Minutes of the Bering Sea Aleutian Islands (BSAI) Groundfish Plan Team

North Pacific Fishery Management Council
1007 West Third, Suite 400
Anchorage, Alaska 99501
November 16-19, 2021

Administrative

The BSAI Groundfish Plan Team ("Team") convened on Tuesday, November 16, 2021 at 09:00 am PST. Participation was remote via Adobe Connect. All SAFE documents were posted to the AFSC draft assessments page, and all other documents provided prior to or during the meeting as well as presentations given during the meeting were posted to the Teams' electronic agenda.

Comments on Assessments in General

The Team recommends that the AFSC prioritize research on best practices for specifying the selectivity schedules used in projections for Tier 1-3 stocks in general.

Ecosystem Status Reports

The Team is impressed with the monumental reports that are assembled each year for our annual assessment and would like to commend the authors on the breadth and synthesis of these reports. The Team discussed the importance of the Ecosystem Status Reports and appreciates the ongoing developments in the content and presentation of the reports that enhances uptake of ecosystem information into the Team discussions. This year, as has been the case in recent years, the Ecosystem Report findings were often referred to when discussing trends in weight at age, changes in distribution (and sampling areas), and changes in recruitment and productivity. The Ecosystem Status Reports provide an important foundation and resource for these discussions. Towards furthering their use in these discussions, the Team discussed the value of having statements of confidence with some of the key findings, such as those summarized in the "Report Card" section. For example, after a given statement "*high confidence*" or "*high agreement, medium evidence*" could be used to provide context for the level of support for each statement. Examples of calibrated language for confidence statements include those used in national and international climate assessments (e.g., Crimmins, A. (2020). Improving the use of calibrated language in U.S. climate assessments. Earth's Future, 8 ,e2020EF001817. https://doi.org/10.1029/2020EF001817).

The Team recommends the Ecosystem Status Report team develop calibrated language statements for certainty (uncertainty) to accompany key messages summarized in the Assessment and Report Card sections of each report (when possible).

Bering Sea Ecosystem Status Report

Elizabeth Siddon presented the 2021 Ecosystem Status Report for the Bering Sea (NEBS and SEBS). The Team deeply appreciates the breadth of information synthesized and presented concisely and commends the author and co-authors on the presentation and contributions to this important Bering Sea report.

Common threads across the report include:

1. Cumulative impacts of thermal exposure and metabolic demands on multiple marine species (e.g., Chinook, chum, and coho salmon during their marine phase since 2016; cumulative impacts of temperature and predation on snow crab)
2. Stratification and shifts in the vertical distribution of prey (hypotheses, not yet published studies); likely related to sea ice dynamics and changes in stratification.
3. Prey switching and lack of functional redundancy (carrying capacity).

In addition to discussion around individual indices, the Team discussed the implications of multiple coincidental declines and collapses of NEBS species (and across trophic levels). The Team noted that the persistent warm conditions in the Bering Sea and the absence of a large cold pool indicate ongoing anomalously warm conditions in the Bering sea, especially in the NEBS. The Team shared the author's concern that climate shocks and subsequent declines across species and trophic levels observed in the NEBS indicate uncertain conditions and carrying capacity for that region going forward. The author noted during discussion that there are some early indications that climate shocks to marine mammals may be subsiding in the system, as evidenced by positive trends in marine mammals that may lead to the closure of the Unusual Mortality Event designation for gray whales and ice seals. However, the Team and author noted that ongoing and large-scale declines in bird, groundfish, and crustacean populations represent multiple "red flags" for the NEBS ecosystem.

Aleutian Island Ecosystem Report

Ivonne Ortiz presented the Ecosystem Status Report for the Aleutian Islands and reviewed the risk tables for stocks in the BSAI; 4 assessments have a Ecosystem Risk level 1 and 4 have a level 2 due to the persistent warming conditions and regionally or species specific poor prey quality. The author noted two points for discussion 1) levels of mercury in sea lion pups in the central and western AI high enough to induce tissue damage, and 2) evidence of non-lethal and lethal effects of plastics in seabirds from the AI. It was noted that phthalate levels are highest in zooplankton feeding seabirds, that a high proportion of ingested plastics are recyclable, and that ingestion rates are highest for birds foraging near marine debris or urban areas. The Team noted the level of plastics impacts on marine fauna in the region, which included increased seabird mortality and other sublethal effects in seabirds due to ingestion. Also, the high abundance of Eastern Kamchatka pink salmon in 2021 was noted because pink salmon biennial patterns can impact zooplankton abundance which, in turn, may impact food available for groundfish and seabirds. There was interest in whether these pink salmon were of hatchery origin and Ivonne noted that they were wild salmon from Eastern Kamchatka. Finally, the Team noted mixed signals in the AI, with some continued marine heatwaves but a subsidence of the extremely warm bottom temperatures noted in previous years.

The Team commends Ivonne and co-authors for the 2021 Ecosystem Status Report and the breadth and clarity of information synthesized within. The Team also notes that more comprehensive analysis and synthesis would be possible if there were an integrated research program in the Aleutian Islands, as has taken place in the EBS, GOA, and Arctic. The Team and author noted that, without a comprehensive integrated study, it is difficult to establish confidence statements regarding causal mechanisms of, or patterns in, changing ecological and oceanographic conditions and fisheries productivity, especially given recent anomalous conditions and marine heatwaves.

The Team recommends that an Integrated Research Project for the Aleutian Islands be initiated in order to help understand climatic, ecological, and social-economic mechanistic linkages in this highly complex region.

The Team would like to gratefully acknowledge Olav's many contributions over the years to multiple assessments including his attention to forage species and wishes him well in his new endeavors.

EBS pollock

Jim Ianelli presented the EBS pollock assessment, and Eleni Petrou (University of Washington) and Ingrid Spies described results of recent genetic research.

This year's assessment includes the current base model (Model 20.0a) and two alternatives (Models 20.0b and 20.0c). The data used by all three models included the usual updates to all time series, but the two alternative models included some additional data from the 2021 fishery as well: Model 20.0b included length composition data, and Model 20.0c included both length composition data and a preliminary estimate of age composition (based on a global age-length key). Development of the two alternative models was prompted by the atypical weight composition observed during this year's "B" season fishery, in which the overwhelming majority of fish were smaller than 500 grams. The authors recommended adoption of Model 20.0c, because they felt that it does the best job of reflecting the younger fish taken by the fishery in recent years. The Team agreed.

The authors responded to several Team and SSC comments. Some of these had to do with the sensitivity of stock-recruitment parameter or F_{MSY} estimates, how to specify the magnitude of reductions from the Tier 1 maxABC (when warranted), or both. In this year's risk table, the authors scored all categories as Level 2 ("substantially increased concern"), which, in the cases of the assessment and population dynamics categories, was an increase from the scores in last year's risk table. The authors presented a detailed decision table showing the likely impacts of alternative 2022 catch amounts. The authors also presented ABC alternatives based on Tier 3, Tier 2, and "constant F" strategies. The Tier 3 strategy, which the Team and SSC have used to specify ABC for this stock since the 2014 assessment cycle, gives a 2022 ABC of 904,000 t. The Tier 2 strategy, which was suggested as a possible alternative by the SSC at this year's October meeting, gives a 2022 ABC of 1,111,000 t. Keeping fishing mortality at the 2021 estimate, which is another strategy that has been used in the past by the Team and SSC, gives a 2022 ABC of 1,150,000 t. This year, the authors recommended use of the Tier 2 strategy because the ratio between the maxABC values resulting from the Tier 1 and Tier 2 harvest control rules is likely to be much less variable than the ratio between the Tier 1 and Tier 3 values. The Team agreed, also noting that the Tier 2 and "constant F" strategies resulted in very similar values.

Results of recent genetic research, which became available just in time for inclusion in the assessment, show clear separation of pollock in Japan from pollock in the U.S. EEZ. In terms of general tendencies within the U.S. EEZ, pollock in the AI, Bogoslof district, and GOA appear to be much more similar to each other than to pollock in other parts of the region, while pollock in the EBS, NBS, and Chukchi Sea tend to cluster together. However, there were some fish from the western GOA that clustered with fish in the EBS/NBS/Chukchi group and some Bering Sea fish clustered with the AI/Bogoslof/GOA. No samples from Russian waters were available for analysis.

The following were among the questions and answers, or stand-alone comments, that arose during Team discussion (and may or may not reflect Team consensus):

- In the context of the large proportion of small fish in this year's B season catch, is some of the variability in selectivity at age or weight at age driven by changes in the time of year when the share of fish of different lengths are caught? Jim's response: The relative amount of catch by season is relatively constant across years, so is probably not a major factor contributing to changes in selectivity or weight at age.

- For projections, is selectivity set equal to the average of the previous two years? Jim's response: That is what was done this year; but in last year's assessment, selectivity for the projection was based on a year (2005) which was deemed to be more representative of likely future selectivity (for the near term). Predicting future selectivity is difficult, and might depend on factors such as the relative strengths of the surimi versus fillet markets, etc. The assessment has always been clear about what selectivity is assumed for projections.
- The problem of projecting selectivity is common across all Tier 1-3 assessments; consistency and predictability would be desirable features.
- This is the first time that the Tier 2 estimates have been calculated since Vidar Wespestad conducted the assessment back in the 1990s.
- Changing from last year's Tier 3 strategy to a Tier 2 strategy, given that the latter results in a higher ABC than the former, seems at odds with the fact that this year's risk table scores were either equal to or higher than last year's. Jim's response: Last year's assessment did not include a Tier 2 option, which might have been recommended had it been considered. The fact that the Tier 2 and "constant F" strategies produce such similar values for 2022 ABC gives added confidence that the Tier 2 strategy is reasonable. Guarding against increasing fishing effort (and by extension, fishing mortality) for a stock that has been estimated to be below B_{MSY} and declining was the main reason for this recommendation.
- The success of the genetic research suggests that, in the future, it may be possible to identify the spawning source of individual fish, or to determine the extent of western GOA contributions to individual EBS year classes.

The Team commends Eleni Petrou, Eleanor Bors, Lorenz Hauser, and Ingrid Spies for their research into the genetics of walleye pollock, and supports efforts to obtain genetic samples from Russian waters for use in future such analyses.

EBS multispecies model

Kirstin Holsman provided an overview of the 2021 Climate-enhanced multi-species stock assessment for pollock, Pacific cod, and arrowtooth flounder in the EBS, which has been included as an appendix to the EBS pollock chapter since 2016. Output from this model is reported in multiple AFSC documents including the ESR and ESPs. Future directions for the model include adding the NBS, including uncertainty around climate scenarios and associated risks with changes in temperature. The Team asked for clarification of future plans to incorporate CEATTLE results within single-species assessment models and further inform how single species models perform under different climate regime scenarios. The current modeling effort is not tailored to mimic the single species models but could be tuned to help inform parameters (such as predation estimates) in single species assessments. The pollock assessment in particular has used indices from CEATTLE to explore natural mortality and climate impacts on that parameter. The modeling work can also help in exploring sensitivity analyses to assist with identifying covariates in assessments or to help to inform priors in these single species assessments. The Team discussed the potential for output from the model (in the single species context) to be used as one of a suite of ensemble models (with appropriate weighting) in one of the single species (e.g., pollock or Pacific cod) assessments in the future. This could also be addressed in the MSE that is under development as part of ACLIM. The Team appreciates the continued development of the CEATTLE model.

The Team recommends that authors work to streamline and coordinate the data pulls for single species assessments and CEATTLE in order to better align the data and multi-species model output for future use.

This would also be helpful for identifying covariates to include as indicators in the ESPs.

It was noted that there are plans for an EBS pollock ESP in 2023, so coordinating and streamlining model development and data pulls now would align well with that schedule. The Team noted the large effort to produce the multi-species model and supported the plans for creating a CEATTLE development team. The Team requested that the climate-informed projections for each species be included in next year's multi-species assessment and thanked the authors for their continued development of this large effort.

AI Pollock

Steve Barbeaux presented the AI pollock assessment. The assessment is a partial assessment this year so only the catch was updated and the projections re-run to obtain reference points for this year. Although open to fishing, there continues to be very little directed fishing for pollock in the AI. The Team accepted the authors' assessment and had no recommendations.

EBS Pacific cod ESP

Kalei Shotwell presented the EBS Pacific cod ESP and report card, noting that the full ESP and the report card are presented as Appendices in the EBS Pacific cod SAFE document. The appendices and the presentation were very comprehensive, noting that fishery performance, narrowly interpreted as fishery CPUE, was not presented in the ESP because it is in the main text of the SAFE chapter. In 2022 a report card will be created and a partial ESP will be provided if new indicators are available.

The Team appreciates the thoroughness of the ESP and report card, and thanks Kalei and others that contributed to these documents.

The Team recommends further consideration of ways to synthesize the EBS Pacific cod ESP and report card to succinctly convey the highlights.

EBS Pacific cod assessment

Grant Thompson provided a thorough presentation of the EBS Pacific cod assessment. All of the recent Team and SSC requests were more than adequately addressed. Following the recommendation from the SSC an ensemble consisting of four models and a corresponding set of model weights was presented in this year's assessment: Model 19.12a is the current base model, and the other three models each differed from the base model with respect to a single, model-specific, feature. Model 19.12 included time-varying survey catchability, Model 21.1 allowed for the possibility that survey selectivity declines at larger sizes ("dome-shaped" selectivity), and Model 21.2 incorporated a fishery catch per unit effort (CPUE) index as a relative measure of stock biomass. A fifth model (21.3), which estimated a constant that is added to the standard deviation of each year's log-scale abundance index, was considered in the preliminary assessment, but the SSC suggested in October that it be omitted. It was noted that the parameter scaling the effective sample size for the Dirichlet-multinomial likelihood for fishery and size compositions was at an upper bound and fixed, thus setting the effective sample size at the input sample size. However, the McAllister-Ianelli approach to compare the empirical variance with the theoretical variance suggested that the effective sample size was greater than the input sample size for size composition data.

As in the last two assessments, a survey index was created using VAST, combining EBS and NBS survey data into a single time-series. Areas with missing observations in some years are predicted in the spatio-temporal model, and no prediction was provided for the year 2020 in which there were no NOAA trawl surveys. The Team discussed using the VAST model to predict the missing 2020 estimates and including those in the data file. The authors had not previously discussed doing this, and the Team did not make any recommendations.

The IPHC fishery-independent setline survey was presented, although not used in the assessment, for further comparison. The Team noted that the IPHC survey design has changed in recent years and some areas are not sampled every year. Therefore, the figure showing station locations in the assessment document is outdated and design-based estimators of an index for the IPHC setline survey in recent years may need to be re-evaluated.

Retrospective patterns varied for each individual model but were within generally accepted bounds. A public comment indicated that it may be worthwhile to investigate other retrospective metrics, possibly related to $B_{35\%}$ or other values, to consider model reliability or model weights.

A Team member asked if in 2020 and 2021 (i.e., COVID years) there were fishing patterns that would indicate differences which could result in apparent changes to fishery data (e.g., heavier fish, etc.) The assessment authors had not addressed this issue with industry representatives.

An in-depth bridging analysis was presented investigating the change in ABC from 2021 to 2022. It was noted that substantial changes occurred from the preliminary 2021 assessment presented in September compared to the 2021 final assessment presented in November. The addition of the 2021 survey index, the 2021 survey size compositions, and the updated historic survey time-series accounted for 85% of the change. It was noted that age 4 fish were a large contributor to the change, the lack of a 2020 survey may have contributed to the large change when updating survey data.

The Team appreciated the pragmatic choice of the assessment authors to present the SSC recommended ensemble given the short timeframe to produce the assessment. However, the Team also expressed concern that there are no clear or consistent criteria for inclusion or exclusion of ensemble model components. One potential benefit of an ensemble is that each model may perform differently in response to new data, which may reduce the interannual variability. However, removing and adding models to an ensemble may introduce interannual variability and potentially important models may be lost to the process. One potential drawback of the use of the ensemble approach is that future model development may be stymied as authors are required to produce the full set of models used in the ensemble in the following year, populated with the most recent data.

The Team recommends the ensemble model consisting of models M19.12a, M19.12, M21.1, and M21.2 be used for management advice.

The Team recognizes that the considerations for development, presentation, and choice of a model ensemble are necessarily different from those associated with an individual model for use in management.

The Team opined that the Team and SSC criteria for reviewing and approving ensembles have not been consistent and recommends a more standardized approach continue to be developed within the Team and SSC process for defining appropriate sets of models and weighting of those models for use in management.

The Team commends Grant's work on developing, explaining, and justifying the risk table. The use of intralevel fractions and an alpha parameter to develop external probabilities was of interest to the Team. The Team indicated that development of more quantitative methods for evaluating when possible reductions from maximum permissible ABC would be warranted, such as the method presented by Grant, and should be explored further.

The Team agrees with the risk table presented in the assessment and recommends an ABC equal to the maxABC as determined in Tier 3b.

The Team recommends exploring environmental drivers of weight-length residuals, especially in recent years.

The Team encourages continued work of the AFSC fishery CPUE group regarding creating CPUE indices from fishery-dependent data and encourages assessment authors to consider best practices for incorporating fishing behavior.

A public comment letter was made available to the Team before the meeting. This letter was not discussed by the Team.

During the presentation, Grant highlighted how this assessment is treated differently from others. He suggested that the time may be right to consider a change to the process. While the Team did not discuss this point, the author's experience and opinion are valuable and it is noted for the record.

The Team expressed deep appreciation for Grant's efforts investigating and improving the Pacific cod assessment over many years, his many contributions to stock assessments in general, his willingness to provide analyses, insights, and presentations to inform the Council process, and his dedication as a Plan team member and co-chair of the BSAI Team. Many members of the public also expressed appreciation for his efforts, including thanks from the stakeholders, scientists, and fishery managers. The Team also learned that Grant "never liked fish too much until [he] found out [he] could count them." Thank you, Grant, for counting all those fish.

AI Pacific Cod

Ingrid Spies presented the Aleutian Islands Pacific cod full assessment. The Team commended the author for addressing Team and SSC recommendations and noted that data weighting remains to be explored. The last survey information for the AI Pacific cod assessment occurred in 2018. Fishery CPUE indices revealed mixed results with a decrease in trawl winter CPUE, but no such decline in other fishery or season CPUE. The author noted that the fishery CPUE trends presented were likely unreliable. Fishery length composition data showed a predominance of the 2016 year class. .

The Tier 5 base model (Model 13.4) was presented along with four alternative age-structured models. One age-structured model (Model 19.0a) used a natural mortality of 0.34 and a maturity ogive based on Bering Sea derived histological samples. The other two age-structured models used an estimated maturity curve based on observer samples and a natural mortality value of 0.34 (Model 19.0) or 0.40 (Model 19.0b). The Tier 5 random effects model (Model 13.4) used a natural mortality value equal to 0.34.

It was noted that there have been recent changes in management and fisheries (e.g., the state fishery and catcher-processors), and an attempt should be made to control for these effects in the analysis of CPUE data.

The Team recommends further examination of fishery CPUE beginning with methods to control for changes in the fisheries and management. Joining current efforts looking at CPUE analyses of other Pacific cod stocks may be beneficial.

The Team recommends further exploration of age-structured models given that there is likely to be an Aleutian Islands trawl survey in 2022.

Correcting for length-stratified age samples using Bayes theorem has improved recent modelling efforts, and ensuring that appropriate years use this approach may further improve fits. Estimating natural mortality using a prior developed from the barefoot ecologist website or other methods may alleviate

concern over the appropriate value of M to use as well as provide a reasonable level of estimation uncertainty.

The authors originally recommended the age-structured model 19.0 and a reduction in ABC from the Tier 3 maxABC to the Tier 5 maxABC (all categories in the risk table were scored as Level 2 except for population dynamics, which was scored as Level 1). Following the presentation and discussion with the Team, the assessment author decided that Model 19.0b (with M=0.4) was the preferred age-structured model, rather than the originally recommended Model 19.0. The Team did not have a discussion considering M=0.4 for the Tier 5 assessment but expects that the four models will be brought forward in the next full assessment with an additional survey observation.

The Team recommends using the Tier 5 Model 13.4 to specify the 2022 and 2023 OFL and maxABC. The Team recognizes that using Tier 5 with 2018 survey results is outdated, especially when the age-structured models predict an increasing trend in biomass. However, the Tier 3 projections would be similarly limited by outdated survey data and based on estimated average productivity with the only recent data included in the models being fishery length compositions, and the age-structured models commonly overestimate spawning biomass in the terminal year. The Team agreed that it was uncertain if the age-structured models, without new fishery-independent data, were an improvement over the Tier 5 model. The Team encourages the author to conduct sensitivity analyses after the 2022 survey data are included.

The Team does not recommend a reduction from the maxABC. The risk table presented by the author was based on the Tier 3 model recommended in the assessment. The Team agreed that using the Tier 5 model for OFL and maxABC addressed some of the reasons that the Assessment Considerations were listed as Level 2. Therefore, using Tier 5 warranted a change from Level 2 to Level 1 for Assessment Considerations. In summary, rather than moving to a new model and then using the risk table to justify using the ABC from the base model, the Team felt it was more straightforward simply to retain the base model for now.

The Team also recommends that authors investigate other sources of fishery-independent data for application in Tier 5, or to fit these within age-structured models. **This effort might begin with a re-examination of previous explorations involving use of the AFSC and IPHC longline survey indices (viz., the 2016 CIE review and Models 16.2, 16.3, and 16.4 from the 2016 assessment).**

Yellowfin sole

Ingrid Spies presented the BSAI yellowfin sole assessment. The assessment considers three models: the base model (18.2), an alternative model (18.2a) which uses a VAST estimate of the bottom trawl survey biomass for the EBS, and another alternative model (18.2b) which uses a VAST estimate of the bottom trawl survey biomass for both the EBS and NBS combined. The author recommended the continued use of the base model (18.2). The Team spent a considerable amount of time discussing the selection of the base model versus the model with the combined EBS and NBS VAST estimates (18.2b). One concern voiced by the author is that Model 18.2b did not use VAST-derived age composition data and that length and weight at age parameters were restricted to those derived from EBS data only. The move to a VAST estimate which includes both regions was considered a move towards consistency with other Bering Sea stocks that straddle the two regions. However there was shared concern that Model 18.2b did not include VAST derived age composition data. The Team discussed the available evidence to indicate whether the NBS and EBS portions of the population were indeed separate. The author indicated that there was no available evidence to preclude their connection. Although the available time series is short there is a trend in the bottom trawl survey yellowfin sole biomass estimates with an increase in the NBS as temperatures increased and a corresponding decrease in the EBS. However in 2021 as temperatures cooled in the

Bering Sea, although there was a drop in abundance in the NBS there was not a corresponding increase in the EBS. Upon examining yellowfin sole distribution in the bottom trawl survey in those years in which both areas were surveyed, there appeared to be no strong evidence of a large separation. An increasing trend in growth of this species was also brought up as a possible indication of stock separation, however it was pointed out that temperatures have been warming in both regions.

Given the lack of strong evidence for or against the connection of these two portions of the population and the lack of NBS age composition data or weight at age data within Model 18.2b, the Team concurred with the author's choice of Model 18.2 for management of BSAI yellowfin sole.

The Team recommends that the connection between the NBS and EBS portions of the yellowfin sole population be investigated and that alternative models be developed for consideration next year using the combined EBS and NBS VAST estimates for biomass and VAST-derived age composition data.

The Team recommends that differences in length and weight at age for yellowfin sole between the two areas be investigated.

The Team discussed possible impacts on fisheries data resulting from implementation of Amendment 80 in 2008. When this species became cooperatively managed there was a large incentive to reduce discards of smaller fish as these were then counted against cooperative quotas. The incentive to reduce catch of smaller fish may have caused the fishery to target larger fish through changes in gear, fishing practices, timing, and location. At this time there was also a change in observer coverage which may have impacted data collections.

The Team recommends the author investigate impacts of management changes since 2008 in the yellowfin sole fishery on fisheries data and subsequent impacts on estimates derived from these data, including mean length and age, length and weight at age, and selectivity.

The author indicated a level 2 risk for assessment considerations, based mainly on the lack of fit of the stock-recruitment curve. There was some discussion as to whether this was new to this year's assessment and, in light of the improved retrospective pattern, whether this met the criteria for a level 2 as the stock was rated level 1 last year. The author indicated that although the stock has always had a poor fit of the stock-recruitment curve, her concern was increased this year over last as she became more familiar with its ramifications within the model. Risk on population dynamics was also rated level 2 for this stock based on a slow, but steady decline in biomass and the 2021 survey estimate being the third lowest in the time series. It was pointed out that a slow and steady decline would not necessarily rate a level 2 and that the low survey biomass should be taken into account in the model. Environmental and ecosystem concerns were also deemed a level 2 by the author while fishery performance was rated as level 1.

Based on these levels, the author recommended a reduction from maximum ABC to the average of the Tier 1a and Tier 3a ABCs. The Team discussed the reasons for the reduction and the applicability and logic of the method of reduction. The Team also discussed the uncertainty of the connection to the NBS and the omission of NBS biomass data from the assessment model, with opinions expressed on both sides as to whether these argued for or against increased caution in setting ABC. As a poor fit of the stock-recruitment curve was one of the justifications for reducing from maximum ABC, there was some discussion as to whether the stock should be regraded to Tier 3a. The majority of the Team concurred that the stock should continue to be managed as Tier 1a.

The majority of the Team recommended some reduction from maximum ABC given the conclusions of the risk table and Team discussion. Two alternatives were proposed for reduction from maximum Tier 1a

ABC: 1) the author's recommended averaging of Tier 1a and Tier 3a maxABCs or 2) a reduction to the Tier 3a maxABC. The argument for reduction to the Tier 3a maxABC centered on the rationale that the Tier 3a maxABC is clearly defined, has a theoretical basis with known criteria meant to address uncertainty in the stock recruitment curve, and has previously been used in reduction from maximum ABC for other Tier 1a stocks, notably EBS pollock. The argument for the stepped approach recommended by the author was that it was a scaled decrease (-24%) from Tier 1a that was not as drastic as the Tier 3a reduction (-48%), and was considered appropriate by the author given their assessment of the risk to the stock, and there was no requirement for consistency among stocks or even within stocks between years for reduction from maximum ABC. A Team vote resulted in a 6:6 tie between these two options. However, in order to move forward with a single recommendation, the Team consensus was to defer to the recommendation of the author. Therefore, the Team recommends a reduction of ABC from the maximum to the average of the Model 18.2 Tier 1a and Tier 3a maxABCs provided by the author.

Greenland turbot

Meaghan Bryan presented the Greenland turbot partial assessment. This assessment is conducted biennially in even years so a full assessment will be presented in 2022. The presentation essentially consisted of an overview of recent catches, exploitation rates, and survey point estimates. The Team appreciated the concise presentation. The Team approved the OFL, ABC, and EBS/AI apportionments produced from the partial assessment.

Arrowtooth flounder

Kalei Shotwell presented the arrowtooth flounder partial assessment. This assessment is conducted biennially in even years so a full assessment will be presented in 2022. Regarding the IPHC survey trends that were presented, a Team member pointed out that the IPHC survey design has changed in recent years, and the 2021 trend in the IPHC survey may not be comparable in this area. Also, there was no IPHC survey in 2020. The author responded that this survey is not used in the assessment, so it is simply a point of reference. Given this, the Team determined that no formal recommendations were needed regarding this piece of information, but Allan Hicks of the IPHC indicated that the issue would be considered by the IPHC, including the implications of these changes for the arrowtooth assessment (and other assessments generated by AFSC)..

The Team appreciated the concise presentation and approved the OFL, ABC, and other reference points produced from the partial assessment.

Kamchatka flounder

Meaghan Bryan presented a partial update of the BSAI Kamchatka flounder assessment. This assessment is conducted biennially in even years so a full assessment will be presented in 2022. The Team commended the author for the clear presentation. The author presented catch and exploitation, showing low catch until Amendment 80 in 2008. Catch increased from 2018-2020 and was above TAC in 2020. Meaghan will look into how catch has changed recently in 2022.

AI, EBS shelf, and EBS slope surveys were used in last year's assessment. The only updated survey was the EBS shelf survey, which showed a 26% decline in 2021 from 2019 (2020 was not conducted). The projection model was re-run with updated catch. The biomass estimates were similar to last year, as were OFL and ABC. The recommended ABC for 2022 is 2.6% higher than 2021.

The Team accepted the author's model, recommended ABC, and other reference points.

Northern rock sole

Carey McGilliard presented the Northern rock sole partial assessment. The brief presentation consisted of fishery, survey, and exploitation rate trends, as well as the method used to project future catches. The Team appreciated the concise presentation and approved the OFL, ABC, and other reference points produced from the partial assessment, as well as the recommendation that no reduction from maxABC is warranted.

Flathead sole

Maia Sosa Kapur presented a partial assessment of the BSAI flathead sole-Bering flounder stock complex. A full assessment is expected in 2022. For this Tier 3 assessment the methodology was unchanged, final catch values for 2020 were used, and projected catch estimates for 2021-2023 were inserted. The Team asked why the spawning biomass increases rapidly in the final year compared to other years, and the author noted that past investigations have highlighted that assumptions about recruitment at the end of the time-series may be driving this rapid increase and that investigations will continue in future stock assessments of this species. The author presented recent trends in spawning and survey biomass which were decreasing and increasing respectively. The Team noted that this species is part of the flatfish exchange program, which may explain the variations in the TAC over time. The Team accepted the author's recommendations for the 2022 and 2023 ABCs and OFLs and had no recommendations.

Alaska Plaice

Olav Ormseth presented a full assessment of Alaska plaice. For this Tier 3 assessment, there were no changes in the methodology and Model 2011_1 was used. Changes to input data included updated and estimated catch, new fishery length compositions, new EBS shelf bottom trawl survey biomass estimate, survey age composition, and survey length composition. The survey biomass estimate for 2021 was 9% lower than the 2019 estimate and the lowest value in the time series. Model estimates of female spawning biomass have declined since 2013. Total biomass estimates, however, show an increasing trend since 2019, likely due to relatively strong recruitment since 2017. The NBS bottom trawl survey continues to estimate high biomass of Alaska plaice, and the 2021 estimate in the NBS exceeded the EBS estimate for the first time. The recommended ABC for 2022 was 3% more than the 2021 ABC and 6% greater than the projected 2022 ABC from the 2020 projection model. The Team concurred with the author's recommended ABC and risk table decisions (level 1 for all categories).

The Team discussed the carrying capacity of the NBS, the presence of small Alaska plaice in the NBS, and the population decline in the EBS, apparently due to warming temperatures. The Team requested clarification regarding the distribution maps and potential connectivity between the EBS and NBS. Olav responded that the distribution appears to be continuous throughout the Bering Sea and the increases in the NBS are not surprising given that Alaska plaice are a cold adapted species. The Team noted that there have not been any changes to this model for many years and asked about the potential for a future model to include NBS estimates. Olav responded that the survey results suggest including the NBS, but he could also understand the rationale not to include the NBS in previous models, as there is no fishing in the NBS.

The Team recommends that authors explore the relationship of the southern part of the stock in the EBS to the northern part of the stock in the NBS and consider developing models that include the NBS data.

Olav also suggested that Alaska plaice could be a candidate for a four-year assessment cycle. The Team discussed the prioritization criteria that were used for developing the stock assessment frequency table in 2017 and noted that Alaska plaice clustered most closely with the two-year frequency group, but was near the dividing line separating that group from the four-year frequency group. The Team noted the

importance of two-year monitoring for this stock given the downward trend in biomass in the EBS and the concerns over possible interconnectedness of this stock with the NBS.

Pacific Ocean perch

Paul Spencer presented a partial assessment for BSAI Pacific ocean perch (POP). Since this is a partial assessment, only the projection model is updated with new catch information. The assessment model is not re-run. Estimates of 2022 projected female spawning biomass are slightly higher than last year's estimate for 2022. The Team accepted the authors' recommendations for the 2022 and 2023 POP ABCs and OFLs and appreciated the concise presentation.

Northern rockfish

Paul Spencer presented the BSAI northern rockfish stock full assessment. Catches are still near record highs, but down in 2021 relative to 2020. The author presented a description of the degree to which the fleet is targeting northern rockfish using Observer data on species composition per tow (applying a similar 'predominance' definition of 'target' as defined by AKRO, but distinguishing between targeting of specific rockfish species rather than a general 'rockfish' target), which appears to be increasing. This became relevant later in the discussion when a public comment was raised regarding opening a directed fishery for northern rockfish.

Fishery CPUE of northern rockfish has declined slightly but has been on an upward trend since 2007. The Team asked whether CPUE data reflect availability of Pacific ocean perch (POP) and the author replied that the POP fishery is relatively clean and there is not a lot of overlap between POP and northern rockfish. A member of the public commented that northern rockfish tend to mix with Atka mackerel and that neither mix with POP.

The author reviewed his response to a Team recommendation about exploring global age-length keys that weight by population size between areas. Upon review, this method was found to be mathematically equivalent to the current method.

The author also addressed the Team recommendation that he explore alternatives to the restrictive priors on key parameters in the model. For this year's assessment, he chose to focus on the issue of selectivity. The author reviewed his exploratory analysis of relaxing constraints on selectivity and presented model results for several alternatives. He argued that the best option involved shifting the constraint from having selectivity reach 1.0 for age-15 fish to one that constrained selectivity to 1.0 for fish once they reach 30 years of age. This model (Model 21) was more flexible, produced results that more closely aligned with empirical survey data, and was more aligned with current knowledge about Alaska rockfish species and how they are modelled.

Model results from the preferred model (Model 21) demonstrated acceptable fit to survey biomass. Some of the age composition data demonstrated underfitting of some age classes and over-fitting of others, which is not unusual for rockfish stocks. Retrospective bias was worse in 2021 compared to 2019. Phase plane diagrams indicate that the stock is still in a good place relative to fishing reference points.

The risk table was scored similarly to 2 years ago with level 2 given to assessment related considerations and 1 given to other categories. The score of 2 for assessment-related concerns was justified based on the strong retrospective bias, the continued use of relatively constrained priors on key parameters in the model, and uncertainty regarding model choice. Despite the elevated concern, the author did not support a reduction in ABC given that stock abundance is high, and the exploitation rates are low.

The Team discussed the fact that the new model had not been presented at the September meeting and thus the bar for accepting the new model at the November meeting was higher. There was some discussion on whether this was permissible, but the policy was reviewed to ensure that the Team was within its bounds to accept a new (non-previewed) model in November. The Team supports the author in using Model 21 for the 2022 and 2023 harvest specifications.

The Team discussed whether the author's score of 2 for assessment-related considerations was appropriate given the elevated risk score for this category in 2019, and what should be the appropriate baseline for determining this score. There was discussion between the Team and the author regarding assessment-level considerations, and some exploratory models were examined and illustrate the large effects of the constraining priors/penalties on model results, indicating potential model misspecification and that the current model is understating uncertainty (and these issues are likely exacerbated by the cancellation of the 2020 trawl survey). The Team felt that concerns raised by the author did indeed warrant the score assigned.

A question was posed as to whether the ABC is the "actual" ABC and if it would be acceptable to open a directed fishery up to that level. With decreasing pollock stocks and halibut and cod constraints on flatfish, there is likely to be interest in this stock, and from a manager's perspective, fishing for northern rockfish would be preferable to fishing for POP, because the former is associated with a lower incidental catch of blackspotted/rougheye. The Team indicated that an ABC recommendation is an overall ABC for all uses and that how it is split among target fisheries is not part of the recommendation.

The author did not recommend a reduction from the maximum ABC despite the level 2 rating in the risk table due to the stock's high abundance and light fishing pressure. The Team accepted the author's model and recommended ABC.

Rougheye/Blackspotted rockfish

Paul Spencer presented the blackspotted and rougheye rockfish partial assessment. Recent catch data were revised, and the projection model was re-run for the AI portion of the stock, with the EBS portion assessed using Tier 5 methods and no changes to input data. The author highlighted that the fishery length composition data in the WAI in 2020 and 2021 show unusually high numbers of small fish (23-29cm) and that the recent survey data for this area also show small fish with larger size classes disappearing. The Team noted this as a research topic, in addition to spatial management concerns, to be addressed at a workshop before the next assessment. Responses to SSC and Team comments specific to this assessment will be addressed during the next full assessment. The Team accepted the authors' assessment and had no recommendations.

Atka mackerel

Sandra Lowe presented on the BSAI Atka mackerel stock assessment. This assessment presented results from the base model (16.0b) used in 2020 with updated fisheries data. There has not been an AI trawl survey since 2018, which is the only fishery-independent data source for this assessment. As this is a biennial survey, the Team would like to emphasize that conducting an AI bottom trawl survey in 2022 is a high priority and essential for the responsible stewardship of groundfish fisheries in this region.

The authors' recommended 2022 ABC is a 7% increase from the 2021 ABC. The author indicated that the increase was predominantly due to two factors: an increase in the projected female spawning biomass, as the 2012- and 2017-year classes were stronger in the fishery than expected last year; and a shift in selectivity to older fish, leading to an increase in F_{ABC} and F_{OFL}. The Team supports the author in using Model 16.0b for the 2022 and 2023 harvest specifications.

The author did not recommend a reduction from maximum ABC, which was supported by level 1 ratings in all categories of the risk table. The Team accepted the author's model and recommended ABC, other reference points, and continued use of a 4-survey weighted average for area apportionment.

There was some discussion of the dome-shaped selectivity for both the fishery and the survey in relation to the older fish.

The Team recommends that the authors continue research into possible reasons for dome-shaped fishery and survey selectivity patterns, including senescence or differential distribution by age.

The Team also discussed the lack of Atka mackerel in Area 542 in the 2018 survey and whether this would be a reason for increasing the level of risk for the stock assessment to a level 2. The author indicated that the model adequately deals with this uncertainty and that an increase in risk level in their opinion was not warranted. During discussion of possible alternative indices for this stock (e.g., AFSC longline), the author indicated that they had investigated a number of possible indices but none of those examined proved to be adequate for this species. The increase in rockfish in the Aleutian Islands was mentioned as a concern. The author agreed that there may be some competition for forage, but also noted that the depth distributions of these species do not greatly overlap and thus direct competition is likely limited.

Skates

Olav Ormseth presented a partial update of the BSAI skate stock complex assessment. This assessment is conducted biennially in even years so a full assessment will be presented in 2022. For the partial update, only the Tier 3 projection model for Alaska skate is re-run with updated catch. The Tier 5 portions of the complex harvest recommendations are rolled over from the previous assessment. The Team accepts the author's recommended ABC and other reference points. The Team noted that this is Olav's final skate assessment before he leaves the AFSC and thanked him for his extensive efforts over the years.

Forage Species

The Team received a presentation on the Forage Species chapter from Olav Ormseth. The Team had an extended discussion concerning trends in some forage species and indications that forage species in the EBS are in decline (e.g., much lower trawl survey biomass estimates of "FMP forage fish" in each of the last four surveys than previously). In particular the Team discussed coordination with ESR reports and data streams as well as the potential for a combined forage fish report across both the BSAI and GOA, similar to Grenadiers. After prolonged discussion of the trends, including a focus on the dramatic increase in squid bycatch in the EBS pollock fishery in recent years, the Team decided to reconvene on the forage discussion later in the week. The extra time was meant to address squid trends, go over the previous rationale for movement of squid to the Ecosystem component, and formulate Team recommendations.

Upon reconvening, the Team received a presentation from Council staff regarding the analyses to investigate moving squid to the ecosystem component in 2017. At the time, the decision was contingent on the assumption that the current levels of squid catch were close to the levels that would be realized if squid were moved to the ecosystem component. The Team discussed calculations for the range of anticipated catch levels and what might be considered low exploitation relative to the actual biomass of the squid population. Previous calculations of OFL were based on catch from 1977-1981, when some targeting of squid was potentially occurring. A Team member noted that current catch levels may have increased due to the recent warm temperatures, as squid bycatch did not seem to be an issue during the colder years in the EBS. In 2020, catch rates were also higher during the fall fisheries, whereas historically higher catch rates occurred in the mid-summer. The Team expressed concern over the more

than doubling of the squid bycatch in recent years following the movement of squid to the ecosystem component and considers this a "red flag" to be investigated further. The Team discussed the recent SSC and Council requests for updates on the squid bycatch and potential avenues for investigating estimation of squid biomass and impacts of climate change. A Team member noted that there are new ecosystem models in development (e.g., size-spectrum model) and a synthesis of current information could be used to develop a more realistic baseline than the large range of biomass estimates that were used in the 2017 analysis. A Team member asked about the availability of diet data for squid, but another Team member noted that the current diet information is very limited as the diet samples on the bottom trawl survey are focused on a limited number of species. The Team discussed the potential to investigate the squid bycatch concern within the larger context of the forage species and to consider conducting an annual update of squid bycatch within the forage species report. The author also noted that a team of forage subject matter experts had recently discussed the potential for an informal discussion on the future of the forage species report and coordination with the forage information in the Ecosystem Status Reports (ESR).

The Team recommends a forage species workshop where scientists, members of the Teams, SSC, and Council staff discuss 1) surveying and population estimation of forage species, 2) importance of forage to different managed species (e.g., evaluate the suite of current food web models), 3) questions about how climate change may impact forage biomass and exploitation rates, 4) how best to report on changing populations, scientific knowledge about forage species, and the dependence of other species on them; including timing, frequency, and scope of the report, and 5) potential resulting management measures from shift in bycatch or spatial distribution of the forage base.

The Team also acknowledged the need for continued research on forage species.

The Team recommends coordinating with the editors of the ESR to reduce redundancy in reporting between the forage and ESR report and consider a combined forage species report for Alaska rather than the two separate regional reports.

2022 and 2023 BSAI Harvest Specification Recommendations

The Team noted the compilation of the 2022 and 2023 harvest specifications, and recommended their adoption by the SSC.

Adjourn

The meeting adjourned at 09:30 PST on Friday, November 19.