly in ABC determinations as far as they inform stock status and risk tables, this information also informs Council actions as it indicates who will be affected by a fishery policy change or changes in economic conditions

or stock status, and by how much, such that additional measures to support fishery participants may be needed.

The SSC suggests the following to improve the role and utility of the profile:

- Have separate subsections for discussion of "Ecosystem" and "Socioeconomic" Processes within the Assessment section. Include a brief statement of the purpose of the socioeconomic indicators in the stock assessment in the introduction of that subsection, so it is clear that their primary intent is not to inform ABC.
- As the ESP template matures, the indicators themselves should move to the main document alongside associated discussion, with methodological points being moved to the appendix.
- The socioeconomic indicators provide a combination of performance and context. To make the aggregate traffic light most useful, it should include only those indicators that reflect performance and on which higher scores are generally "good". Indicators that reflect composition of product form or market share are useful for context but are not themselves indicators of performance (separate from the price they imply).
- The SSC appreciates the discussion of the shift from engagement to dependency, and that ESPs are reflecting earlier recommendations to incorporate relevant local knowledge (LK), traditional knowledge (TK), and subsistence information. It would be useful to include an LK/TK statement in each ESP, even if it just states there was no known LK/TK information available to address the domain of this document.
- The SSC suggests that the analysts consider how much of the predictive covariate analysis is appropriate to include in a profile or dashboard indicator document. While the research reported is useful for identifying indicators to include in each species profile and their association with stock or socioeconomic performance, such analyses are not typically included in annually updated monitoring reports.

C4 BSAI and C5 GOA Ecosystem Status Reports

The SSC received presentations from Elizabeth Siddon (NOAA-AFSC), Ivonne Ortiz (University of Washington), and Bridget Ferriss (NOAA-AFSC). Lauren Divine (Aleut Community of St. Paul Island) provided public testimony on the eastern Bering Sea (EBS) Ecosystem Status Report (ESR); there was no public testimony for the Aleutian Islands (AI) or Gulf of Alaska (GOA) ESRs. The SSC thanks the presenters for their efforts in providing excellent, clear, and well-focused summaries of information on the status of the marine ecosystems that support federally managed fisheries off Alaska. The SSC appreciated the structure of the reports and the In-Briefs and noted that the various ways of communicating the information in the reports was valuable in reaching different audiences and informing different purposes. The SSC welcomed the addition of graphics in each report demonstrating how this information is incorporated into Council processes and was pleased to hear from communities and stakeholders that they value seeing their contributions in the report and the "In Brief" products.

There were no new major environmental concerns reported from 2022, but unusual warm conditions persist in the western Aleutian Islands and conditions in the northern Bering Sea (NBS) remain of concern.

General Comments Applicable to all three ESRs

The SSC was pleased to see several instances where authors provided very long time series, which provided a context for present observations. The SSC notes that there is a need for some authors to define what is "normal" and when some aspect of the environment is considered an anomaly that is above or below

"normal." When there is a reference to "long-term-mean", **the SSC requests that authors for each section be encouraged to state the period over which "normal" (the mean, or median) is calculated, and the degree of departure from the mean or median needed to identify something as an anomaly.** It would also be helpful if authors would state the source(s) of their data and the website/url where the data can be found, if applicable.

The SSC recognizes that considerable thought has gone into developing a statistically sound definition of marine heat waves based on excursions above the mean temperature for a given time of the year at a given place. **The SSC suggests that it would be useful to consider that different species may react differently to a given temperature**, regardless of location and time of year. Is there a need, and a way, to present marine heat waves in relation to the temperature sensitivities of the species of concern?

The SSC understands the challenges of reporting zooplankton to species in the Rapid Assessments. That said, **the SSC suggests that additional information indicating the abundance of key copepod species that are large and lipid-rich at later stages (C4 or C5) would be valuable.**

For indicators that do not have any updated data in 2022 (e.g., groundfish surveys, Steller sea lion surveys)**, the SSC recommends that the authors are consistent in providing headers but omit repetition of data** that was presented in the prior year without any additional updates.

The SSC supports further efforts to enhance the uptake of this ecosystem information into stock assessments, consistent with a nationwide push for strengthening ecosystem-based fishery management.

BSAI Ecosystem Status Reports

Aleutian Islands

Most climate indices were within their expected ranges and did not present issues of concern to fisheries management. However, sea surface temperatures (SST) remained high in 2022 throughout the AI, with temperatures above the 1985-2014 mean. As in the past, marine heat waves were recorded throughout the Aleutian passes, with especially strong heat waves in the central and western Aleutians. **This was the warmest year on record for SSTs in the western Aleutians;** mid-water and bottom temperatures were above average, as they have been since 2014. The heatwave in the western Aleutians raised surface-water temperatures close to 11-11.5° C, the upper limits observed during and after Atka mackerel spawning.

The AI region was surveyed in 2022 by bottom trawl for the first time since 2018. In 2022, as in recent past surveys, several groundfish species had low weights-at-length. **Since 1985, there appears to be a downward trend in this condition index for Pacific cod, Pacific ocean perch, northern rockfish, and arrowtooth flounder, though the statistical significance of these apparent trends has not been tested**. The authors suggest two possible sources of increasing competition for prey: East Kamchatka pink salmon and Pacific ocean perch (POP), both of which have been increasing in recent years. Increased competition is supported by the apparent negative impacts on timing of nesting and reproductive success of seabirds at Buldir Island associated with high densities of East Kamchatka pink salmon in odd-numbered years. **NOAA bottom-trawl surveys in the Aleutians are only conducted in even-numbered years, so it has not been possible to determine if fish condition shows an alternating year pattern, which would also support the possibility of Russian pink salmon as a significant source of competition**. The SSC suggested that additional information from odd years would allow for better understanding of the impacts of high densities of pink salmon on the AI ecosystem. One example would be to conduct additional AI trawl surveys in odd years (even if for a limited period of time) in addition to conducting trawl surveys in the AI in even years. Recognizing the limitations of funding for surveys (the SSC did not discuss this suggestion in the context of survey prioritization), other research could also be informative. For example, archived otoliths from groundfish in the AI may be available to examine annual growth patterns.

The marine ecosystems of the western and central Aleutian Islands (e.g., the Delarof, Rat, and Near Islands) have been changing. To the west of Samalga Pass, Steller sea lion counts continue to show little or no sign of recovery. In addition to declining condition indices, there have been major declines in the abundances of cormorants and other breeding seabirds, harbor seals, Steller sea lions, and sea otters. The cause(s) of these declines are not known. The species involved are not commercially harvested, and the implications for the continued productivity and management of commercial fisheries are unclear. **The SSC encourages efforts to explore mechanistic and food-web links for these observed trends, prioritizing diet data when samples are available.**

Other trends to note are continued harmful algal blooms in the Unalaska area, with toxin levels above those which are toxic to humans (3x the legal limit). The level of toxins in shellfish in other areas of the Aleutians is not known. **Also, in the eastern and central AI, school enrollments are dropping, which may affect the stability of these AI communities and could be of concern to the Council, as the fishing industry is dependent on these communities for processing and logistic support.**

Weather predictions for 2022–2023 indicate that there is a 76% chance of La Niña conditions during December–February 2022–23, with a transition to ENSO-neutral favored in February–April 2023 (57% chance). It is expected that the PDO will continue to be negative and that warm conditions in the western Aleutians will persist.

Eastern Bering Sea

The EBS ESR provided a thoughtful recap of conditions in the EBS during the recent warm period (2014–2021) that included the winter of 2017/2018 and 2018/2019 (summers 2018 and 2019), which were "unprecedented" in terms of low sea ice and subsequent reduced cold pool extent. During this time, the groundfish community as a whole shifted northward, primarily associated with major movements of pollock and Pacific cod from the southern shelf into the NBS and southern Chukchi Sea. During this same period, there was also a precipitous decline in snow crab abundance.

Two contributions on Noteworthy Topics were provided, one on factors affecting 2022 western Alaska Chinook salmon runs and subsistence harvest, and one reporting on development of "long-range" climate models that provide predictions out to 2100. **The excellent report on the Yukon-Kuskokwim salmon declines was notable because of the broad collaboration of individuals from federal and State of Alaska agencies, as well as from the Kuskokwim River Inter-Tribal Fish Commission, the Bering Sea Fishermen's Association, and the Ocean Conservancy. These groups cooperated in the examination of the multiplicity of factors, both within the watershed and in the ocean, that are likely to be contributing to the declines of these salmon runs.** The inclusion of an infographic, a map of the region and the locations of communities and villages impacted by the declines in salmon, was very helpful. The second Noteworthy Topic focused on a new model offering high resolution climate change projections for the EBS. This model provided projections of surface and bottom temperatures in the EBS out to 2100. The projections were based on two different emission scenarios, a high mitigation scenario SSP 126 and a low mitigation scenario, SSP 585. Temperature projections based on the high mitigation estimates suggested that by 2050, bottom temperatures in summer will exceed 4°C.

I**n 2022, the physical aspects of the marine environment of the EBS returned to values like those in past "average" years**. The EBS in 2021–2022 exhibited "near-normal" sea surface temperatures, with marine heat waves being infrequent and brief. Winds in winter 2022 were more northerly than the "long-term average", promoting rapid sea-ice growth in November 2021, but sea ice was thin over much of the shelf and mostly absent in the south. Sea ice extent in 2022 was greater than in 2021, but ice retreated quickly in April. The cold pool was "average" in extent when compared to other cool years. pH was relatively low over the outer and middle shelf in 2022, and near the Bering Strait, decreasing at a rate comparable to the global oceans due to ocean acidification. The impacts on the marine ecosystem from Typhoon Merbok, which occurred in mid-September 2022, are presently unknown.

The biological aspects of the marine environment of the EBS were also similar to what has been seen in past "average" years. The timing of the spring bloom peak was "average" but there was a continued decrease in chlorophyll-a concentrations near the shelf break without a clear cause. There were more small copepods and fewer large copepods and euphausiids than usual in spring. The lack of large copepods in spring is likely not of concern as larval and juvenile fish will be consuming mostly small prey items during spring. However, in late summer/fall, there were fewer large copepods than usual at a time when juvenile pollock require lipid-rich prey for building energy reserves for overwintering. The SSC suggests that the contrast between spring and fall conditions in light of different prey requirements for juvenile fish in the spring and fall could perhaps be captured through an index that combines prey conditions across both seasons. The acoustic survey of euphausiids revealed a below average abundance, though near-surface net surveys in late summer/fall showed higher numbers of euphausiids relative to the spring survey in both the southeastern Bering Sea and to past years in the northeastern Bering Sea. Jellyfish catch per unit effort (CPUE) in the bottom trawl survey was higher than the CPUE in 2021.

Given the sea-ice cover in the winter of 2021–2022, it might have been expected that the production of large, lipid-rich *Calanus glacialis* would have been favored in 2022. The lack of *C. glacialis* in 2022 may be a reflection of the exceedingly low levels of sea-ice coverage in 2018, 2019, 2021, and, to a lesser extent, in 2022. It is important to note that a recent publication (Tarrant, A.M., Eisner, L.B., and Kimmel, D.G. 2021. Mar. Ecol. Prog. Ser. 674: 73-88) has demonstrated that the vast majority of large copepods over the eastern shelf are *C. glacialis*, and not *C. marshallae*. *C. glacialis* grazes on ice algae in late winter/early spring to gain energy for egg production. In years with little or no sea ice over the southeastern shelf, *C. glacialis* is scarce, e.g., as in 2018. *C. marshallae* overwinters at depth off the shelf in the GOA and southward to Oregon. They feed on micro-zooplankton at depth in spring and are advected onto the shelves of Oregon, Washington and the GOA. They have been identified in the NBS and possibly are advected through the passes of the Aleutian Islands and subsequently north in the Bering Slope Current. Unless there is on-shelf advection in spring or early summer, it seems unlikely that *C. marshallae* will have large populations over the southeastern shelf when and where they would be required by age-0 pollock in the absence of *C. glacialis*. It is therefore likely that age-0 pollock will have to depend on the euphausiid *Thysanoessa raschii* as their major prey in years when sea ice fails to extend southward to the southeastern Bering Sea. However, given that there is evidence from the Barents Sea that *T. raschii* is more abundant in cold years, it is not clear how well *T. raschii* will do in a warming Bering Sea.

Fish populations were near or above average biomass within the standard southern EBS bottom trawl grid in 2022 with a notable increase in pelagic foragers, in particular pollock and Pacific herring. Benthic foraging species (yellowfin sole, northern rock sole, flathead sole, and Alaska plaice) increased relative to 2021, although all but flathead sole remain below the 1982–2022 mean. Likewise, the biomass of pelagic foragers increased by 70% since 2021, a shift driven by pollock (on average 67% of pelagic fish biomass) that was up 50% from 2021. Pacific herring biomass was up 200% from 2021. The biomass of apex predators (dominated by Pacific cod and arrowtooth flounder) was up from 2021 and nearly equal to their long-term mean.

Groundfish condition in the southeastern Bering Sea declined during the recent warm stanza ending in 2021 but improved in 2022 for all species except walleye pollock, possibly reflecting improved prey availability and lower metabolic demands due to the cooling that started in 2021. Groundfish condition trends were more variable for monitored species over the northern shelf. The northward shift in the groundfish community during the recent warm stanza reached its northern maximum in 2019 before shifting south again as conditions cooled. Overall production of the groundfish community on the EBS shelf can be measured as total annual surplus production (ASP). The aggregated ASP of 14 groundfish stocks on the EBS shelf between 1978 and 2020 was highly variable, with or without pollock included, ranging from a high of more than 1.4 million mt in 1980 to a low of less than 200,000 mt in the late 1990s. Total exploitation rates (aggregated catch / aggregated mature biomass) ranged from 6 to 13%, reflecting relatively conservative exploitation rates with the highest rates occurring early in the time series.

The high reproductive success of both planktivorous and piscivorous seabirds nesting on the Pribilof Islands indicated that both large crustacean zooplankton and forage fish were sufficiently available over the shelf near the Pribilof Islands. Despite the heavy coccolithophore bloom over much of the middle and inner shelf, there were no reports of a major shearwater die-off, as has happened in the past (a small number of carcasses were reported from the Alaska Peninsula near False Pass). These positive trends are in line with those of improved groundfish condition in 2022.

The numbers of seabirds estimated to be caught incidentally in the southeastern Bering Sea fisheries in 2021 (1,892 birds) decreased from 2020 by 24% and was 52% below the 2012–2020 average. In 2021, 23 Laysan albatrosses were taken, but no black-footed or short-tailed albatrosses were bycaught. In contrast, the number of stranded northern fur seals on the Pribilof Islands increased. On St. Paul Island, 40 fur seals were entangled in fishing gear and were freed alive by the Ecosystem Conservation Office (ECO) of the Aleut Community of St. Paul Island.

For climate projections through March 2023, the National Multi-Model Ensemble shows that SST over the EBS is expected to be within ~0.5°C of average, indicating the short-term persistence of average thermal conditions.

Northern Bering Sea

Zooplankton in the NBS were surveyed during a late summer near-surface bongo net survey. In 2022, the abundances of both small and large copepods over the inner shelf of the NBS were lower than in recent years, whereas euphausiid abundance was higher. Lipid content of copepods in the Chirikof Basin was particularly high, suggesting that they may have been close to descending for diapause.

Similar to the most recent near-average cold-pool-extent-year in 2017, the NBS bottom trawl survey encountered moderate densities of adult walleye pollock and Pacific cod in 2022. The total CPUE of all groundfish combined increased between 2010 and 2018, and then declined to very low values in 2021 and 2022. A relative condition index calculated with the VAST model showed all species examined in 2022, including pollock 100-250 mm and >200 mm in length had below-average condition, although within one standard deviation of the (short) time series mean. On St. Lawrence Island, piscivorous seabirds failed in their reproductive efforts, indicating a low availability of forage fish, which was corroborated by extremely low estimates of forage fish abundance in the NBS surface waters in 2022.

The NBS is a region where much of the annual primary production sinks to the bottom, thereby supporting a benthic food web. In 2022, the unusually low biomass of forage fish, the reproductive failure of piscivorous seabirds at St. Lawrence Island, and the poor condition in groundfish in the NBS suggest that the **NBS system may have been at or near carrying-capacity for pelagic piscivores**. If so, this may have ramifications for juvenile salmon passing through the area.

An ongoing concern is the weak returns of Chinook, chum and coho salmon to the Arctic/Yukon/Kuskokwim region. This is a problem of both national and international importance. The cause(s) of the decline in Chinook salmon returns is not well understood, but it is likely that climate warming in both the marine and freshwater environments and, to some extent, bycatch in EBS fisheries may be factors (see EBS ESR Noteworthy Topics).

The 2021 incidental catch of seabirds in the NBS commercial fisheries was estimated at 415 birds, a decrease of 27% from the 2020 bycatch, and below the 2012–2020 average of 621. Northern fulmars, shearwaters, and gulls were the most commonly caught. Ten Laysan albatrosses were also caught.

The SSC suggested that for species that span the EBS and NBS, indicators could be presented separately unless management is combined. Further, to help clarify some of the dynamics between these two regions, the SSC suggested that it might be valuable to see more spatial indicators incorporated (e.g.,

centroid/density of biomass as a 'ticker-tape' over time) that would assist in interpreting changes in abundance observed between the two regions.

GOA Ecosystem Status Report

This year (2022) was an 'off' year in the alternating GOA schedule of NOAA's bottom trawl, summer acoustic, and spring ecosystem (EcoFOCI) surveys, limiting available information related to groundfish ecosystem conditions, especially in the western GOA. It was also an 'off' year for Steller sea lion surveys in the GOA.

There were no major ecosystem concerns identified for the GOA. Overall the western GOA experienced cooling conditions for the third consecutive year in 2022**.** This year (2022) was the most consistently productive year since the last year dominated by marine heatwave conditions (2019). This productivity was consistent spatially across the GOA and across numerous ecosystem metrics. All GOA groundfish stocks were evaluated as Level 1 in the Risk Tables.

Two noteworthy topics were identified in the Gulf of Alaska. Invasive green crabs were detected in Alaska for the first time in July 2022. They are known to expand their range northward in summers following warm winters, so their potential range expansion will be important to monitor if warm temperatures persist in the eastern GOA. The primary ecological impacts of invasive green crab are through shellfish predation and eelgrass habitat disruption, which alters nearshore nutrient cycling. Second, in 2022, three northern elephant seal yearlings stranded in Alaska, two of which required relocation to a more remote beach. The third seal died. An additional two northern elephant seals were reported hauled out and molting in Alaska. **The SSC supports continued monitoring for patterns of invasive and southern latitude species in Alaska waters, and the potential impacts they may have on habitat and species interactions.**

Western GOA

Overall the western GOA experienced cooling conditions for the third consecutive year in 2022, with the Pacific Decadal Oscillation in its negative phase. There was moderate warming in the latter half of summer/early fall, which may have impacts on lipid storage and overwintering of juvenile groundfish. In 2023, conditions are expected to be cooler.

There was average copepod biomass in 2022, but their average size across the community was large, indicating larger copepods were abundant. Surveys indicated spatial variation, with low biomass southwest of Kodiak that was reflected in lower planktivorous seabird reproductive success in this region. Capelin prevalence remained low as sampled in Rhinoceros Auklet diets in 2022, but Black-legged Kittiwake reproductive success improved in 2022, indicating good forage available to surface feeding piscivorous seabirds.

For groundfish, new data were presented from the ADF&G trawl survey. Overall biomass caught in both the inshore and offshore stations increased in 2022. Arrowtooth flounder and Tanner crab have been the predominant species in the ADF&G trawl survey catches in the last three years, with significant increases in both the inshore and offshore stations. The SSC discussed whether these changes might be linked to decreases in cod in certain years and supports efforts to explore those connections. Flathead sole also showed a slight increase in 2022. Pacific cod, Pacific halibut, and walleye pollock were below average for both inshore and offshore stations, while skates showed a large increase in the offshore stations. Nearshore sea stars showed evidence of recovery in 2022 for the first time after the heatwave years.

There were no new data for Steller sea lions in 2022, but Skipper Science contributions reported more fish with 'seal/sea lion' bites on salmon with observations reported from WGOA and SEAK. **The SSC appreciates this on-ramp for information into the ESR and supports continued integration of this type of data to complement indicators.** Depredation is important to continue to track and the SSC looks

forward to receiving more details on direct interactions between marine mammals and fisheries in the future.

Eastern GOA

A third consecutive winter of La Niña conditions is predicted for winter 2022/2023. In 2022, the eastern GOA experienced a cool winter and spring, but more warming in the summer and early fall (SST were above average (1985– 2022) in the eastern GOA and close to one standard deviation (1SD) above the long-term mean).

Plankton biomass in the inside waters of SEAK was above average, and reproductive success of planktivorous seabirds offshore of Sitka suggests that there was also good plankton forage on the shelf. Forage fish conditions were mixed. Sitka herring biomass remained 1SD above the long-term average and an increasing trend in fish-eating rhinoceros auklet growth continued in 2022, though the latter indicator was still below the long-term average. Age-0 sablefish were observed in Middleton Island seabird diets, suggesting capacity to move from nursery habitat to within foraging distance on the shelf. Conversely, eulachon, and juvenile salmon estimates were low. Humpback whales in Prince William Sound abundance/encounters were up, but calf production there remained low.

The SSC noted that several black-footed albatrosses were taken in the inside waters of southeast Alaska. If this becomes prevalent, it may be necessary to re-examine the adequacy of seabird bycatch mitigation measures in these waters.

GOA Shelf Edge/Upper Slope

There were some habitat concerns for the shelf-edge and upper-slope. Temperatures around 250 m depth, along the shelf edge, have been consistently above average since 2016. Also, structural epifauna (primarily sponges), which is an important habitat for rockfish, has experienced a multi-year decline in the western GOA. In addition, adult female sablefish had below-average condition in 2022, potentially indicating that they experienced challenging forage conditions, despite their characterization as opportunistic predators.

C4 BSAI and C5 GOA Groundfish Specifications

Jim Ianelli (NOAA-AFSC; GOA GPT co-chair), Steve Barbeaux (NOAA-AFSC; BSAI GPT co-chair) and Diana Stram (NPFMC) presented the Joint Groundfish Plan Team (JGPT) report from the November 2022 JGPT meeting. Dr. Barbeaux gave an overview of the November 2022 BSAI GPT meetings and on recommendations for BSAI groundfish OFLs and ABCs. Finally, the SSC received a presentation by Dr. Ianelli and Sara Cleaver (NPFMC) on the November 2022 GOA GPT meeting and on GOA groundfish OFL and ABC recommendations. Kalei Shotwell (NOAA-AFSC; BSAI GPT co-chair) and Chris Lunsford (NOAA-AFSC; GOA GPT co-chair) were available online, as was Cindy Tribuzio (NOAA-AFSC, lead author of the BSAI and GOA sharks assessments and BSAI-GPT vice-chair), Dan Goethel (NOAA-AFSC, sablefish assessment lead author), and Pete Hulson (NOAA-AFSC, GOA Pacific cod assessment lead author). Dr. Ianelli presented the EBS pollock stock assessment. Dr. Barbeaux presented the EBS Pacific cod stock assessment, and Dr. Tribuzio presented the BSAI and GOA sharks assessments.

The SSC reviewed the Stock Assessment and Fishery Evaluation (SAFE) report chapters and 2022 OFLs with respect to status determinations for BSAI, GOA, or Alaska-wide groundfish. **The SSC-approved models indicated that no stocks were subject to overfishing in 2021. Also, in reviewing the status of stocks with reliable biomass reference points (all Tier 3 and above stocks), 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 2022 and harvest specifications were rolled over for 2023.**

These include: BSAI Other flatfish, GOA Shortraker rockfish, GOA Other rockfish, GOA Atka Mackerel, GOA Octopus and GOA Skates.

To streamline and simplify the SSC report, recommended ABCs, 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 2023 and 2024. Bold text indicates where the SSC recommendation differed from the BSAI Plan Team.

		2022			Catch as of	2023		2024	
Species	Area	OFL	ABC	TAC	11/5/2022	OFL	ABC	OFL	ABC
Pollock	EBS	1,469,000	1,111,000	1,111,000	1,103,996	3,381,000	**1,910,000**	4,639,000	**2,275,000**
	AI	61,264	50,752	19,000	2,895	52,383	43,413	52,043	43,092
	Bogoslof	113,479	85,109	250	256	115,146	86,360	115,146	86,360
Pacific cod	BS	183,012	153,383	136,466	127,885	172,495	144,834	166,814	140,159
	AI	27,400	20,600	13,796	6,178	18,416	13,812	18,416	13,812
	BSAI/GOA	40,432	34,521	n/a		47,390	40,502	48,561	41,539
Sablefish	BS	n/a	5,264	5,264	5,205	n/a	8,417	n/a	10,145
	AI	n/a	6,463	6,463	2,193	n/a	8,884	n/a	10,299
Yellowfin sole	BSAI	377,071	354,014	250,000	149,869	404,882	378,499	495,155	462,890
Greenland turbot	BSAI	7,687	6,572	6,572	1,477	4,645	**3,960**	3,947	**3,364**
	BS	n/a	5,540	5,540	1,038	n/a	**3,338**	n/a	**2,836**
	AI	n/a	1,032	1,032	439	n/a	**622**	n/a	**528**
Arrowtooth flounder	BSAI	94,445	80,389	20,000	7,626	98,787	83,852	103,070	87,511
Kamchatka flounder	BSAI	10,903	9,214	9,214	8,349	8,946	7,579	8,776	7,435
Northern rock sole	BSAI	214,084	206,896	66,000	18,242	166,034	121,719	196,011	119,969
Flathead sole	BSAI	77,967	64,288	35,500	14,559	79,256	65,344	81,167	66,927
Alaska plaice	BSAI	39,305	32,697	29,221	11,006	40,823	33,946	43,328	36,021
Other flatfish	BSAI	22,919	17,189	10,000	2,550	22,919	17,189	22,919	17,189
Pacific Ocean perch	BSAI	42,605	35,688	35,385	22,629	50,133	42,038	49,279	41,322
	BS	n/a	10,352	10,352	9,665	n/a	11,903	n/a	11,700
	EAI	n/a	8,083	8,083	5,924	n/a	8,152	n/a	8,013
	CAI	n/a	5,950	5,950	5,823	n/a	5,648	n/a	5,551
	WAI	n/a	11,303	11,000	10,882	n/a	16,335	n/a	16,058
Northern rockfish	BSAI	23,420	19,217	17,000	7,801	22,776	18,687	22,105	18,135
Blackspotted/Rougheye Rockfish	BSAI	598	503	503	386	703	525	763	570
	EBS/EAI	n/a	326	326	137		359		388
	CAI/WAI	n/a	177	177	249		166		182
Shortraker rockfish	BSAI	722	541	541	284	706	530	706	530
Other rockfish	BSAI	1,751	1,313	1,144	1,224	1,680	1,260	1,680	1,260
	BS	n/a	919	750	647		880		880
	AI	n/a	394	394	577		380		380
Atka mackerel	BSAI	91,870	78,510	66,481	54,311	118,787	98,588	101,188	86,464
	EAI/BS	n/a	27,260	27,260	15,504	n/a	43,281	n/a	37,958
	CAI	n/a	16,880	16,880	16,599	n/a	17,351	n/a	15,218
	WAI	n/a	34,370	22,341	22,208	n/a	37,956	n/a	33,288
Skates	BSAI	47,790	39,958	30,000	27,799	46,220	38,605	44,168	36,837
Sharks	BSAI	689	517	500	125	689	450	689	450
Octopuses	BSAI	4,769	3,576	700	254	4,769	3,576	4,769	3,576
Total	BSAI	2,953,182	2,383,653	1,871,000	1,586,764	4,859,585	3,155,268	6,219,700	3,590,412

Sources: 2021 OFLs, ABCs, and TACs and 2022 OFLs and ABCs are from harvest specifications adopted by the Council in December 2020 and December 2021 respectively; 2021 catches through December 31, and 2022 catches through November 5, 2022 from AKR Catch Accounting.

Table 2. SSC recommended OFLs and ABCs for Groundfish in the Gulf of Alaska (metric tons) for 2023 and 2024. Bold text indicates where the SSC recommendation differed from the GOA Plan Team.

Species	Area	2022 OFL	2022 ABC	2022 TAC	Catch as of 11/5/2022	2023 OFL	2023 ABC	2024 OFL	2024 ABC
Pollock	State GHL	n/a	3,327	n/a		n/a	3,723	n/a	4,027
	W (610)	n/a	23,714	23,714	23,595	n/a	26,958	n/a	29,156
	C (620)	n/a	69,250	69,250	69,341	n/a	77,005	n/a	83,283
	C (630)	n/a	30,068	30,068	30,499	n/a	33,729	n/a	36,478
	WYAK	n/a	6,722	6,722	6,441	n/a	7,523	n/a	8,136
	Subtotal	154,983	133,081	129,754	129,876	173,470	148,938	186,101	161,080
	EYAK/SEO	15,150	11,363	11,363	-	15,150	11,363	15,150	11,363
	Total	170,133	144,444	141,117	129,876	188,620	160,301	201,251	172,443
Pacific Cod	W	n/a	9,942	6,959	4,926	n/a	7,464	n/a	6,873
	C	n/a	19,752	14,814	13,070	n/a	14,830	n/a	13,655
	E	n/a	3,117	2,338	279	n/a	2,340	n/a	2,155
	Total	39,555	32,811	24,111	18,275	29,737	24,634	27,507	22,683
Sablefish	W	n/a	3,727	3,727	2,799	n/a	4,473	n/a	4,626
	C	n/a	9,965	9,965	7,342	n/a	9,921	n/a	8,819
	WYAK	n/a	3,437	3,437	2,643	n/a	3,205	n/a	2,669
	SEO	n/a	5,665	5,665	4,747	n/a	5,602	n/a	4,981
	GOA Total	n/a	22,794	22,794	17,531	n/a	n/a	n/a	n/a
Alaska-wide OFL and ABC	AK Total	40,432	34,521	n/a	n/a	47,390	40,502	48,561	41,539
Shallow-Water Flatfish	W	n/a	21,256	13,250	33	n/a	22,485	n/a	23,299
	C	n/a	25,305	25,305	1,251	n/a	26,769	n/a	27,737
	WYAK	n/a	2,531	2,531	8	n/a	2,677	n/a	2,774
	EYAK/SEO	n/a	1,518	1,518	2	n/a	1,606	n/a	1,664
	Total	62,273	50,610	42,604	1,294	65,736	53,537	68,015	55,474
Deep-Water Flatfish	W	n/a	256	256	2	n/a	256	n/a	255
	C	n/a	2,139	2,139	117	n/a	2,105	n/a	2,068
	WYAK	n/a	1,431	1,431	3	n/a	1,407	n/a	1,383
	EYAK/SEO	n/a	2,082	2,082	-	n/a	2,048	n/a	2,013
	Total	7,026	5,908	5,908	122	6,918	5,816	6,802	5,719
Rex Sole	W	n/a	2,981	2,981	40	n/a	3,236	n/a	3,314
	C	n/a	12,076	12,076	654	n/a	13,110	n/a	13,425
	WYAK	n/a	1,361	1,361	-	n/a	1,439	n/a	1,453
	EYAK/SEO	n/a	2,723	2,723	-	n/a	2,879	n/a	2,905
	Total	23,302	19,141	19,141	694	25,135	20,664	25,652	21,097
Arrowtooth Flounder	W	n/a	33,658	14,500	438	n/a	30,469	n/a	30,093
	C	n/a	68,394	68,394	10,926	n/a	65,000	n/a	64,200
	WYAK	n/a	6,707	6,707	36	n/a	7,886	n/a	7,789
	EYAK/SEO	n/a	11,020	6,900	56	n/a	16,130	n/a	15,932
	Total	143,100	119,779	96,501	11,456	142,749	119,485	141,008	118,014
Flathead Sole	W	n/a	14,755	8,650	42	n/a	12,793	n/a	13,033
	C	n/a	22,033	15,400	521	n/a	21,487	n/a	21,892
	WYAK	n/a	1,511	1,511	-	n/a	2,320	n/a	2,363
	EYAK/SEO	n/a	1,876	1,876	-	n/a	2,880	n/a	2,934
	Total	48,928	40,175	27,437	563	48,161	39,480	49,073	40,222
Pacific ocean perch	W	n/a	2,602	2,602	2,506	n/a	2,529	n/a	2,461
	C	n/a	30,806	30,806	25,039	n/a	29,940	n/a	29,138
	WYAK	n/a	1,409	1,409	1,398	n/a	1,370	n/a	1,333
	W/C/WYAK	41,470	34,817	34,817	28,943	40,308	33,839	39,229	32,932
	SEO	4,110	3,451	3,451	-	3,994	3,354	3,888	3,264
	Total	45,580	38,268	38,268	28,943	44,302	37,193	43,117	36,196
Northern Rockfish	W	n/a	1,944	1,944	474	n/a	2,614	n/a	2,497
	C	n/a	3,202	3,202	1,405	n/a	2,350	n/a	2,244
	E	n/a	-	-	-	n/a	-	n/a	-
	Total	6,143	5,146	5,146	1,879	5,927	4,964	5,661	4,741
Shortraker Rockfish	W	n/a	51	51	7	n/a	51	n/a	51
	C	n/a	280	280	287	n/a	280	n/a	280
	E	n/a	374	374	149	n/a	374	n/a	374
	Total	940	705	705	443	940	705	940	705
Dusky Rockfish	W	n/a	269	269	106	n/a	149	n/a	141
	C	n/a	4,534	4,534	2,455	n/a	7,647	n/a	7,264
	WYAK	n/a	427	427	6	n/a	90	n/a	85
	EYAK/SEO	n/a	142	142	1	n/a	31	n/a	30
	Total	8,614	5,372	5,372	2,568	9,638	7,917	9,154	7,520
Rougheye and Blackspotted Rockfish	W	n/a	184	184	95	n/a	180	n/a	180
	C	n/a	235	235	183	n/a	232	n/a	231
	E	n/a	369	369	160	n/a	363	n/a	361
	Total	947	788	788	438	930	775	927	772
Demersal shelf rockfish	Total	579	365	365	163	376	283	376	283

Table 2 (continued). SSC recommended OFLs and ABCs for Groundfish in the Gulf of Alaska (metric tons) for 2023 and 2024. Bold text indicates where the SSC recommendation differed from the GOA Plan Team.

Species	Area	2022 OFL	2022 ABC	2022 TAC	Catch as of 11/5/2022	2023 OFL	2023 ABC	2024 OFL	2024 ABC
Thornyhead Rockfish	W	n/a	352	352	108	n/a	314	n/a	314
	C	n/a	910	910	173	n/a	693	n/a	693
	E	n/a	691	691	74	n/a	621	n/a	621
	Total	2,604	1,953	1,953	355	2,170	1,628	2,170	1,628
Other Rockfish	W/C	n/a	940	940	1,134	n/a	940	n/a	940
	WYAK	n/a	370	370	76	n/a	370	n/a	370
	EYAK/SEO	n/a	2,744	300	56	n/a	2,744	n/a	2,744
	Total	5,320	4,054	1,610	1,266	5,320	4,054	5,320	4,054
Atka mackerel	Total	6,200	4,700	3,000	880	6,200	4,700	6,200	4,700
Big Skate	W	n/a	591	591	163	n/a	591	n/a	591
	C	n/a	1,482	1,482	668	n/a	1,482	n/a	1,482
	E	n/a	794	794	113	n/a	794	n/a	794
	Total	3,822	2,867	2,867	944	3,822	2,867	3,822	2,867
Longnose Skate	W	n/a	151	151	58	n/a	151	n/a	151
	C	n/a	2,044	2,044	482	n/a	2,044	n/a	2,044
	E	n/a	517	517	400	n/a	517	n/a	517
	Total	3,616	2,712	2,712	940	3,616	2,712	3,616	2,712
Other Skates	GOA-wide	1,311	984	984	822	1,311	984	1,311	984
Sharks	GOA-wide	5,006	3,755	3,755	2,112	6,521	4,891	6,521	4,891
Octopuses	GOA-wide	1,307	980	980	111	1,307	980	1,307	980
TOTAL		626,738	520,038	448,118	221,675	**646,826**	**539,072**	**658,311**	**550,224**

Sources: 2022 OFLs, ABCs, and TACs are from harvest specifications adopted by the Council in December 2021, 2022 catches through Nov 5, 2022, from AKR Catch Accounting.

General Groundfish Stock Assessment Comments

The SSC recommends that for future Tier 1-3 assessments some consideration be given as to how best to represent biomass estimates in the Executive Summary table for each stock (currently, model total biomass and spawning stock biomass are provided) so that the relationship of the biomass to the OFL and ABC in the stock status table is clear,

The SSC appreciates the innovative work being done by the assessment authors through random effects (RE) modeling, by treating area-specific process variation as a random effect to properly weight and, where appropriate, consistently weight, the variation across areas. If not currently included in assessments, the SSC requests full documentation of the justification for the weighting schemes applied. Specific to GOA assessments, the SSC also supports a previous GOA GPT recommendation to use a common process error across the GOA and to compare that approach with the current approach that allows process error to vary by sub-region. If process errors are treated separately by sub-region, then justification for that decision should be provided.

For all assessments using VAST, the SSC requests a figure comparing the VAST estimate used in the previous assessment to the current assessment (if new data are added), noting that VAST will refit the time series when additional data are added and the estimated extent and directionality of spatial correlation may change. The SSC anticipates the changes will likely be small; however, given these are new methods for many assessments, this figure would provide information on the stability of estimates.

The SSC requests that the Plan Teams consider common methods among partial assessment projections for estimating catch for the end of the calendar year (also see SSC December 2021 Report). The method used should be clearly stated in the partial assessment document.

The SSC reminds authors and PTs to please bring forward and respond to SSC comments from previous assessments, particularly where updates with minimal change to the assessment have been conducted in the intervening year(s).

The SSC highlights that in several cases adjustments to estimated recruitment were proposed for forward projection as a way to deal with large and highly uncertain recruitment events. The SSC highlights that ad hoc adjustments are less than ideal in this context and that model-based approaches to constraining extreme and uncertain recruitments are preferred. In cases where a revised or fixed recruitment estimate for a year class is assumed, the SSC requests:

- Authors include a footnote in the projection summary table (Executive Summary table in SAFE chapters) indicating the exact nature of the adjustment to recruitment for transparency.

- Authors include a figure showing how previous recruitment estimates have changed, or been revised downward, in past years with the addition of new data (similar to Fig 3.33, pg. 88 in the 2022 Sablefish SAFE chapter), in addition to the standard retrospective figure for recruitment.

Joint Plan Team Report

The SSC received a presentation on selected JGPT report topics; the remainder of the topics were included in the JGPT report only.

Timing and assessment schedules

The SSC notes the ongoing challenges of data availability, time for assessment modeling, and provision of documents prior to PT and Council meetings with sufficient time for review and public comment. The SSC recognizes that adequate time for multiple levels of review and public comment

is critically important to the entire process. The SSC encourages the Council to continue to consider options in addition to efficiencies in the current assessment schedule; these might include reviewing the majority of model research and development in the spring and then keeping model changes to a minimum in the fall. This may require an additional PT meeting and some SSC review in the spring or moving the September GPT meeting to the spring; the SSC noted the previous recommendation on this topic in its February 2022 report.

Fish condition

The SSC supports the JGPT recommendation to make reporting of fish condition routine and standardized across assessments.

Risk tables

There was a discussion of the application of risk tables, both during the JGPT presentation and as specific applications were reviewed for each stock assessment. **The SSC reiterates its previous recommendation that the number of levels should be collapsed from four to three to make the choices easier for the authors. Further, the SSC recommends that the PTs review previous risk scores, as well as GPT and SSC recommended reductions from maxABC across stocks, from previous years prior to beginning the process each year.** The SSC recognizes that completing this efficiently may require coordination among the PTs, SSC, and Council staff to compile necessary information. While each species should be considered on a case-by-case basis, such a review could allow for increased consistency among authors and species as well as easier identification of cases where the use of ABC buffers is becoming routine and a broader review of uncertainty in an assessment should be triggered. The SSC recognizes that the authors provide important experience and expertise and are encouraged to continue to provide as much detail as possible to support recommended risk levels. The SSC appreciates hearing different opinions and perspectives during this process, and values the contributions of authors, the PTs and public testimony. The SSC also reminds authors and the PTs to review guidance and recommendations on risk tables from an SSC Workshop on Risk Tables (see Appendix A in the June 2021 SSC report).

Review of observer program products

The SSC notes that it has not reviewed a full observer program report in several years and **recommends that such a report is needed to improve understanding of the performance of the previous year(s) before reviewing proposed changes and deployment plans for upcoming years.**

Age and growth staffing

The SSC expresses concern over staffing challenges in the age and growth program and highlights the critical importance of timely age information to the stock assessment process.

Working Groups

The SSC received a request from the JGPT to recommend two working groups:

1. A working group focused on data-limited/Tier 6 methods, and
2. A working group that addresses current policies affecting harvest control rules and develops new approaches for accounting for changes in ecosystems related to climate change, including the exploration of environmental data to help inform recruitment.

The SSC recognizes that it may be important to prioritize working group recommendations and consider working group needs across both groundfish and crab, especially for working groups that may benefit from SSC participation. The SSC discussed the two crab working groups recommended at its October 2022

meeting, recognizing that the steps to initiate these may already be underway The two working groups were focused on:

1. Development of simpler models for snow crab, Tanner crab and Bristol Bay red king crab, and
2. Developing a framework for how to estimate the magnitude of unobserved mortality for use in stock assessments.

During the course of the SSC meeting, a number of additional topics were identified that were related to the application of harvest control rules for groundfish:

- Use of Tier 1 vs Tier 3 calculations and appropriate ABC buffers
- Interaction between recruitment variability and harvest control rules
- The effects of truncated age structure on the performance of harvest control rules
- The treatment of recruitment in projections and its effects on reference points, including considerations of the appropriate time periods over which reference points should be calculated and how to account for ecosystem effects on recruitment
- Concepts that may be relevant for harvest control rules and also TAC considerations, including maximum economic yield, catch stability, future value, and other considerations

After considerable discussion, the SSC supports the proposed work on data-limited/Tier 6 methods but suggests that this work may be sufficiently focused to be conducted internally by the AFSC. The SSC looks forward to this work as it pertains to approaches both for analysis of data-limited groundfish species as well as how and if such species should be elevated out of existing complexes. The SSC emphasizes that there is considerable flexibility within the tier structure to consider innovative alternatives for how to use available catch and biomass time series when determining reference points.

Given the wide range of potential topics related to harvest control rules, the SSC recognized that some of the topics may be addressed, and the specific questions more clearly focused, at its upcoming February 2023 workshop. Therefore, the SSC recommends pausing further consideration of an additional working group until after that workshop and considering whether initial efforts should focus on scoping and prioritizing rather than specifically addressing these topics.

Sablefish

The SSC received a presentation summarizing the results of the sablefish stock assessment and JGPT recommendations. No changes were made to the assessment methodology since the last assessment; however, the SSC recognizes the work by the authors on data preparation and graphics, the new appendices providing valuable supporting information, and the updated whale depredation analysis.

Written and oral public testimony was provided by Linda Behnken (Alaska Longline Fishermen's Association). Testimony included concern over the currently truncated age structure in the stock as well as shifts in the apportionment to the Bering Sea. Economic considerations regarding the stability of the resource and the relative value of small vs larger sablefish were also highlighted. The SSC considered this information during its deliberations.

The SSC notes that the results of the sablefish assessment continue to show very positive trends in recruitment and spawning biomass, with a series of large recruitments estimated for 2014, 2016, and 2017–2019, as well as subsequent increases in spawning biomass. Further, the spatial trends of biomass increasing in the west and Bering Sea also continue. Reflecting this, the potential apportionment stairsteps for 2023 and 2024 result in decreases in area-specific ABCs in the eastern regions despite increases to the total ABC.

The SSC recommends the Tier 3a OFL and ABC, adjusting the ABC for whale depredation, and including the 3rd step in the 4-year stairstep in area apportionment toward a 5-year moving average of biomass distribution in each region, noting that next year will represent the end of this phased approach. The SSC recommended no additional reduction from maxABC (beyond the whale depredation correction) based on the risk table, but the SSC recognizes the current truncated population age structure and the heavy reliance on younger fish contributing to the spawning biomass (also highlighted during public testimony).

Given the relatively small magnitude of estimated whale depredation, the SSC supports only periodic updates of this information, but continued inclusion of the mortality in the assessment and projected ABC calculations. **The SSC recommends including other sources of mortality (e.g., recreational and research catches) noting that they are of a comparable magnitude to whale depredation. Further, the SSC recommends consideration of whether there is biological justification for continuing to assess sablefish in federal waters and some State waters separately.**

The SSC appreciates the analyses to date investigating the rapid transition from longline to pot gear in the sablefish fishery and the possible ways in which this shift can be best modeled in the stock assessment. There was considerable discussion on the relative merits of including a calibrated fishery CPUE series, separating the two gears into different fleets, allowing for changes in selectivity to reflect the change in gear types, or some combination of these approaches. The SSC recommends side-by-side comparisons of size and age distributions from the two gear types to better understand potential differences in selectivity. **As recommended last year, the SSC would also like to see a model that allows for separate fleets, even if compositional data are sparse, to evaluate how important differences in selectivity might be to assessment results.** The SSC recommends that this investigation be a high priority for the next assessment.

During discussion, the use and dimensions of escape rings in sablefish pots were identified as potentially important contributors to selectivity. **The SSC recommends that observer and logbook programs consider adding specific data collection of escape ring use and dimension as soon as possible.**

The SSC recognizes the extensive work presented as an appendix on fishery dependent data and encourages the authors to highlight specific fishery data concerns in the next assessment.

The SSC notes that there are statistical and economic analyses that could be conducted for sablefish that could be relevant to TAC (but not OFL/ABC) considerations. These include: maximum sustainable yield vs maximum economic yield reference points, the relative value of stable versus variable catch levels, economic impacts of spatial apportionment, and economically optimal fish size/age considerations. **The SSC highlights that these tools exist in case the Council wants analysts to consider these types of approaches.** The SSC also suggests that sablefish could be one of the case studies for a working group on harvest control rules if it is established (see previous section).

The SSC appreciates the list of data gaps and research priorities and looks forward to work on those items as well as the longer list of specific SSC recommendations from the last full assessment.

C4 BSAI SAFE and Harvest Specifications for 2023/2024

BSAI Walleye Pollock

Eastern Bering Sea Pollock

The SSC received a separate presentation on the 2022 assessment for the EBS pollock. Public testimony was provided by Austin Estabrooks (At-Sea Processors Association) and Brent Paine (United Catcher Boats). Their comments focused on risk table considerations and the need for more consistency in applying the risk tables over time. As an example of apparent inconsistency, they noted the decrease in risk scores this year, but a considerable increase in the associated ABC buffer. They also noted support for keeping

walleye pollock in Tier 1 and expressed concerns over using the Tier 3 approach, as well as the need for a clear justification for any reductions from maxABC. The use of Tier 3 calculations and risk table considerations were discussed at length during SSC deliberations.

This year's assessment was a straightforward update of last year's approved model (20.0c, renamed 20.0 in this year's assessment) with updated data, including new, adjusted weight-at-age estimates. Other updates included: (1) catch-at-age and average weight-at-age data from the 2021 fishery, (2) 2022 catches, (3) VAST estimates of the combined EBS and NBS bottom trawl survey biomass index through 2022, (4) VAST estimates of survey age compositions, (5) an opportunistic acoustic index collected during the bottom trawl survey, and (6) data from the 2022 MACE acoustic trawl survey (numbers and biomass at age, age compositions).

In addition to last year's model, the authors fit two alternative models that had minimal impacts on results and were not considered further.

After a declining biomass trend following a peak in 2016, this year's assessment estimated a substantially higher total biomass in both 2021 and 2022 compared to last year's estimate for 2021 and projection for 2022. This was primarily due to a strong 2018 year class, which was estimated to result in the highest age-1 recruitment observed in the time series (1964–2021).

The SSC concurs with the author and Plan Team to use Model 20.0 for specifying 2023 harvest levels. Walleye pollock are managed under Tier 1 and the stock is currently in Tier 1a, given that the estimated biomass is well above B_{MSY}. The authors and BSAI GPT recommended setting the ABC below the maximum permissible using the Tier 3 calculations that were used from 2014–2020, with an additional modification to set the 2018 year-class strength (in terms of numbers at age-4) equal to the mean of the two strongest year classes observed previously (2012 and 2013). This reduction was recommended based on the risk table, specifically a substantially increased concern (Level 2) for assessment considerations. The primary concern was the substantial and unexpected increase in estimated biomass relative to the low 2021 survey biomass resulting from a very high, but uncertain, estimate for the magnitude of the 2018 year class. The authors illustrated how the apparent magnitude of previous large year classes (such as 2008 and 2012) tended to decrease as more years of data became available.

The SSC agrees with the proposed risk level (Level 2) for assessment considerations and with the recommended Level 1 (no elevated concern) for population dynamics, ecosystem and fishery performance considerations. The SSC also notes some concern with respect to the truncated age distribution and the elevated risk in the decision table (Table 1-34) that the age diversity in the population will skew further towards younger ages.

The SSC discussed several options to account for the additional uncertainty associated with the 2018 year class. Last year, the SSC used a Tier 2 calculation to address risk table considerations. Given the large increase in apparent biomass in this year's assessment, the Tier 2 calculation would result in a near doubling of the ABC for 2023 relative to the 2023 ABC estimated in last year's assessment. In the past, when confronted with unexpected changes in biomass and associated reference points of a similar magnitude, the SSC has sometimes employed a stair-step approach to reduce potential risks associated with a large increase in the ABC. The SSC considered several options, which included using the Tier 2 approach based on the justification provided last year, combined with a stair-step approach to increase the ABC gradually. After considerable discussion, **the SSC agreed with the author and BSAI GPT to use the Tier 3 approach to reduce ABC from maximum ABC**, which had been used prior to last year to address risk table concerns and would result in a similar effect to a stair-step approach. **However, the SSC does not support the additional modification proposed by the authors and BSAI GPT to reduce the 2018 year-class strength for projections.** Although the SSC acknowledges the high uncertainty in the magnitude of this year class, the SSC's rationale for the Tier 3 approach already addresses this concern, hence a further reduction using the same rationale is not deemed appropriate. Moreover, the SSC notes that environmental and ecological conditions in 2018 were favorable for the production of an abnormally large year class.

Therefore, the SSC proposes harvest levels for 2023 and 2024 based on the Tier 3 calculation without an additional buffer, resulting in a 2023 ABC of 1,910,000 mt or a 36% reduction from the maximum permissible. The SSC acknowledges the considerable increase in the size of the buffer relative to last year, despite an apparent reduction in overall risk as reflected in the risk table score. However, the SSC notes that the ABC reflects a very substantial increase in the recommended ABC and the larger proportional buffer results from an even larger increase in maxABC based on the dramatically higher estimates of pollock biomass for both 2021 and 2022 compared to last year's assessment. This case serves as a good illustration of why ABC reductions are context-specific and should not be based on rigid guidelines for how to translate risk scores into percent reductions.

The SSC suggests that walleye pollock is a good candidate for considering the impacts of highly variable recruitment on reference points in the context of the Council's harvest control rules (see discussion on working groups in the JGPT report section). For example, the SAFE authors suggested exploring an explicit harvest control rule that maintains productivity at the level observed over recent decades (p. 33). The SSC supports considerations of modified harvest control rules, particularly for stocks with highly variable and uncertain recruitment. If the Council chooses, this could include considerations for stabilizing catches over time or including other economic considerations in the harvest control rules.

The SSC had the following additional recommendations for the authors:

- Maturity and growth information from the NBS has not been examined yet. Given the possible importance of the NBS to walleye pollock and other species in the future, the SSC suggests this should be a high priority.
- The SSC supports efforts to implement recent advances in improving the statistical treatment of compositional data using the Dirichlet distribution or other approaches.
- The SAFE document lists a number of research recommendations (p. 36/37). The SSC notes that some of these are at least in progress. The SSC generally supports these recommendations but requests that the authors update the list of priorities to clarify to what extent some of these priorities have been partially or fully addressed.
- In particular, the SSC notes that genetic sample collection and analyses are listed as a research priority across all pollock stocks and that some work has been completed. The SSC highlights the importance of additional genetics work and would appreciate an update on the status of this work either as part of the assessment or separately.
- The SSC appreciated the adjustments to weight-at-age in the survey that was included in this year's assessment and suggests that these changes may be substantial enough to warrant an examination of their impact on assessment results.
- With respect to the multi-species CEATTLE model, the SSC concurs with GPT recommendations to use the model to inform risk table discussions and to consider ways in which model outputs, in particular estimates of predation mortality, can inform single-species assessments.
- The SSC encourages the authors to consider model-based solutions to uncertain recruitment estimates rather than ad-hoc adjustments. In particular, reductions in the assumed recruitment variance parameter may result in less extreme recruitment estimates. Other systematic approaches to addressing the uncertainty may also be considered.
- The SSC suggests that authors include a plot to compare estimates of recent recruitments as they change over time similar to Fig 3.33 (pg. 88) in the sablefish assessment.
- The SSC supports the move across assessments from design-based estimates of survey biomass to VAST estimates. The SSC recommends that the design-based estimates be produced as a check on

VAST estimates and as a fallback option if needed, although they may not need to be included in the assessment.

Bogoslof Pollock

The Bogoslof assessment uses a random effects model to estimate survey biomass and estimates natural mortality using an age-structured model developed in 2015. The stock is managed under Tier 5. The input data from the 2020 acoustic trawl survey were updated for this assessment but there were no new data. Natural mortality estimates were also reevaluated in the model with additional age composition data. The authors noted no elevated concern in the risk table analysis (values of 1 for all categories).

The SSC supports the authors' and BSAI GPT's recommended Tier 5 estimates of the ABCs and OFLs for 2023 and 2024.

The SSC notes that genetic analyses are a high priority across this and other pollock stocks.

Aleutian Islands Pollock

The previously accepted base model (15.1) was updated for 2022 to include available catch data through 2022, fishery age compositions for 2019 and 2020, and the 2022 Aleutian Islands bottom trawl survey index. In addition, all survey age composition data prior to 1991 were removed from the model, consistent with removing other Aleutian Islands bottom trawl survey data prior to 1991. A second model (15.2), which included age-specific natural mortality, was again provided for comparison.

The SSC supports the authors' and BSAI GPT's recommendation to continue using model 15.1 for determining the OFL and ABC for this stock.

Model results indicate that spawning biomass has been increasing since its minimum value in 2010 but remains well below its historical peak in the 1980s. The estimated biomass decreased slightly from 2021 to 2022 and is projected to decline slightly more in 2023, perhaps indicating that biomass is leveling off at a relatively low level despite low exploitation rates. This can be attributed to generally low recruitment since 1990 compared to the period before 1990, suggesting a possible change in productivity.

The author and Plan Team determined that there was no elevated concern based on the risk table but noted a number of potential concerns that are not accounted for in the model, including uncertain interactions with the EBS stock, uncertainty about productivity of the stock (such as recent low recruitments and anomalous 1978 year class), a high level of aging error and others. In addition, the SSC notes the fairly strong retrospective bias and suggests that these concerns in combination may justify an elevated risk (Level 2) in the stock assessment category of the risk table. Therefore, the SSC supports the GPT recommendation to revisit risk scores next year based on these considerations.

The SSC concurs with the authors and the BSAI GPT to use the maximum ABC from Model 15.1 using the standard Tier 3a approach.

The SSC provided a number of recommendations for the assessment author during the 2020 assessment, which are included here again for reference:

- Following the SSC comments in 2018, 2019, and 2020, provide a basis for the time-period over which recruitment estimates are used to determine biological reference points for this stock and assess whether this time period reflects current productivity.
- Consider the relatively high level of aging error and whether this constitutes the basis for a higher risk level within the assessment-related considerations. Also explore avenues for improved aging, including an evaluation of the apparent shift of the 2011 cohort into a 2012 cohort in the recent observations. Comparisons with similar shifts from the 2012 to 2013 cohorts in the EBS pollock data may be helpful.
- The bottom trawl survey age composition data appear to be largely uninformative and show little evidence of larger cohorts in the fishery data. Consider whether this has implications for the strong

assumption that survey catchability is equal to 1.0, and perhaps explore other plausible values for catchability.

- Continue genetic analyses of walleye pollock including this portion of the species range in addition to the Bogoslof area, GOA and EBS in order to better understand the stock structure and potential for demographic exchange among these areas (see related comments in the EBS pollock section).
- In the next assessment, explore potential effects of the apparent inconsistency between the input recruitment variability (0.6) and the estimated variability (0.28 in Table 1A.18).
- In addition, the SSC suggests examining whether the extremely high coefficient of variation (CV) in the 2022 survey should be considered in the risk table or whether it is appropriately accounted for in the model.

BSAI Pacific Cod

Eastern Bering Sea Pacific Cod

The SSC received a presentation on the 2022 EBS Pacific cod assessment and GPT comments and recommendations for this assessment. The SSC thanks Dr. Barbeaux for his efforts in taking over leadership of this assessment, which includes an ensemble of four individual assessment models, and the significant updates to the SAFE chapter to improve transparency and readability.

Written public testimony was provided by the Freezer Longline Coalition (FLC) and oral public testimony was provided by Jim Armstrong (technical advisor to FLC), Scott Hansen (self), and Kenny Down (advisor to several cod-reliant fixed gear groups). Public comment highlighted appreciation for the functionality of the new SAFE chapter and ease of access to data, and inclusion of an expanded set of model performance diagnostics. However, public testimony also highlighted serious concerns with the ensemble model structure at present, including: (1) the seeming implausibility of the phase-plane diagram (F/F_{MSY} vs B/B_{MSY}) during the 2009–2017 period where the model ensemble estimates increasing biomass during a period of apparent overfishing, (2) that spatial dynamics may be obscuring the true stock dynamics as estimated by the assessment model(s), (3) the overly complicated nature of the current model ensemble and the need for reevaluation of model weighting, and (4) the urgent need for assessment model development to incorporate available fishery age composition data. Other public comment highlighted support for expanded Pacific cod tagging and diet research, analysis of fishery-dependent catch per unit effort across gear groups, and exploration of small Pacific cod bycatch in non-pelagic trawls as an additional source of information. **Given these concerns, the SSC requests the authors include a simple catch/biomass or OFL/biomass plot to complement the standard apical F and phase-plane plots in future assessments.**

The SSC appreciates the authors' efforts to automate and streamline the data import and compilation process to improve transparency and reduce the potential for errors, and the transparency and reproducibility provided by having all data, model files, and scripts available for public and SSC download and review. Further, the SSC highlights the well-designed layout for the assessment document with helpful links to web-based versions of model figures, fits to data, and diagnostic plots, which improve the ease of review for the current set of model ensemble members.

New data included in the 2022 assessment model ensemble members:

- Final 2021 fishery catch biomass, and projected 2022 catch
- 2022 fishery size compositions
- An updated VAST fishery-dependent CPUE index (Model 22.4 only)
- Updated model-based estimate of the EBS+NBS bottom trawl survey numerical abundance index through 2022

- Updated EBS+NBS bottom trawl survey age compositions based on a VAST model-based approach

The model-based combined NBS+EBS bottom trawl survey index declined in 2022, consistent with the southward shift in the center of gravity observed since 2019. The VAST model-based fishery-dependent abundance index informing Model 22.4 increased in 2022, as did the scale of the complete index time series. The author noted the change in scale of the fishery-dependent index was unlikely to have substantive influence given that catchability is freely estimated.

No substantive changes were proposed for the assessment model ensemble members in response to 2021 SSC recommendations. However, several moderate changes were proposed at the September GPT meeting and approved by the SSC, including: (1) change in the catch weighting approach for commercial fishery size compositions (2), removal of seasonally-corrected weight-at-length adjustments, and (3) removal of the post-2007 aging error bias correction given recommendations from the AFSC Age and Growth Laboratory. The SSC appreciates the authors' comparison of the Thompson series models with the new models, and notes that minimal differences in estimates for 2023 were observed between these model variants**. The SSC supports these changes to the data inputs to the ensemble model members.**

The current model ensemble includes four members, three of which add features to model 22.2, including:

- 22.1 - estimating time-varying survey catchability
- 22.3 – assuming dome-shaped survey selectivity
- 22.4 – fitting to a VAST fishery CPUE index

The SSC concurs with the PT in supporting the use of the new model ensemble series (22.1, 22.2, 22.3, and 22.4) for 2023 harvest specification, given the stability this approach provides for estimated stock trends and reference points. Based on the model ensemble, the projected 2023 spawning biomass is above $B_{35\%}$ but below $B_{40\%}$, **placing this stock in Tier 3b. The SSC supports the 2023 recommended OFL and maxABC, with no reduction from maxABC**.

While the SSC continues to support the use of a model ensemble to provide stability for this assessment, it highlights that the continuation of an ensemble modeling approach should not come at the cost of the authors' ability to pursue alternative model structures, including research track models that address PT recommendations and those that:

- Incorporate fishery age compositions
- Explore linkages between time-varying survey catchability (Model 22.1) and plausible environmental processes that may be regulating movement of this stock in and out of the EBS+NBS region
- Include an empirical weight-at-length relationships

Given recent evidence for Pacific cod movement in and out of the EBS+NBS regions and stock structure considerations, the SSC encourages collaboration with other Pacific cod assessment authors to explore the feasibility and utility of a more spatially comprehensive assessment model for Alaska that considers connectivity with the GOA. The SSC notes that several alternative approaches may be applicable including combining indices and data across regions as is done for Alaska sablefish, treating areas as fleets, or a spatially-explicit model structure.

The SSC notes that current year incomplete fishery length compositions are used in the assessment. It appears that a fairly substantial amount of catch occurs after October which may be harvesting different sized fish because of movement or growth. The SSC requests that the authors evaluate the benefit of

including these data by showing the incomplete versus complete length compositions for the past few years and a retrospective of the assessment including and excluding these data.

The SSC continues to encourage the authors to work with the PT to define a process for how ensemble member weights are reviewed and updated, based on the existing or a new set of scoring criteria that consider model plausibility and performance. While the author responded that they view this as appropriate for a 5-year CIE review timeline, the SSC expresses concern that reliance on the CIE review cycle for this purpose may slow progress toward incorporation of possibly valuable and informative alternative model structures or treatments of data and that independent CIE reviews may lack consistency over time.

EBS Pacific Cod ESP

The SSC reviewed the EBS Pacific cod ESP. Please refer to the "Ecosystem and Socioeconomic Profiles" section in the General Stock Assessment Comments section for the SSC's comments.

Aleutian Islands Pacific Cod

The SSC received a presentation on the 2022 Aleutian Islands Pacific cod assessment and associated PT recommendations. The SSC appreciates the authors' efforts in bringing forward two variants of an age-structured Tier 3 assessment framework for this stock, as well as the authors' responsiveness to past SSC comments including: (1) exploration of updated maturity specific to the AI region, (2) exploration of alternative methods for estimating natural mortality, and (3) exploration of appropriate methods for incorporating abundance index information from the AFSC longline Survey. The SSC notes that all of these components have been incorporated within at least one of the age-structured models presented, while the natural mortality assumed under the Tier 5 assessment approach still retains the old natural mortality estimate. There was no public comment.

The AI Pacific cod stock has been assessed using a Tier 5 methodology since 2013. While an age-structured assessment model alternative has been presented in parallel to Tier 5 methods (2013–2015, 2020, 2021), the Tier 5 model has been used for harvest specification in the past. The data used in the Tier 5 model includes 13 years of biomass and associated error estimates from the 1991–2022 NMFS Aleutian Island bottom trawl surveys.

In addition to the Tier 5 random effects model (13.4), the two alternative age-structured Tier 3 assessment models include: 20.0 which fits to aggregated fishery composition data, and 22.1 which treats fleets independently and fits to separate fishery compositions.

The risk table for AI Pacific cod indicates a Level 1 (Normal) for the assessment considerations and fishery performance indicators, and a Level 2 (Substantially increased concern) for population dynamics and environment/ecosystem categories, due to the downward trend in the trawl survey biomass index for which the 2022 index value is the lowest in the entire time series, and the observation of below-average cod condition since 2021.

The SSC supports the PT and author recommendation for continued use of the Tier 5 assessment approach in 2022, due to strong positive retrospective pattern in both age-structured model variants 22.0 (Mohn's rho: 0.316) and 22.1 (Mohn's rho: 0.252), which highlight a history of overly optimistic projections for increasing abundance. The SSC also notes that both Tier 3 age-structured models exhibit a positive bias in their fit to the AI bottom trawl survey, for the period prior to and including 2014. **The SSC supports the PT and authors' recommendation to use the Tier 5 random effects model for 2023 and 2024 harvest specification, and associated OFLs and ABCs, with no reduction from the maximum permissible ABC.**

The SSC supports the PT recommendation for continued efforts to develop a viable age-structured assessment model framework for this stock and retaining the annual assessment cycle at this time. However,

the SSC encourages the authors and PT to consider whether this stock might be a viable candidate for reduced assessment frequency given the timing of available survey information and the opportunity for more model development in off-cycle years.

The SSC notes that the majority (65.8%) of harvest is taken during the January-April spawning season while fish are aggregated, during which the majority of harvest comes from trawl (40.5%) and pot (58.3%) gears. However, the fishery length composition data are collected primarily from the longline and trawl fleets. The SSC encourages the authors to work with the observer program to identify whether it is possible to collect additional length composition data from the pot fleet to ensure representative composition samples are available to inform continued development of fleet-disaggregated models such as Model 22.1. Otherwise, the data may not support a fleet-specific model.

The SSC is encouraged by the authors' progress in developing age-structured models for this stock and offers the following suggestions for future development:

- If the fleet disaggregated Model 22.1 is pursued in the future, the SSC encourages consideration of dome-shaped selectivity for the HAL fleet, given the observed differences in size compositions among fleets.
- If the fleet-aggregated Model 22.0 is pursued in the future, the SSC encourages the authors to explore the potential for time-varying fishery selectivity as one option for addressing the retrospective pattern, and changes in fishing behavior and gear use over time.
- Given the uncertainty of the AI bottom trawl survey, a version of Model 22.0 that includes the AFSC longline survey and/or IPHC survey data could be a viable alternative

With respect to future use of the Tier 5 assessment method, the SSC supports the PT recommendation to consider a hybrid approach where the natural mortality estimated by a Tier 3 age-structured model is used for Tier 5 harvest specification.

BSAI Flatfish

Yellowfin Sole

Yellowfin sole is assessed annually and therefore a full assessment was presented this year. Three models (18.2, 22.0, and 22.1) were presented for this Tier 1 assessment. Model 18.2 was the accepted model in 2021, Model 22.0 included a single-sex survey selectivity, and Model 22.1 included the single-sex survey selectivity and VAST estimates for the EBS and NBS. Updated data included fishery age compositions for 2021; total catch for 2021; estimated catch for 2022; shelf trawl survey biomass estimates, standard errors, and survey length composition for 2021. Additionally, VAST estimates and standard errors were included. There was no public testimony.

Overall, there was an increase in total and spawning biomass compared to last year; much of this was due to the inclusion of the NBS in the author's preferred model (22.1). The spawning biomass was estimated to be 1.86 times greater than B_{MSY}, which qualifies it for management under Tier 1a. However, the long general decline in spawning biomass continues, but a relatively large recruitment in 2017 is predicted to mediate this decline over the next few years.

The risk table has a Level 1 risk in all categories as many of the previous modeling concerns have been improved and many of the ecosystem considerations have returned to near baseline conditions.

The SSC accepts the BSAI GPT's and authors' recommended model (22.1) with its associated OFL and ABC and no reduction from maxABC for 2023 and 2024.

The SSC commends the author for thoroughly addressing previous SSC comments as demonstrated by the acceptance of Model 22.1 as a notable improvement over the previous base model (18.2).

The SSC supports the November 2022 BSAI GPT recommendations and suggests continued examination of the role of temperature, especially with the addition of the NBS survey data. This suggestion is not solely for model improvements, but also as a way to improve our understanding of the impacts of climate change on Bering Sea stocks. Given demonstrated links between yellowfin sole and water temperatures, a stable assessment, and low catch/biomass ratios, this avenue of research could provide a large step forward.

The SSC recommends a more detailed examination of the role of including the NBS survey data with and without VAST estimates to better understand the relative importance of these two changes, and a comparison of VAST model-based indices with and without the NBS.

The SSC also recommends the examination of the large 2017 recruitment through a retrospective analysis. The SSC requests retrospective estimates of the estimated recruitment timeseries be included in all future SAFE documents for this stock.

Greenland Turbot

A full assessment was presented for Greenland turbot. There was no public testimony. This stock is assessed on a biennial basis, with the last full assessment in 2020. The 2022 assessment considered three models, and projections were based on Model 16.4c.

Model changes were minor. The AFSC longline survey length data were included and selectivity was estimated in Models 16.4b and 16.4c. The EBS slope bottom trawl survey mean length-at-age data were included in Model 16.4c. Updated data include:

- 2021 and 2022 NMFS shelf bottom trawl survey biomass estimates and length compositions
- 2021 and 2022 NMFS shelf bottom trawl survey length-at-age data
- 2021 and 2022 AFSC longline survey relative population numbers (RPNs)
- Updated fishery catch estimates, and a preliminary estimate for 2022
- Fishery length compositions from 2021 and 2022

The SSC concurs with the use of Model 16.4c as recommended by the author and the BSAI GPT. This model performs similarly to Model 16.4a and 16.b, uses the AFSC longline data to estimate selectivity, and uses all available information to model growth. The projected 2023 female spawning biomass, based on Model 16.4c, is 33,554 mt, which is a 29% decrease from last year's 2023 projection of 47,376 mt. Results from this model indicate that total biomass (age 1+) has slowly declined since a slight increase leading up to 2017 and the spawning biomass has similarly declined since the strong 2007–2010 year classes have become fully integrated into the fishery.

The estimated 2023 female spawning biomass is above $B_{40\%}$, placing **Greenland turbot in Tier 3a.** An updated risk table indicates scores of Level 2 (substantially increased concerns) for assessment-related and population dynamics considerations. Assessment-related concerns include uncertainty about the length of fish at 50% maturity and the fact that **the biomass index for the adult population – the EBS slope survey – has not been conducted since 2016**. Population dynamics concerns are related to uncertainty in future recruitment. The Greenland turbot stock is characterized by infrequent spawning events, but the last event occurred between 2007 and 2009. Recruitment has been below average since 2012, and fish younger than

4 years-old have not been observed in the EBS shelf bottom trawl survey since 2018. All other risk table categories were scored as Level 1. The SSC appreciates the sensitivity analysis of length-at-maturity to illustrate its influence on estimated spawning biomass. The authors recommended a reduction from the maximum permissible ABC given the uncertainty about length at 50% maturity. The BSAI GPT agreed with the authors and recommended a 6% reduction from maximum permissible ABC, based on the lower range determined by the sensitivity analysis of maturity. **The SSC agrees with this tier designation and the recommended OFL. With respect to the ABC, the SSC disagreed with the authors and BSAI GPT for the need to reduce the ABC from the maximum permissible level.** The SSC discussed the reasons for the elevated levels of concern provided by the authors and agreed that there is reason to consider additional uncertainty. However, the recommendation to reduce the ABC from the maximum permissible and the value recommended was based primarily on the uncertainty in the estimated length of maturity. The SSC was concerned that the sensitivity analysis used information from a study (Cooper et al. 2007) that the authors were hesitant to use to inform the stock assessment model, as recommended by the SSC in the past. In addition, while the SSC recognizes the uncertainty in future recruitment, the assessment model captures the current below-average recruitment and therefore a reduction in the ABC is not warranted. **The SSC recommends the ABC be set at the maximum permissible ABC for BSAI Greenland turbot as calculated by the authors in the stock assessment.**

Apportionment of the ABC to the AI and the EBS uses an average of adult biomass in the AI region of 15.7%, as in previous years. This is based on an unweighted average of the EBS slope and AI survey biomass from the four most recent survey years when both of these surveys were conducted. **The SSC supports this area apportionment.**

A number of recommendations to improve the stock assessment have been identified by the authors, BSAI GPT and SSC in this assessment and in the past. These include the treatment of estimates of length at 50% maturity (currently fixed at 60 cm, and uncertainty not accounted for) and estimates of trawl survey catchability (also currently fixed in model) to assess their impacts on model fits. The SSC looks forward to the authors investigating and reporting on these in the next full assessment. The BSAI GPT also recommended that the authors revise the interpolation method used to combine the EBS and AI longline survey relative population numbers, continue exploration of killer whale depredation impacts on longline survey abundance estimates, and present newly available sex-structured length composition data from the longline survey. The SSC agrees with these recommendations.

Arrowtooth Flounder

A full assessment was presented for arrowtooth flounder. This stock is assessed on a biennial basis, with the last full assessment in 2020. There was no public comment. Updated data included NMFS Bering Sea shelf 2021 and 2022 survey biomass along with 2021 survey age composition data, 2022 NMFS Aleutian Islands survey biomass, 2021 and 2022 fishery catch biomass, and 2021 and 2022 catch length compositions. An age-structured model using AD Model Builder RE was used and there have been no changes in the assessment methodology since it was first accepted in 2018 (18.9; Spies et al. 2018). The assessment uses a $B_{35\%}$ proxy for the full assessment time frame (1992–2022). **The SSC agrees with the authors and BSAI GPT on the use of Model 18.9 for use in setting harvest specifications, placing the stock in Tier 3a**.

The SSC agrees with the authors' and BSAI GPT's recommended OFL and ABC. The SSC agrees with the author and GPT that no reduction from the maximum ABC is necessary based on the risk table.

The SSC supports the author's proposed future work on selectivity, growth, age-length conversion matrices, and estimates of predation mortality. Additionally, the SSC looks forward to seeing a more detailed follow-up on parameterization of selectivity as recommended in December 2021.

Kamchatka Flounder

A full assessment of Kamchatka flounder was presented. There was no public testimony. This stock is assessed on a biennial cycle, and the last full assessment was in 2020. The assessment method remained unchanged from the last full assessment and projections were based on Model 16.0b. Updated data include:

- 2021 and 2022 EBS shelf bottom trawl survey biomass and length composition
- 2022 Aleutian Island bottom trawl survey biomass and length composition
- Updated fishery catch estimates (all years), and preliminary estimate for 2022
- 2021 and 2022 fishery length composition data

The SSC concurs with the use of Model 16.0b as recommended by the author and the BSAI GPT. While the model fits to the data are generally adequate, the addition of the 2021 and 2022 EBS shelf and AI survey data resulted in the previous several years not being estimated as well. The EBS shelf and Aleutians Islands survey biomass for Kamchatka flounder showed relatively large declines in recent years, which has resulted in an overall scaling down in the spawning stock biomass, total biomass, and age-2 recruit trends through time – particularly after 2010. The spawning stock biomass exhibited a declining trend between 1998 and 2015, then an increase until 2020, which has since leveled off. The EBS shelf and Aleutians Islands survey biomass showed relatively large declines in recent years. The EBS shelf declined 26% in 2021 and another 10% in 2022 from 2019 levels and in the Aleutian Islands the decline in 2022 was 42%. Total biomass estimates also show a slight decline in recent years. The projected 2023 female spawning biomass, based on Model 16.0b, is 47,877 mt, which is a 16% decrease from last year's projection for 2023. The total biomass (age 2+) is estimated to decrease in 2023 and 2024.

The estimated 2023 female spawning biomass is above $B_{40\%}$, placing Kamchatka flounder in Tier 3a. In the risk table, the authors scored assessment-related considerations at Level 2 (substantially increased concerns) because of the degrading model fit to the survey biomass. All other categories were scored at Level 1. The authors and the BSAI GPT recommended that the ABC be set at the maximum permissible value. **The SSC agrees with the recommended OFL and maximum permissible ABC for BSAI Kamchatka flounder under Tier 3a.**

The SSC supports authors' plans and BSAI GPTs recommendations for data exploration and model improvements. Specifically, the SSC supports the evaluation of formal data weighting (given the fits to the EBS shelf survey), incorporation of aging error into the assessment, and plans to explore separating age- and length-composition data between the Bering Sea and Aleutian Islands subareas. The SSC appreciates the re-examination of the age-length transition matrix and looks forward to the evaluation of assumptions about constant or changing CV in the next full assessment. Finally, the SSC continues to encourage the examination of the relationship between catchability and bottom temperature or cold pool extent.

Northern Rock Sole

A full assessment was presented this year for BSAI northern rock sole. There was no public testimony. This stock is assessed on a biennial basis and is managed in Tier 1. In this assessment, the previously accepted model (18.3), was presented and updated with 2022 catch estimates, fishery and age composition data, and the 2021–2022 survey index. The survey index increased 25% from 2021.

Two alternative model runs (22.1 and 22.2) were also presented in the stock assessment appendix. Model 22.1 incorporates Francis data weighting methods to address conflicts between survey and fishery age composition data in the base model. Model 22.2 estimated female natural mortality with a normal prior with mean 0.15 and a standard deviation of 0.2.

The SSC supports the author and BSAI GPT recommendation on the use of Model 18.3. The projected 2023 spawning biomass is greater than the current estimate of B_{MSY}, **placing the stock in Tier 1a.**

Risk considerations to ensure that the recommended ABC does not exceed the true (but unknown) OFL, were Level 1 for Population Dynamics, Environmental/Ecosystem, and Fishery Performance. However, the author recommended a Level 3 risk associated with Assessment considerations. The base model has a consistent pattern of overestimating recruitment in the most recent years, which are corrected downward with additional years of data leading to a positive retrospective pattern in spawning biomass. To address this additional uncertainty, the authors derived a buffer from what the OFL would be in an alternative model (22.1) that incorporated data weighting methods to better fit the more recent survey data. The SSC appreciates the author's consideration of a method to account for the additional uncertainty and supports the inclusion of a reduction from the maximum permissible ABC.

The SSC accepts the authors' and BSAI GPT's recommended 2022 and 2023 OFLs and ABCs, including the 23% reduction from maxABC.

The SSC thanks the authors for being responsive to the SSC comments. In particular, the alternative model provided reasonable estimates of natural mortality and shows promise for estimating catchability closer to empirical results. The SSC looks forward to future analyses on weighting to address model fits to survey and age composition data as well as development of the climate-enhanced projection model.

Flathead Sole

A partial assessment was prepared for BSAI flathead sole. This stock is on a biennial cycle and the last full assessment was in 2020. However, due to staffing constraints, a partial was conducted in 2022 and the next full assessment is scheduled for 2023. "Flathead sole" represents a two-species complex consisting of true flathead sole (*Hippoglossoides elassodon*) and Bering flounder (*H. robustus*). A statistical age-structured model is used as the primary assessment tool for the BSAI flathead sole assessment, a Tier 3 stock. In a partial assessment year, the full assessment model is not rerun but instead a Tier 3 projection model with an assumed future catch is run to estimate the stock level in future years. There was no public testimony.

New input data for the projection model included updated catches for 2020 and 2021 and estimates for the total catches in 2022–2024. The catch for 2022 (14,659 mt) was estimated by adding the average catch between October 19 and December 31 over the years 2017–2021 to the 2022 catch as of October 19, 2022. The 2023 and 2024 catches (11,130 mt) were estimated as the average catch over the previous 5 years (2017–2021). The resulting OFL and ABC recommendations for 2023 are nearly identical to those projected by the 2020 full assessment model and slight increases are projected for the 2024 OFL and ABC. The catch-to-biomass ratio for this stock is low in 2022 (approximately 0.02).

The SSC accepts the authors' and BSAI GPT's recommended 2023 and 2024 OFLs and ABCs, with no reduction from maxABC.

Alaska Plaice

A partial assessment was prepared for the BSAI Alaska plaice stock. This stock is on a biennial cycle and its last full assessment was in 2021. A statistical age-structured model is used as the primary assessment tool for the BSAI Alaska plaice assessment, a Tier 3 stock. In a partial assessment year, the full assessment model is not rerun but instead a Tier 3 projection model with an assumed future catch is run to estimate the stock level in future years. There was no public testimony.

New input data for the projection model included an updated 2021 catch estimate (15,862 mt) and new catch estimates for 2022 through October 15, 2022. Following methods used in the 2021 full assessment, the full-year 2022 catch (12,226 mt) was estimated by averaging the three weeks of catch prior to October 15 and using this value as the assumed weekly catch for the remaining 11 weeks in 2022. The catch-to-biomass ratio for this stock is low in 2022 (approximately 0.025).

The SSC accepts the authors' and BSAI GPT's recommended 2023 and 2024 OFLs and ABCs, with no reduction from maxABC.

BSAI Rockfish

Pacific Ocean Perch

A full assessment was conducted for BSAI Pacific ocean perch (POP). The SSC appreciates the work by the authors and the discussions at the BSAI GPT on this assessment. There was no public testimony. Changes to the model input data include:

- Catch data were updated through 2021 and the 2022 catch was projected.
- Estimated biomass and length compositions from the 2022 AI survey were included.
- 2020 and 2021 fishery age compositions were included.
- Sample sizes for the age and length compositions were reweighted using the McAllister-Ianelli procedure.

The 2022 AI bottom trawl survey biomass estimate of POP continues to increase, as seen in previous surveys (2012 – 2018), with the 2022 biomass estimate being the largest on record and showing a 5% increase compared to 2018. Data from the EBS slope survey are also included in the assessment model, but biomass estimates are highly variable, and this survey has not been conducted in recent years. There was no AI survey in 2020 due to the COVID pandemic and the model (Model 16.3) from the 2020 assessment fit these recent biomass estimates poorly. **The POP assessment underwent a CIE review in 2022** and the lack of fit to the AI survey, noted by both the BSAI GPT and the SSC in recent years, was a primary focus of this review. Explorations were conducted with time-varying natural mortality and alternative data weighting procedures were explored but without improvement to the AI survey model fit.

Two alternative models were presented by the author. The base model (16.3) was updated with new data and, based on a CIE suggestion, an alternative model (Model 22) where the model was fit to survey abundance indices for each survey rather than biomass. As input data differed between these two models, the root-mean-squared error (RMSE) was used to compare the magnitude of the data type residuals. Fits to the two surveys were similar between the two models, as was the Mohn's rho value for the retrospective evaluation. As noted by the author, fitting to abundance indices did not substantially alter the stock dynamics as estimated by the models. **Given the similarity between the two models, the SSC concurs with the author and BSAI GPT's recommendations to use the updated base model (16.3) for setting harvest specifications.** Given that the estimated 2023 spawning stock biomass is above the estimate of $B_{40\%}$ (359,074 mt > 261,050 mt), **POP qualifies for management under Tier 3a**.

The SSC thanks the assessment authors for providing the risk table for this stock. The SSC found the discussion of environmental/ecosystem considerations particularly helpful. The assessment considerations category (risk level = 2) was the only category ranked above 1 by the assessment author, primarily due to the increased retrospective pattern as compared to the previous assessment. However, the author and BSAI GPT did not feel a reduction from the maxABC was warranted due to the repeated high biomass estimates in the AI survey. **The SSC concurs with the use of maxABC to set harvest specifications and agrees with the use of the random effects model to set ABC apportionments based on survey subarea**

biomass. The SSC thanks the author for use of the new *rema* package to estimate these apportionments, in response to BSAI GPT and SSC recommendations.

The retrospective pattern resulting from the lack of fit to the AI survey continues to be a significant issue with this model. The SSC appreciates the author's effort to resolve this, through the CIE review and with the alternative model put forward here. The SSC concurs with the BSAI GPT suggestion to pursue time-varying survey selectivity for the AI bottom trawl survey and supports the BSAI GPT's other suggestions for model improvements.

Northern Rockfish

The SSC received a partial assessment for northern rockfish in the BSAI, which is fully assessed in Tier 3 during odd years. Catch was updated for 2021, and for 2022 through October, with an added expansion factor to estimate catch for the remainder of 2022. Catches for 2023 and 2024 were estimated and the projection model was used to determine the 2023 and 2024 ABC and OFL. There was no public testimony.

The SSC accepts the authors' and BSAI GPT's recommended OFL and ABC for northern rockfish for 2023 and 2024 with no reduction from maxABC. Catches have typically been well below the ABC and the subarea exploitation rates remain low.

The SSC supports authors' intent to re-evaluate the stock structure template and update the aging error matrix for the full 2023 assessment.

Blackspotted/Rougheye Rockfish

This was a full assessment for the BSAI blackspotted/rougheye (BS/RE) rockfish complex. This stock is on a biennial assessment cycle. Oral public testimony was received from Todd Loomis (Ocean Peace). His testimony provided information on the various tools that the fleet is using to stay within the maximum subarea species catch (MSSC) limit and noted that the fleet has been fishing shallower to avoid BS/RE and, consequently, is catching a lower proportion of large fish. Mr. Loomis also confirmed that the fishery has been encountering more young fish in the past several years. He noted that the MSSC was still a useful tool and stated that turning these into area-specific ABCs would not be effective in reducing catch. Finally, Mr. Loomis stated that he felt that the subareas were not delineated on the basis of any meaningful biological context for rockfish but were simply for distributing effort. The SSC appreciates his candid and thoughtful comments.

The BS/RE stock is assessed using an age-structured model for the AI portion of the stock in Tier 3 and a Tier 5 random effects model for the EBS portion. The AI age-structured model is a single-sex model with a single fishery and survey fleet. The SCC appreciates the work done by the assessment authors to respond to SSC and BSAI GPT comments and the informative discussions at the BSAI GPT. Updated input data for the 2022 assessment include:

- Updated 2021 catch data and projected 2022 catch
- 2022 AI survey biomass and length compositions
- 2013 and 2019 AI fishery length compositions were replaced by age compositions
- 2020 and 2021 AI fishery age compositions
- Input sample sizes were re-weighted using the Francis method

The authors presented two alternative models for this year's assessment in the AI. Model 20 (2022) was last year's accepted model but was updated with new data. Model 22 used a bicubic spline to model fishery

selectivity, similar to the BSAI POP assessment, and allows for time-varying selectivity. The SSC notes that the estimated temporal pattern in selectivity estimated by Model 22, with reduced selectivity for older age classes, is consistent with the expected change due to shifts in fleet behavior to shallower depths as an avoidance measure in recent years. Both models estimate a large year class in 2010, fit the AI survey biomass time series poorly, and have similar retrospective patterns. These are a continuation of issues present in the previous two full assessments (2018 and 2020), including an apparently rapidly increasing population based on young fish inadequately observed through time that create uncertainty in recruitment estimates. The BSAI GPT and the authors recommended Model 20 with updated data because allowing for time-varying fishery selectivity did not strongly influence the results, nor did it alleviate the issues noted with the retrospective pattern or the survey biomass model fits. **The SSC concurs with the use of Model 20 (2022) for use in setting harvest specifications for 2023 and 2024.**

The estimated large year class in 2010 was over six times greater than the next highest recruitment in 2002 and was highly uncertain (CV = 0.58). Following precedent from other assessments with implausibly large, estimated recruitment events (e.g., sablefish), the authors substituted the estimated value of the 2010 value equal to the next largest event in 2002 for the purpose of setting specifications and evaluating stock status, specifically the average recruitment used to calculate the $B_{40\%}$ reference point. The SSC notes that using the unadjusted values to calculate $B_{40\%}$ results in an implausibly large increase in this reference point (32% - table presented in the executive summary, pg. 3), given the population dynamics of this stock. **The BSAI GPT supported this approach, and the SSC concurs with this approach as a temporary measure**. However, the unprecedented change in the reference point with the unadjusted recruitment calls into question the reliability of this reference point for this stock and the SSC notes that such ad hoc adjustments are not desirable. **The SSC suggests that this stock would be an excellent candidate to include in the proposed JGPT working group on harvest control rules. Results from this model, using the adjusted 2010 recruitment value, place BS/RE rockfish in Tier 3b.**

The SSC appreciates the thorough discussion presented by the author in the risk table and notes the elevated values of Level 3 in the assessment considerations category and Levels 2 in the population dynamics and fishery performance sections in the risk table. The SSC shares the author and BSAI GPT's concerns as outlined in the risk table. The author recommended a reduction from the maxABC, using the projected 2023 ABC from the 2021 projection model, that equates to a 12.8% reduction. Their justification for this reduction includes (as outlined in the risk table):

- A strong, persistent, and positive retrospective pattern and poor fit to the AI survey biomass estimates
- The model is unable to account for the decline in the abundance of older fish in recent years, where these proportions for fish older than 20 are overestimated in both the survey and fishery age compositions
- The population has a large proportion of immature fish that are still selected for in the fishery and the survey, potentially impacting the future reproductive capacity of the stock
- There is a need for tight priors on M and survey catchability
- Bycatch rates have continued to increase
- Spatial pattern of CPUE in the fishery differs from the spatial pattern of the survey biomass estimates

The SSC concurs with the proposed reduction from maxABC, as suggested by the author and supported by the BSAI GPT, for the reasons listed above.

The total ABC for the BS/RE rockfish complex is the sum of the ABC from the AI age-structured model and the Tier 5 model in the EBS. This ABC is apportioned between two subareas, the western/central AI and the eastern AI/EBS. Proportions are obtained by using a random effects model to smooth survey

biomass. The WAI/CAI subarea ABC has been separated into a "maximum subarea species catch" (MSSC) for the WAI and CAI areas in recent years to provide voluntary catch limits. This approach was co-developed with the fishing industry through the application of the Council's spatial management policy. This MSSC is apportioned in the same manner as the subarea ABCs. **As both the assessment author and the BSAI GPT noted, the WAI MSSC has been exceeded nearly every year since its inception in 2015, and the WAI/CAI subarea ABC has also been exceeded in each year since 2019.**

In October 2022, a discussion paper was provided to the Council that included background on the Council's spatial management policy and its application to the BS/RE stock. The SSC thanks Council staff for putting this together, as its background information was helpful to provide context for the ongoing spatial management issues with BS/RE. At that meeting, the Council elected to amend the spatial management policy and their motion requested that the situation continue to be monitored and that the SSC should "advise the Council if there are associated conservation concerns and any changes to the scale of the concern, if identified, during the next full assessment cycle."

As the BSAI GPT and the SSC have previously stated (see December SSC reports in 2018, 2020, 2021), the SSC continues to register strong concern with the disproportionate harvest in excess of the WAI/CAI subarea ABC and the WAI MSSC in recent years and reiterates that the available life history information for BS/RE rockfish suggest that this complex may be especially vulnerable to localized depletion. However, there are several points that relate to determining whether the scale of concern has changed since the SSC last noted their concerns on this issue. An updated genetic study shows no significant isolation by distance, as described in the assessment document. This is in contrast to an earlier study with a limited sample size that was a part of the motivation for splitting the ABC into the current two subareas. Estimated survey biomass appears to be increasing or stable across the AI subareas, and in particular, in the WAI. The SSC notes that this biomass is composed primarily of young, immature individuals, as noted throughout the assessment, that do not yet substantially contribute to the spawning biomass. Both the fishery and the survey encounter these species years before they mature. However, the consistent disproportionate harvest in the WAI/CAI subarea that, based on our understanding of the spatial distribution of the complex, disproportionately impacts blackspotted rockfish, has continued for multiple years. Further, the magnitude of the overages has increased over time. Finally, the MSSC appears to be an ineffective standalone tool, despite the best and significant efforts of the industry, as documented in public testimony. **The summation of these mixed circumstances makes it difficult to ascertain if the level of concern has changed this year.**

There were two options for action that the SSC discussed to try to provide a path forward on this issue. The first discussion point was a recommendation to the Council to reconstitute the spatial management working group with a proposed goal to develop additional voluntary measures or tools to augment the existing MSSC so that the industry can better manage catch levels of this non-target species. However, as public testimony confirmed, the industry is already using additional tools to augment their ability to avoid BS/RE and the SSC felt this would be an ineffective use of time and resources. As such, the SSC does not recommend reconstituting the spatial management work group for this issue at this time. **The SSC suggests that future applications of the spatial management policy should include clearly defined performance metrics to provide information on whether a particular tool is effective.** Secondly, the SSC considered splitting the WAI/CAI subarea ABC into its separate components (WAI and CAI). In practice, subarea ABCs are generally intended to reflect differences in spatial distribution of the stock within the overall stock area. The SSC recognizes that splitting the WAI/CAI ABC is unlikely to result in reduced mortality to BS/RE rockfish in the WAI and CAI as it will simply increase discards and BS/RE rockfish presumably has high discard mortality rates, as noted in the 2020 BS/RE assessment and in public testimony. The SSC noted that the fishery operates partially in untrawlable habitat and questioned whether the bottom trawl survey was the most appropriate singular data source to apportion ABC among the subareas. Ultimately, neither

of these suggestions were deemed viable at this time and the SSC expressed frustration at the lack of options to address the long-standing concern with this stock.

Following this discussion, the SSC concurred with the author and BSAI GPT's recommended ABC apportionments and continues to recommend the use of the MSSCs to provide a harvest limit for the fleet until the next full assessment.

The SSC offers the following comments on the assessment:

- With regard to the spatial management of this complex, the SSC requests that the authors continue to provide their opinion on this concern in the future.

- The SSC notes that the continuation of the AI bottom trawl survey is critical for this assessment. Additional data on the 2010 year class will be crucial for refining the estimate of this incoming year class on which the population is so dependent.

- The SSC looks forward to the spatial stock structure work for blackspotted rockfish in the AI (upcoming graduate research mentioned in the assessment document).

- Also, the SSC supports the BSAI GPT recommendations to investigate NMFS and IPHC longline survey data for larger fish and looking at the ratio of BS/RE to POP in survey tows over time.

- Recognizing that the proportion of rougheye rockfish is much smaller in the BSAI than in the GOA and that species identification remains an issue, the SSC requests the author, to the extent possible, separate survey trends by species to refine understanding of species-specific impacts.

- Finally, the SSC requests that the authors continue to track current biomass as compared to 1991 biomass over time.

In the long-term,

- Information from ongoing research on untrawlable habitat in the GOA that was brought up in public testimony could potentially inform future discussions around the spatial distribution of the complex and may enhance the information available for apportionment.

- The SSC reiterates that additional species-specific life history research, particularly on blackspotted rockfish, would be helpful in refining this assessment.

- As a research track model, the assessment author could consider a spatially explicit model that better accounts for the differences in survey and fishery data and trends among the distinct AI subareas, to the extent this is practicable given the available data. The canary rockfish model on the West coast utilizes a three-area spatially explicit model to account for differences in exploitation history among the three states. The SSC acknowledges that this would require significant time from the authors, and that the available data may be insufficient to disaggregate.

Finally, the SSC thanks the assessment author for their responsiveness to past GPT and SSC requests, including investigations into natural mortality, survey and fishery patterns, and alternative survey data sources. These explorations are detailed in an appendix to the assessment and provided helpful context for the assessment.

Shortraker Rockfish

BSAI shortraker rockfish is on a biennial schedule and a full assessment was presented this year. There was no public testimony.

New data added to this assessment include catch data that have been revised and updated through November 5, 2022; 2022 AI bottom trawl survey (BTS) estimates; and AFSC longline survey (LLS) relative population weights (RPWs) on the EBS slope, 1997–2021. The EBS slope is sampled by the AFSC LLS in odd years.

The models presented were:

> 1) Model 18.9: The accepted model in the last full assessment as implemented in 2018 and 2020 using the univariate version of the random effects (RE) model. Model 18.9 was bridged from AD Model Builder (ADMB) to TMB and to the multivariate version of the RE model. This bridging analysis was presented to and accepted by the BSAI GPT in September 2022. In October 2022, the SSC supported the JGPT's recommendation that stock assessment authors transition from the ADMB RE variants to the *rema* framework. In the bridged Model 18.9, three separate strata (AI, EBS slope, southern Bering Sea (SBS)) are fit and share process errors across strata.
>
> 2) Model 22 (author-recommended): Same as the bridged Model 18.9 with the addition of the EBS slope LLS RPWs as a separate abundance index.

Authors considered also including the IPHC LLS data as an additional index in the assessment. However, due to changes in sampling protocol and coverage of the IPHC LLS, the authors did not include the index, as these changes were expected to limit the survey utility moving forward.

Estimated shortraker rockfish biomass in the BSAI slowly decreased from 1998 to 2010 and remained relatively stable to 2022. Survey biomass estimates decreased in the western and eastern AI and increased in the central AI in 2022 compared to 2018. Relative population weights have been variable over time in the EBS slope portion of the LLS with an increase in 2019 followed by a decrease in 2021. Exploitation has generally been well below the ABC levels and have been close to ABC in 2013 and 2021.

Shortraker rockfish is managed under Tier 5 and the SSC supports the author and BSAI GPT recommended Model 22. The SSC concurs with the recommended OFL and ABC estimates for 2023 and 2024, with no reduction from maxABC.

The BSAI GPT encouraged the author to simplify and combine the SBS stratum with the AI in the future. Before implementing this change, the SSC requests that the authors provide the background on why the original stratification was used, whether the authors recommend a change in stratification, and a justification for changing the stratification.

The SSC supports the GPT recommendation to continue to use the *rema* approach until the appropriateness of the VAST approach can be investigated for shortraker rockfish.

The SSC appreciates the authors' tracking and careful consideration of previous SSC comments. The SSC recommends the authors re-evaluate the current estimate of natural mortality for the next full assessment in light of the recent technical memo containing updated life history information for Alaska rockfishes (Sullivan et al. 2022). The SSC also supports the research priorities listed, including the authors' listed primary research priorities of validating aging techniques and obtaining ages from archived samples. Now that the BSAI slope LL survey is included in the assessment, the SSC also recommends continued research

to better quantify the effects of hook competition and computing adjustment factors for shortraker survey catch rates as a long-term research priority.

Other Rockfish

The other rockfish complex contains up to 24 species, though shortspine thornyhead (SST, *Sebastolobus alascanus*) comprises approximately 95% of the total exploitable biomass. The remaining non-SST species are dominated by dusky rockfish (*Sebastes variabilis*) and to a lesser extent harlequin rockfish (*Sebastes variegatus*) though many other species occur at low biomass. The complex is currently managed in Tier 5 and assumes that natural mortality differs between SST and non-SST species. Therefore, they have different definitions of F_{OFL} and F_{ABC} and are assessed separately. The resulting ABC's and OFL's for the SST and non-SST components have been summed to obtain BSAI-wide harvest specifications since 2005. A full stock assessment was conducted in 2022 using a random effects model, which was bridged from ADMB to TMB this year and fit in the new *rema* package in R; the bridging analysis was presented and endorsed by the SSC and GPT in October 2022. There was no public testimony.

Changes in the input data included:

- Catch and fishery lengths were updated through October 3rd, 2022.
- The 2022 AI bottom trawl survey estimates for both SST and non-SST species were added, as were the 2021 and 2022 EBS shelf bottom trawl survey estimates for non-SST species. A new time series was added this year in the author-preferred model for SST only, which provided relative population weights from the NMFS longline survey in the EBS slope from 1997–2021.

The combined biomass from the author-preferred model (Model 22) was slightly lower than predicted in the most recent full and partial assessments, as was the 2022 BSAI-wide OFL (1,680 tons) and ABC (1,260 tons). A random effect model was used to develop apportionments and, as in the last full assessment model, the majority of non-SST species were in the Aleutian Islands (78% in AI), while the majority of SST were found in the Eastern Bering Sea (74% in EBS). **The SSC agrees with the authors' preferred model (Model 22), the BSAI ABC and OFL for the other rockfish complex, and the area apportionments. The SSC agrees that no reduction from max ABC is warranted.**

Catches for the entire BSAI area have exceeded the combined TACs in 2014, 2018, 2019, 2020 and 2021 but have remained below the BSAI ABC. However, catches in the AI have consistently exceeded area-specific TACs since 2011, and in many years have exceeded area-specific ABCs. Catches in the EBS area have been below area-specific ABC except in 2002. **However, the recent catch remains well below the overall BSAI OFL**.

Non-SST catch has been increasing in the AI, along with increased effort in several of the directed fisheries. Given this, coupled with regional ABC's being exceeded in the area dominated by non-SST species, **the SSC encourages the authors to continue closely monitoring information which may be informative to population-level trends in abundance of non-SST species.** The SSC also encourages authors to bring forth essential fish habitat information to the extent available for non-SST species to contextualize estimates of survey biomass, which are thought to underestimate population-level biomass.

The SSC thanks the authors for their responsiveness to prior SSC and BSAI GPT requests. The authors provided additional information on the spatial and temporal distribution of non-SST catch in the directed fisheries in the AI based on analysis of observer data. This analysis shed light on a concentration of incidental catch of non-SST species in the eastern AI, noting that this area coincides with aggregations of Atka mackerel and could not be reasonably avoided by the directed fleet. The authors also presented results

from a working group evaluation into the treatment of zero survey observations, which are prevalent for this complex. Based on information presented, the SSC agrees with the continued treatment of zero's as NA observations in the assessment model. The SSC also encourages and supports future efforts to re-evaluate the current assumed natural mortality value for non-SST species for the next full assessment using more recently available life history information for rockfish species in the Bering Sea.

Atka Mackerel

The SSC received a presentation of the 2022 Atka mackerel stock assessment. The last full assessment was in 2021. AMAK (Model 16.0b), a statistical catch-at-age model for Alaska, was used. There were no changes in model configuration, but data were updated with a new AI survey biomass estimate, 2021 fishery age compositions and estimated catches for 2022 – 2024.

Spawning biomass increased from the 2021 assessment, moving the stock above $B_{40\%}$ and into Tier 3a. For catch specifications, the SSC concurs with the author and GPT recommendations for OFL and ABC. The SSC agrees with the authors that the information provided in the risk table suggests no reduction of the ABC from maximum permissible is warranted. The SSC supports the updated area-specific apportionments.

The SSC appreciates the author's work and recommends continued development of this assessment in the following areas::

- Testing the sensitivity and value of implementing a stock-recruitment relationship within this Tier 3 model.
- Exploration of why fishery ages have such a large effect on biomass estimates, given they should primarily affect fishery selectivity and the estimated recruitment history.
- Plot and calculate correlation of shared years of fishery ages and survey ages to evaluate if the high variability in fishery selectivity is reasonable, compared to survey selectivity.
- Explore whether this assessment would be a good candidate for biennial schedule given that new survey data are available on a biennial basis.

The SSC reiterates several previous SSC recommendations:

- 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.
- The SSC highlighted the sensitivity of projections and F_{OFL} estimates to the assumed selectivity for future years in this assessment and reiterated its recommendation from December 2021 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 with time-varying selectivity (see General Groundfish Stock Assessment Comments in the SSC December 2021 Report, p. 13).

Sharks

The SSC received a presentation on the sharks assessment from Dr. Tribuzio. The assessments for sharks in the BSAI and GOA management regions follow a new format this year, consisting of a single, streamlined document that outlines a common approach but provides separate OFL and ABC specifications for each region. The SSC provides comments applicable to the combined BSAI and GOA shark assessment

in this section. Refer to the GOA shark section for recommendations specific to that region. The new format resulted in a more efficient review. The SSC commends the authors' efforts and particularly appreciates the detailed responses and clarifications regarding previous PT and SSC comments.

The BSAI and GOA shark complexes include four components: spiny dogfish, Pacific sleeper sharks, salmon sharks (GOA only) and other/unidentified sharks. The authors brought forward proposed changes to the other/unidentified and Pacific sleeper shark components.

Specifically, for other/unidentified sharks, the authors suggested using the 90th percentile of catches over a specified time period to reduce the impacts of occasional large hauls of rare shark species, which can lead to unrealistic extrapolations. The GPTs had concerns about the lack of a supporting rationale for the 90th percentile approach and the SSC shares this concern. The SSC encourages the authors and GPTs to further evaluate this and other alternatives to the status quo approach. This should include consideration of different time periods over which to compute average or maximum catches.

For Pacific sleeper shark, the authors responded to previous requests to explore model options for data-limited stocks. The approach that the authors settled on was the 'Only Reliable Catch Stock' or ORCS method, recommended by Free et al. (2017) based on evaluating the performance of ORCS and other data-limited methods for predicting stock status. The SSC notes that testing and refining the method using data-rich, targeted stocks may not be predictive of its application to a data-limited bycatch only species, where some of the attributes may not be applicable or may be poorly defined. The approach requires a number of somewhat subjective decisions about different attributes of the Pacific sleeper shark 'fishery' and it is unclear to what extent the metrics capture these attributes. However, the authors note that the status assessment was fairly robust to the selection of different attributes and changes in individual scores.

The SSC in principle supports the development of the ORCS approach, which has the potential to make better use of available information about the stock and provides a way to use life history information for a Tier 6 approach. However, the SSC concurs with the GPTs that the ORCS approach should be further vetted and refined through the proposed data-limited methods / Tier 6 working group (if established) or by the authors and GPTs before use in setting harvest specifications. Regarding the list of attributes, the SSC supports the GPTs recommendation to consider different attributes or a different weighting approach to better reflect the peculiarities of Pacific sleeper shark and its important life history characteristics such as late maturity and longevity.

With respect to the BSAI specifications, the GPTs recommended using the status quo approach with one exception for Pacific sleeper shark. **The SSC acknowledges the conservation concerns over Pacific sleeper shark and agrees with the BSAI GPT approach to use a reduction from maxABC for the Pacific sleeper shark component of the BSAI shark complex based on the ORCS method and adding the resulting component ABC to the status-quo-based ABCs for the other components.**

The SSC was encouraged by the authors and GPTs efforts to consider alternative approaches for the shark complex and looks forward to future recommendations on data-limited approaches for this and other species complexes as noted under the JGPT section of this report. Finally, the SSC encourages the authors and GPTs to consider further refinements to the format for presenting and reviewing information on shark stocks across Alaska at the Plan Team and SSC meetings, both for meeting efficiency, and so that consistency in recommendations across BSAI and GOA regions can be discussed, if the review bodies choose.

Octopus

A partial assessment was presented for the octopus complex this year. The last full assessment was presented in 2020. This stock is assessed on a biennial basis and is managed in Tier 6. While 2022 would normally be a full assessment year, a partial was presented this year due to staff limitations. The next full assessment is planned for 2023, pending any changes in stock prioritization. There was no public testimony.

Octopus are managed as an assemblage of at least nine species. The BSAI octopus complex is assessed using an alternative Tier 6 method. This method uses an underlying model from Tier 5 where MSY is obtained at half the total natural mortality. For octopus, a predation-based estimate of total natural mortality was first accepted by the SSC in 2011, which is derived from Pacific cod stomach collections. The amount of octopus consumed is considered a conservative estimate of total natural mortality for octopus. There have been no updates to the consumption estimate since the 2016 assessment.

New data reported in this assessment were 2021 and 2022 EBS shelf survey data, 2022 AI trawl survey data, and incidental catch data through October 12, 2022. The 2020 catch (691 mt) is the highest in the time series, while the catches in 2021 (170 mt) and to date in 2022 (235 mt) are substantially lower.

The SSC supports the GPT recommendation that the next author reviews the consumption model to determine if it is still relevant and applicable.

The SSC accepts the authors' and BSAI GPT's recommended 2023 and 2024 OFLs and ABCs, which are the same as those since the 2016 assessment, with no reduction from maxABC.

Skates

Typically, full assessments for this complex occur in even years. Staffing limitations precluded the completion of a full assessment, so a partial was presented this year. The last full assessment was presented in 2020 and the next is currently scheduled for 2023, pending any revisions to stock prioritization. Skates in the BSAI are managed at the complex-level, which represents the sum of harvest specifications from two separate assessments. Alaska skate is more abundant and assessed with an age-structured model under Tier 3. The remaining skate species are assessed together under Tier 5. There was no public testimony.

No changes were made to the assessment. For Alaska skate, the Tier 3 model was updated with catch data through October and estimated catch for the remainder of 2022. Catch was estimated through 2023 for the updated projection model. The Tier 5 specifications for the remaining skate species remained unchanged since no new biomass estimates were produced. Survey biomass estimates were provided as supplementary information and demonstrated little change from those projected in 2021. Harvest recommendations for 2023 are very similar to those projected last year.

The SSC accepts the authors' and BSAI GPT's recommended OFL and ABC for the skate complex for 2023 with no reduction from maxABC.

There SSC continues to support prior SSC and GPT recommendations for the next full assessment, including transitioning the model from ADMB to the *rema* framework and considering whether updating the stock structure template for Alaska skate is warranted.

C5 GOA SAFE and Harvest Specifications

Walleye Pollock

The SSC received a presentation on the GOA walleye pollock assessment. The SSC thanks Cole Monnahan and co-authors for the detailed document and presentation materials, particularly the innovative new diagnostic figures. There was no public testimony on this item.

This year's pollock assessment features the following new data: 1) 2021 total catch and catch-at-age from the fishery, 2) 2022 biomass and age composition from the Shelikof Strait acoustic survey, 3) 2021 NMFS bottom trawl survey age composition, 4) 2021 summer GOA-wide acoustic survey age composition, and 5) 2022 biomass from the ADF&G crab/groundfish trawl survey.

Beyond updating the data with new survey, fishery, and compositional data, there were two minor changes to the model including adding a new penalty to the recruitment deviations for all years and estimating selectivity of the summer acoustic survey. In addition, the data weights were updated using the Francis method. This resulted in Model 19.1a for the W/C/WYAK areas of the GOA. The Tier 5 random effects model used for the Southeast Outside management area was unchanged (except for new data).

The changes for Model 19.1a in combination with the updated data from 2021 and 2022 increased the scale of the population biomass, particularly at the end of the time series. **The SSC is concerned this scale change indicates the model is particularly sensitive to changes in catchability with new data and reweighting which may need to be more constrained in future models.** The assessment has a fairly small retrospective pattern presently, but the most recent peels indicate the potential beginning of a substantial retrospective bias which could be related to this sensitivity in scale. **The SSC recommends further exploration of catchability constraints, particularly for the Shelikof and bottom trawl surveys.**

The authors adopted a larger sigma-r (standard deviation of recruitment) of 1.3 based on an outside estimation from the random effect Woods Hole Assessment Model (WHAM). While this is an interesting approach, it should be further examined as this high sigma-r is providing little constraint on recruitment variability and results in estimates of near total recruitment failures in some years. This could also relate to the emerging retrospective pattern. **The SSC recommends continued exploration of the assumed value of sigma-r.** The SSC appreciates the analysis provided using WHAM and supports further investigation of the modeling approach as a research tool.

The SSC inquired about the "Author's recommended F" projection in Table 1.25. Typically, this scenario is used to project estimated catches instead of maximum ABC for the current and next several years. This table appears to use maxABC for 2023 and 2024 at first and then something different in subsequent years. **The SSC requests the authors check what is being done for this projection and how future catches are estimated.**

The SSC concurs with the GOA GPT and author recommended Model 19.1a for setting 2023 and 2024 OFLs and ABCs for the western portion of the pollock stock (W/C/ WYAK areas), placing the stock above $B_{40\%}$ (Tier 3a). The SSC also agrees with the authors and GOA GPT to use the random effects model fit to the updated 1990–2022 survey biomass time series 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 SSC agrees with the authors and GOA GPT that there were no elevated concerns this year; and no reduction from the maximum ABC was deemed necessary**.

GOA Walleye Pollock ESP

The SSC reviewed the GOA walleye pollock ESP. The ESP was updated with new data for 2022. There were fewer updates in the GOA ecosystem section due to the lack of a GOA survey, and the socioeconomic indicators were limited. The SSC thanks the authors for an informative summary of the updates of trends in ecosystem conditions, which suggested average to above average conditions for walleye pollock in 2022. Please refer to the "Ecosystem and Socioeconomic Profiles" section in the General Stock Assessment Comments section for additional SSC comments.

Pacific Cod

The SSC thanks the authors for their detailed assessment and quick uptake of this complicated assessment. Data updated for the 2022 assessment included federal and State catch data for 2021, preliminary federal and State catch data for 2022, commercial federal and State fishery size composition data for 2021, and preliminary commercial federal and State fishery size composition data for 2022. The GOA Pacific cod abundance index and length composition data from the AFSC longline survey for 2022, the AFSC bottom

trawl survey conditional length-at-age data for 2021, commercial federal conditional length-at-age data for 2021 were included, and commercial State catch from 1997 – 2002 were added to the model's catch time series. The AFSC longline survey relative population number index in 2022 compared to 2021 declined by 24%. The accepted model from 2021 (19.1) was updated with new data and was the only model alternative.

The SSC supports the authors' inclusion of the previously excluded State water catches, which should improve the accuracy of the assessment. The SSC requests that the authors determine if there are any observed length composition data from State catches to determine if there might be any difference in selectivity for those fisheries, recognizing that it is not a large amount of total catch.

The authors noted that incomplete fishery length compositions are used for the current year in the assessment. It appears that a fairly substantial amount of catch occurs after October, at least in 2022. The SSC requests that the authors evaluate the benefit of including these data by showing the complete versus incomplete length compositions for the past few years and a retrospective of the assessment including and excluding these data.

The SSC appreciates the preliminary evaluation of conditional age-at-length patterns and recommends further evaluation of growth-related issues, including updating the length-weight relationship with more recent data, evaluating if there have been significant growth changes, and examining empirical weight at age. The SSC encourages consistency with EBS and AI cod assessments in approaches to these and other issues, where possible.

Based on recent tagging and genetic studies, the SSC encourages further exploration of fish movement as a potential major cause of population changes. 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 GOA/EBS model. The SSC recognizes this may be a longer-term goal.

The SSC agrees with the GOA GPT and authors to use Model 19.1 for 2023 and 2024 harvest specifications. The estimated 2023 spawning stock biomass remains below $B_{40\%}$; however, the stronger 2018 recruitment and limited fishing mortality in 2020 - 2021 are projected to result in increased spawning biomass in 2023 and 2024, with **both years projected to be above $B_{20\%}$.** The authors and PT highlighted a concern about GOA Pacific cod achieving average recruitment in future years and being able to rebuild. The SSC shares that concern, but it is germane to all Tier 3 groundfish and warrants broader discussion. The authors and GOA GPT did not suggest any reduction based on the risk table and the SSC concurs. **The SSC supports the authors' and GOA GPT's recommendation to set ABC and OFL for 2023 and 2024 at the maximum permissible level under Tier 3b. The SSC also supports area-specific ABC apportionments, which did not change because there was not a new GOA trawl survey.**

Specific additional recommendations include:

- 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.
- Along with analyses addressing other previous recommendations, the SSC looks forward to an investigation of large residuals in the fit to pot fishery data and for smaller fish in the fit to bottom trawl survey data.
- The SSC suggests including information on changes in fishing practices that may explain the increase in the mean length of cod caught in pot fisheries (Figure 2.14).

- The SSC requests the authors provide the mean catchability used in the calculation of the temperature-adjusted and time-varying q

GOA Pacific Cod ESP

The SSC reviewed the GOA Pacific cod ESP. The SSC appreciated receiving the ESP report card, noting that in off-GOA survey years, fewer ecosystem indicators are available to update. Please refer to the "Ecosystem and Socioeconomic Profiles" section in the General Stock Assessment Comments section for the SSC's comments. Specific to Pacific cod, physical indicators were average, and lower trophic indicators were above average in 2022, upper trophic indicators were above average and socioeconomic indicators were below average in 2021. Bottom temperature increased at depth to above average in 2022 but habitat suitability improved, suggesting that bottom temperatures are within the suitability range for Pacific cod.

GOA Flatfish

Shallow-water Flatfish Complex

The shallow-water flatfish complex consists of eight species and is assessed every four years. The last full assessment was in 2021. This year, a partial assessment was presented. There was no public testimony.

Northern and southern rock sole are assessed separately from the other shallow-water flatfish in this complex using age-structured models and are managed in Tier 3. For these species, the standard projection models were updated with the final 2021 catch and estimated 2022–2024 catches. Other shallow-water flatfish are assessed in Tier 5. For these species, biomass was estimated for each species using the GOA bottom trawl data through 2022 in the random effects model. The OFL and ABC for the complex are calculated as the sum of the Tier 3 rock sole assessment values and the Tier 5 other shallow-water flatfish assessment values. The 2023 biomass is a 2% increase from 2022 biomass. The apportionment by area was estimated by fitting the random effects model to the survey biomass summed over all species (including Tier 3 rock sole) by area and estimating the percent biomass by area. This was done in 2021 and remains unchanged.

The SSC concurs with the GOA GPT's and authors' recommended ABC and OFL for the shallow-water flatfish complex for 2023 and 2024, as well as the associated area apportionments of ABC.

Deepwater Flatfish Complex

The deepwater flatfish complex is composed of Dover sole, Greenland turbot, Kamchatka flounder and deepsea sole and is assessed on a four-year cycle. This is a partial assessment as the last full assessment was in 2019. The next full assessment is scheduled for 2023. There was no public testimony. Dover sole is assessed with an age-structured model under Tier 3, whereas the other species are assessed under Tier 6.

New catch data were added from 2021 and 2022. Based on the projection model, the ABC and OFL recommendations are similar to those developed in 2021. The ABC for deepwater flatfish is determined at the level of the complex by summing species-specific portions of the ABC. Area apportionment for ABC of deepwater flatfish is currently based on the proportion of survey biomass of Greenland turbot, Kamchatka flounder, and deepsea sole found within each management area from 2001–2021 and estimates of 2023 and 2024 biomass for Dover sole in each management area based on results from the random effects model. The ABC by area for the deepwater flatfish complex is the sum of the species-specific portions of the ABC.

The SSC concurs with the GOA GPT's and authors' recommended ABC and OFL for the deepwater flatfish complex for 2023 and 2024, as well as the associated area apportionments of ABC.

Rex Sole

GOA rex sole is assessed every four years and the last full assessment was in 2021. This year, a partial assessment was conducted. Rex sole is assessed using an age-structured model in two areas with distinct growth patterns (WGOA-CGOA and EGOA) and is managed under Tier 3. For this partial assessment, the

model was updated with catch information for 2021–2022. The OFLs and ABCs are summed across the two areas.

The ABCs calculated for the Western-Central area (based on model estimates) are apportioned based on random effects model predictions of the proportion of Western-Central survey biomass in the Western and Central areas, respectively, in 2023–2024. Likewise, the ABC calculated for the Eastern area (based on model estimates) is apportioned based on random effects model predictions of the proportion of Eastern survey biomass in the West Yakutat and Southeast areas, respectively.

The SSC concurs with the authors' and GOA GPT's recommended OFL and ABC for GOA rex sole for 2023 and 2024, as well as the associated area apportionments of ABC.

Arrowtooth Flounder

A partial assessment was presented this year for GOA arrowtooth flounder. There was no public testimony. GOA arrowtooth flounder is assessed on a biennial basis with an age-structured model in Tier 3. The last full assessment was in 2021. New input data for the projection model included an updated 2021 catch estimate and estimated catches for 2022–2024. The OFL and ABC recommendations for 2023 and 2024 are similar to those projected for 2022 and 2023. Area apportionments were based on the proportion of survey biomass projected for each area using the survey-averaging random effects model. Catches of arrowtooth flounder have been well below the ABC.

The SSC concurs with the author's and GOA GPT's recommended OFL, ABC, and apportionment for GOA arrowtooth flounder.

Flathead Sole

A full assessment was presented for GOA flathead sole. There was no public testimony. This stock is assessed every four years, but the last full assessment was in 2017. A full assessment was scheduled for 2021, but it was postponed because of staffing issues. There were no changes in the model structure, and the model was bridged to the current version of Stock Synthesis (SSv3.30.17). Updated data include:

- 2019 and 2021 design-based GOA trawl survey biomass and length composition data
- Updated finalized catch estimates through 2021 and preliminary estimate for 2022
- Fishery length composition data from 2018–2022

The authors also updated the aging error matrix using GOA flathead sole data, whereas previously the aging error matrix used BSAI flathead sole data. **The SSC concurs with the use of Model 17.1a as recommended by the author and GOA GPT.** This model performs similarly to the previous model and the new data had minimal influence on model results. However, the model does not fit the two most recent survey estimates very well, which show a decline in survey biomass. The authors note that this might be an issue with data weights (the model scale is sensitive to the treatment of the conditional age and length data and the sample sizes are highly influential). The spawning biomass for this stock has been stable since 1990, with an increasing trend since 2012. The projected 2023 female spawning biomass, based on Model 17.1a, decreased 4% from last year's 2023 projection. The total biomass (age 3+) is estimated to increase in 2023 and decrease slightly in 2024. The flathead sole catch is consistently low and is less than 10% of ABC.

The 2023 spawning biomass estimate is well above $B_{40\%}$, placing the flathead sole stock in Tier 3a. The authors did not identify any areas of increased concern in the risk table. The SSC discussed whether the scoring of the assessment-related concerns category was appropriate given the poor fit of the recent two years of survey biomass data and the retrospective patterns in the recruitment. Other assessment authors had elevated scores for stock assessments with similar issues. The SSC encourages the authors to carefully

consider risk table score assignment in future if survey data fits and retrospective patterns do not improve with the next full assessment. **The SSC agrees with the recommended OFL and ABC for GOA flathead sole. The SSC also concurs with the area apportionment based on the random effects model applied to GOA bottom trawl survey biomass in each area.**

Several analyses were conducted by the authors in response to SSC and CIE review recommendations. These included the exploration of scientific uncertainty, including likelihood profiles on several key parameters (i.e., natural mortality, survey catchability, and unfished recruitment), and evaluation of different data weighting procedures. The profiles for natural mortality and catchability revealed data conflicts with different data components. The SSC appreciates these analyses and supports the authors plans for continued research and model improvements; specifically, to examine the interaction between data weights and catchability, explore priors on catchability and natural mortality, and revisit/investigate selectivity for the next full assessment.

GOA Rockfish

Pacific Ocean Perch

The SSC received a partial assessment for POP in the GOA. No public testimony was provided. This stock is fully assessed in Tier 3 in odd years. No changes were made to the underlying assessment model. Catch was updated for 2021 and for 2022 through October, with an added expansion factor to estimate catch for the remainder of 2022. Catches for 2023 and 2024 were estimated with an updated yield ratio to better reflect a more recent ratio of catch to ABC. The projection model was used to determine the 2023 and 2024 ABC and OFL. The area apportionment percentages for setting sub-area ABCs and OFLs were not updated from the 2021 assessment, although the authors intend to estimate these using the *rema* framework in the next full assessment.

The SSC accepts the authors' and GOA GPT's recommended OFL and ABC for POP for 2023 and 2024 with no reduction from maxABC.

Northern Rockfish

The SSC received a presentation on a full assessment for northern rockfish. The SSC appreciates the work done by the new authors for this assessment. No public testimony was provided.

The last full assessment for northern rockfish was presented in 2020. The updated assessment includes updated biomass estimates, age, and length compositions for 2021; updated fishery age compositions with 2020 data and length compositions for 2021; final catch values for 2020 and 2021, and preliminary catch for 2022. The authors presented several model configurations: the 2020 model (18.2b, last full assessment) that includes survey data from the 1980s; the 2020 model with data updated through 2022 and using Groundfish Assessment Program's (GAP) default VAST (18.2b); a model using the GAP default VAST, but without 1980s survey data; evaluation of changes to the length plus group bin size (22.1); Francis re-weighting (22.1a); and a model with the weighting on survey biomass set to 1. No public comment was received. The SSC notes that the model investigating weighting (22.1a) was preliminary.

The SSC agrees with the authors and the GPT to use Model 22.1 for setting harvest specifications. Model 22.1 addresses an important long-standing development topic for this assessment. which has been the large plus size fishery length compositional bin. The authors increased the length composition plus bin by 5cm, which provided a substantial improvement in the assessment. The models fit well to fishery length composition data in recent years (2003 and forward); however, the fit to the fishery length composition diverges in the 1990s, which could be related to changes in harvest patterns due to the rebuilding of POP. **The SSC supports the GOA GPT recommendations to investigate potential mechanisms for the underlying pattern and recommends the authors consider whether a selectivity time block, to account for changes in the fishery (i.e., POP rebuilding), is appropriate and improves fit to the compositional information.**

The SSC also agrees with the authors' and GOA GPT's recommended maxABC and OFL. Given that the 2023 spawning biomass estimate is above $B_{40\%}$, **northern rockfish are in Tier 3a**. The authors assigned a risk level of 1 for all categories except population dynamics (ranked as 2) due to continued low estimated recruitment and the potential for skip spawning. **The SSC reiterates its past support of empirical research projects on maturity and skip spawning, perhaps with industry partnership**.

The SSC agrees with the authors and GOA GPT recommendation to continue exploring alternative weighting methods in the model**.** The SSC also supports exploration of proper variance attribution of VAST indices and recommends investigation of a delta-lognormal VAST configuration, as is done with dusky rockfish.

The SSC notes the MCMC on the estimates of q include a long right tail with unrealistic values of q. The SSC requests the authors investigate a model run with a fixed M.

The SSC also requests the following for future assessments: bubble plots of Pearson residuals for all age and length data, including the sign and scale of residuals; and inclusion of a figure showing changes in previous VAST estimates due to updating with new survey information.

Blackspotted/Rougheye Rockfish

The SSC received a partial assessment for the blackspotted/rougheye (BS/RE) complex, which is fully assessed in Tier 3 in odd years. No public testimony was provided. No changes were made to the underlying assessment model. Catch was updated for 2021 and catches through October 2022 were expanded to estimate catch for the remainder of 2022. Catches for 2023 and 2024 were estimated with an updated yield ratio to better reflect a more recent ratio of catch to ABC. The projection model was used to determine the 2023 and 2024 ABCs and OFLs. The area apportionment percentages for setting sub-area ABCs and OFLs were not updated from the 2021 assessment.

T**he SSC accepts the authors' and GOA GPT's recommended OFL and ABC for BS/RE rockfish and sub-area apportionments for 2023 and 2024 with no reduction from maxABC**.

Dusky Rockfish

The SSC reviewed a full assessment of the dusky rockfish assessment. The last full assessment for dusky rockfish was presented in 2020. No public testimony was provided.

The assessment updated the following data: survey biomass estimates for 2021; survey age compositions with 2021 data, fishery age compositions with 2020 data and fishery size compositions with 2021 data; final catch values for 2020 and 2021; and preliminary catch for 2022. The authors explored several different approaches to VAST configurations and their implications for the assessment model. The authors also addressed long-standing requests by the SSC and GOA GPT to investigate expanding the length and age composition bins and consider removing survey information prior to 1990 from the assessment. These were explored using both the VAST model with a lognormal parameterization and design-based indices from the trawl survey. The SSC notes exploitation on this stock has been low in recent years with 54% of the TAC taken in 2021, for example.

The SSC appreciates the authors' efforts in Appendix 12c to evaluate VAST models in the context of overall model fits. **The SSC supports the author's recommended Poisson-delta lognormal VAST configuration** as it provided good fits based on model diagnostics and smoothed out some of the higher survey indices that are biologically implausible.

The SSC agrees with the authors' and the GOA GPT's recommended model (Model 22.3a) that places the stock in Tier 3a. This model includes survey data from 1990+, the author recommended VAST configuration, and expanded age and length composition bins. This model is an improvement in that removal of the survey points prior to 1990 is appropriate given changes in the survey design, the VAST

configuration for the survey indices is improved compared with the previous VAST configuration, and the fits to the compositional data are improved. The SSC also notes the model based on the design-based survey is poorly informed by the 2021 survey biomass due to the very large variance and has a relatively high estimate of q (estimate is greater than 1).

The SSC agrees with the author's and GPT's recommended OFL and maxABC. The maxABC is a 12% increase in this assessment compared to the 2022 maxABC and an 18% increase from the projected 2023 maxABC.

The SSC implemented a stair step for the 2020 assessment because of a large positive retrospective pattern that was likely due to new data and, potentially, due to the new VAST parameterization. In the current assessment, these concerns appear to have been addressed, as shown by much improved retrospective patterns (Mohn's rho decreasing from 0.51 in the base model to -0.123 in the accepted model), and reasonable fits to the survey data when using the preferred VAST configuration (Appendix 12c).

The authors note an elevated level of concern (Level 2) about assessment risk and population dynamics. Concerns still remain regarding the generally high apparent precision of VAST estimates and their influence on model fits to the survey indices. This compares with unprecedented high variance (sampling error) in the design-based estimate from the 2021 trawl survey. The high variance in the design-based estimate is likely caused by the patchy distribution of dusky rockfish in the survey. There is concern that VAST fits the data too precisely and the **SSC supports the author and GOA GPT recommendation to investigate proper variance attribution of VAST indices within the assessment model, and to explore model sensitivity to data weighting.** The authors highlight the apparent misalignment of the relatively strong year class in 2010 and cohorts that may be due to aging error and recent low levels of recruitment. The authors also note this stock may undergo skip spawning, leading to increased uncertainty in recruitment. **The SSC continues to recommend research investigating skip spawning**.

The SSC concurs with the authors' and GOA GPT's apportionment method. However, the SSC notes the random effects model used for apportionment is resulting in a large change and small values in apportionments to the western and eastern GOA, and stock proportions concentrating in the central GOA. **The SSC recommends the authors investigate alternative apportionment methods that provide stability while also satisfying subarea-level biological concerns**. This includes bringing forward a VAST apportionment method as recommended by the GPT, as well as other methods the author deems appropriate, for example a survey-weighted approach or recent-period survey means.

Finally, the SSC requests bubble plots of Pearson residuals for all age and length data, including the sign and scale of residuals, to help in evaluating fit.

Demersal Shelf Rockfish

The SSC received a presentation on the 2022 GOA demersal shelf rockfish (DSR) stock assessment and thanks the authors for being responsive to requests to re-assess the biomass and error calculation in a random effects model and subsequently reconsider appropriate use of the maxABC and uncertainty in the assessment. There was no public testimony.

An accounting of the information used in the model to estimate $F_{35\%}$ and $F_{40\%}$ was conducted and it was determined that a Tier 5 approach would be most appropriate based on biomass and natural mortality estimates. **The SSC agrees with the authors and the BSAI GPT on moving the yelloweye portion of the DSR complex from Tier 4 to Tier 5 based on the information available for the assessment**.

The ABC and OFL for non-yelloweye DSR (canary, China, copper, quillback, rosethorn, and tiger rockfish) are calculated in Tier 6. The Tier 6 ABC and OFL are added to the Tier 5 values for yelloweye rockfish to determine the ABC and OFL for the DSR complex.

The assessment updated the region-specific catch information and commercial fishery average weights through October 24, 2022. Relative abundance estimates from the ROV survey were updated with new 2022 survey data for the Central Southeast Outside (CSEO) management unit. For the first time, CPUE data of yelloweye rockfish from the IPHC longline survey were included as a secondary index of abundance.

The authors provided six alternative models. A number of models represent step-wise improvements on the base model (Model 21). Model 21.1 recalculated historical biomass estimates using updated weight data. Models 22.1, 21.2, 22.4 and 22.5 used the *rema* approach to provide more statistical rigor to biomass estimates and incorporated IPHC CPUE data (Model 22.1) and included an extra observation error term for the biomass estimates (Model 22.2) which improved the model fit. Based on some concern that the IPHC CPUE data may not be appropriate to include in the model due to the patchy distribution of yelloweye, the authors provided two additional model runs based on the previous two models without the IPHC longline survey (Models 22.4 and 22.5). The results of these models were used to justify inclusion of the IPHC longline survey CPUE estimates.

The authors also provided a new Bayesian state-space surplus production model (Model 22.3) fit to ADF&G biomass estimates, CPUE estimates in the IPHC longline survey, catch data, and estimated discards in the halibut fishery. The SSC agrees that this is a valuable model to continue to develop.

The SSC agrees with the use of Model 22.2 in this year's assessment as recommended by the authors and GOA GPT.

Due to concerns over an apparent decline in biomass, previous assessments took a conservative approach and used the lower 90th confidence interval of biomass for setting the OFL and ABC. Based on the improved *rema* approach used in this assessment, the OFL and ABC were set using the biomass point estimate, which increased biomass estimates relative to last year.

In consideration of additional uncertainty and risk in the assessment, the author recommended Level 2 concerns for the Assessment, Population Dynamics, and Fishery Performance considerations. The authors recommended a 15% reduction from maxABC based on these concerns. The GOA GPT did not recommend a reduction, based on the consideration for uncertainty in moving from a Tier 4 to Tier 5 stock. **The SSC does not recommend a reduction from maxABC, in agreement with the GOA GPT, and considers the concerns raised by the authors as being incorporated into the assessment.** Therefore, an additional reduction from maxABC is not warranted.

The SSC recommends following through with the reassessment of M given a potential unrealistic number for these species and looks forward to additional work on yield per recruit, aggregation of data across the SEO sections, and further exploration of IPHC survey bycatch data.

Thornyhead

The SSC received a presentation from the GOA GPT on the thornyhead rockfish assessment. Catch was updated through October 6, 2022. Length compositions were updated for longline and trawl fisheries, and GOA bottom trawl and longline surveys. Longline survey relative population weight (RPW, 2021/2022) and trawl survey biomass values (2021) were updated for use in the *rema* model. Biomass estimates from the 1984 and 1987 GOA trawl surveys were removed from input to the *rema* model. A coding error in the *rema* model was corrected (Model 18*). A new model (Model 22) with an additional observation error term estimated for both the AFSC longline survey and bottom trawl survey was recommended. This is a Tier 5 assessment.

The 2022 catch is up 26% from 2021. This is about 18% of the Gulf-wide ABC. The GOA trawl survey indices for thornyhead biomass were down 13% across areas. The GOA longline survey RPW for thornyhead increased by 23% across areas, but remained below the time series mean.

The SSC agrees with the authors' and GOA GPT's recommended OFL and maxABC. The SSC appreciates the application of the risk table in this assessment (all elements scored 1) and agrees with the authors and GPT that no reduction from the maximum ABC is necessary. The SSC agrees with the GOA GPT and author recommended apportionments.

The SSC appreciates the author's detailed responses to each of the SSC (December 2020, October 2022) and the GOA GPT (September 2022) recommendations and encourages continued development of the assessment including follow up on a general GOA GPT recommendation from November 2022 to use a common process error across the GOA as noted in General Groundfish Stock Assessment Comments section of this report.

The row "Fishery contribution to bycatch" in Table 15-8 (thornyhead fishery effects on the ecosystem) indicates that bycatch of species managed under ACLs is a "possible concern" or "probably no concern." The SSC requests the author provide rationale for these ratings and consider whether current ratings should be changed to "no concern" given total catch management practices.

Sharks

For the GOA shark complex, the SSC agrees with the GPT to use the status quo approach (species-specific average catch from 1997-2007) for setting harvest specifications for the shark complex. The approach uses component-specific OFLs and ABCs, which are then added to obtain the overall OFL and ABC for the shark complex. The approach did not include a reduction in maxABC for the Pacific shark sleeper component. While this resulted in some inconsistency between the GOA and BSAI, Pacific sleeper sharks are a minor component of the GOA shark complex and the GOA GPT felt that the minimal reduction in the overall OFL and ABC for the complex was unlikely to provide any additional protection. However, the SSC recommends using the same approach for Pacific sleeper shark reference points across the GOA and BSAI in future years, consistent with the authors' intent. Please refer to the BSAI shark section for additional comments applicable to the combined BSAI and GOA shark assessment.

Forage Report

The 2022 GOA Forage Report is not a formal stock assessment; the SSC appreciates the report and its useful context for conditions in the GOA. There was a new author this year who replicated the analysis from the previous report with updated data and some small additions.

Overall, most species appear to be showing signs of recovery after the marine heatwave in the GOA, with increasing trends in 2021, though there remains a high degree of uncertainty in estimates of abundance and biomass. Incidental catches of the GOA FMP forage group were low in 2022. Prohibited species catch of herring was higher than average in 2022; this trend was largely driven by the mid-water walleye pollock trawl fishery in the central GOA.

Estimates of capelin abundance and biomass, based on the 2021 NMFS bottom trawl surveys, were near all-time highs in 2021. The SSC noted the connection to the GOA ESR, where it was reported that the frequency of occurrence of capelin in seabird diets from Middleton Island has remained low since the 2014–16 marine heatwave, which likely are more reflective of presence of capelin in the near-surface waters. The GOA Forage Report author noted that they are interested in future efforts to incorporate multiple data sources and to link spatiotemporal changes in these indices to environmental variables. The author also noted the potential for more quantitative, model-based assessments of forage species that include indices of the biomass of their predators as seen through diet data. **The SSC supports and encourages these efforts.**

The SSC suggests this report and other ecosystem species' reports are presented after the ESRs in the future, to provide context for evaluation and discussions of the stock assessments.

SSC Member 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 that 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 immediate line of supervision by an SSC member, then that 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 associations 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 this December 2022 meeting, a number of SSC members acknowledged associations with specific agenda items under SSC review. Chris Siddon supervises Katie Palof (CPT co-chair), Phil Joy (DSR stock assessment author) and is married to Elizabeth Siddon (ESR editor). Robert Foy is the second line supervisor for Dana Hanselman (C4 BSAI groundfish – arrowtooth flounder assessment) and the third or greater level supervisor for contributors to the following agenda items: AFSC members of the CPT and GPT; Cody Szuwalski (agenda item C2 Snow crab rebuilding); Elizabeth Siddon, Ivonne Ortiz (affiliate), Jim Ianelli, Steve Barbeaux, Kalei Shotwell, Cindy Tribuzio, and other AFSC assessment co-authors (C4 BSAI groundfish); Bridget Ferris, Chris Lunsford, and other AFSC assessment co-authors (C5 GOA groundfish). Sherri Dressel, Franz Mueter and Ian Stewart were contributors to sections in the BSAI and GOA ESRs. Jason Gasper is married to Cindy Tribuzio who is an author on the EBS Skate and GOA/BSAI Shark assessments. Finally, Dana Hanselman directly supervises Chris Lunsford (GOA GPT co-chair) and is the second or third level supervisor for multiple groundfish assessment authors and ESR editor (Elizabeth Siddon). Dr. Hanselman is also married to Kalei Shotwell (BSAI GPT co-chair, BSAI shortraker assessment author, GOA and BSAI arrowtooth assessments, and author of multiple ESPs). Dr. Hanselman is also a co-author on sablefish, and GOA and BSAI arrowtooth flounder assessments. Brad Harris supervises Scott Smeltz and Felipe Restrepo (co-authors on C2 Snow crab rebuilding plan) and Keith Fuller (C4/C5 BSAI/GOA sharks).