Table 1. SSC recommendations for BSAI groundfish OFLs and ABCs for 2020 and 2021 are shown with the 2019 OFL, ABC, TAC, and Catch amounts in metric tons (2019 catches through November 2nd, 2019, from AKR Catch Accounting include CDQ). Recommendations are marked in **bold** where SSC recommendations differ from those of the BSAI Plan Team. **The sablefish OFL is duplicated in this table and in Table 2 (and added into the totals for both), because the SSC recommends that it be Alaska-wide.**

		2019			Catch as of	2020		2021	
Species	**Area**	**OFL**	**ABC**	**TAC**	**11/2/2019**	**OFL**	**ABC**	**OFL**	**ABC**
Pollock	EBS	3,914,000	2,163,000	1,397,000	1,406,063	**4,085,000**	**2,043,000**	**3,385,000**	**1,767,000**
	AI	64,240	52,887	19,000	1,592	66,973	55,120	70,970	58,384
	Bogoslof	183,080	137,310	75	121	183,080	137,310	183,080	137,310
Pacific cod	BS	216,000	181,000	166,475	148,142	**191,386**	155,873	**125,734**	102,975
	AI	27,400	20,600	14,214	12,954	27,400	20,600	27,400	20,600
	BSAI					**50,481**	**5,126**	**64,765**	**6,786**
Sablefish	BS	3,221	1,489	1,489	3,202	n/a	**2,174**	n/a	**2,895**
	AI	4,350	2,008	2,008	662	n/a	**2,952**	n/a	**3,891**
Yellowfin sole	BSAI	290,000	263,200	154,000	122,309	287,307	260,918	287,943	261,497
Greenland turbot	BSAI	11,362	9,658	5,294	2,855	11,319	9,625	10,006	8,510
	BS	n/a	8,431	5,125	2,681	n/a	8,403	n/a	7,429
	AI	n/a	1,227	169	174	n/a	1,222	n/a	1,080
Arrowtooth flounder	BSAI	82,939	70,673	8,000	9,591	84,057	71,618	86,647	73,804
Kamchatka flounder	BSAI	10,965	9,260	5,000	4,494	11,495	9,708	11,472	9,688
Northern rock sole	BSAI	122,000	118,900	47,100	25,497	157,300	153,300	236,800	230,700
Flathead sole	BSAI	80,918	66,625	14,500	15,062	82,810	68,134	86,432	71,079
Alaska plaice	BSAI	39,880	33,600	18,000	15,812	37,600	31,600	36,500	30,700
Other flatfish	BSAI	21,824	16,368	6,500	3,756	21,824	16,368	21,824	16,368
Pacific Ocean perch	BSAI	61,067	50,594	44,069	41,653	58,956	48,846	56,589	46,885
	BS	n/a	14,675	14,675	13,178	n/a	14,168	n/a	13,600
	EAI	n/a	11,459	11,009	10,324	n/a	11,063	n/a	10,619
	CAI	n/a	8,435	8,385	8,263	n/a	8,144	n/a	7,817
	WAI	n/a	16,025	10,000	9,888	n/a	15,471	n/a	14,849
Northern rockfish	BSAI	15,507	12,664	6,500	9,057	19,751	16,243	19,070	15,683
Blackspotted /Rougheye Rockfish	BSAI	676	555	279	387	861	708	1,090	899
	EBS/EAI	n/a	351	75	82	n/a	444	n/a	560
	CAI/WAI	n/a	204	204	305	n/a	264	n/a	339
Shortraker rockfish	BSAI	722	541	358	355	722	541	722	541
Other rockfish	BSAI	1,793	1,344	663	1,254	1,793	1,344	1,793	1,344
	BS	n/a	956	275	685	n/a	956	n/a	956
	AI	n/a	388	388	569	n/a	388	n/a	388
Atka mackerel	BSAI	79,200	68,500	57,951	56,563	81,200	70,100	74,800	64,400
	EAI/BS	n/a	23,970	23,970	22,802	n/a	24,535	n/a	22,540
	CAI	n/a	14,390	14,390	14,320	n/a	14,721	n/a	13,524
	WAI	n/a	30,140	19,591	19,441	n/a	30,844	n/a	28,336
Skates	BSAI	51,152	42,714	26,000	17,873	49,792	41,543	48,289	40,248
Sculpins	BSAI	53,201	39,995	5,000	5,300	67,817	50,863	67,817	50,863
Sharks	BSAI	689	517	125	141	689	517	689	517
Octopuses	BSAI	4,769	3,576	400	244	4,769	3,576	4,769	3,576
Total	BSAI	5,340,955	3,367,578	2,000,000	1,904,939	**5,584,382**	**3,272,581**	**4,910,201**	**3,020,356**

General Stock Assessment Comments

Joint Plan Team Report

The SSC received a presentation from Grant Thompson (AFSC) on the Joint Plan Team and BSAI Plan Team Reports.

Risk Tables

Dr. Thompson provided the SSC with an overview the application of risk tables to this year's full assessments, as well as the Joint Plan Team's (JPT's) requested clarification and additional guidance on their application in the future. Public comment was provided by Jon Warrenchuk (Oceana), Ruth Christiansen (United Catcher Boats), Julie Bonney (Alaska Groundfish Data Bank), Chad See (Freezer Longline Coalition), Chris Woodley (GFF), and Austin Estabrooks (APA). Written comments were received from Jon Warrenchuk (Oceana).

The SSC had a general discussion about the purpose and structure of the risk tables and reiterated the SSC's specific statements that were provided in our December 2018 minutes. It was noted that, to provide comprehensive guidance on the tables, the SSC needed to review them for each assessment and, therefore, decided to finalize our responses to the Joint Plan Team's request after completing our review of the complete suite of BSAI and GOA stock assessments. There was also some discussion of the need to make risk tables neutral, or to have some category that corresponded to less risk than typical for either that assessment or across assessments.

Prior to consideration of the Joint Plan Teams' requests, the SSC provided an overview of key considerations included in our October 2018 and December 2018 minutes:

> *Adjustments from the maximum ABC are used to address uncertainty and risk that is not already accounted for via the Tier system and associated harvest control rules. Reductions from the maximum ABC are an infrequent action prompted by extraordinary circumstances, or considerable uncertainty, in attempt to respond to substantial unquantified risk. Although it is a work in progress, the SSC considers the risk table approach an efficient method to organize and report this information. The risk table approach includes four increasing levels of concern crossed with four types of contributing factors: (1) assessment, (2) population dynamics, (3) ecosystem and (4) concerns related to fishery/resource-use performance and behavior, considering commercial as well as local/traditional knowledge for a broader set of observations. This framework is intended to clarify the basis for any potential reduction. The SSC did not request this approach in order to add new reasons for adjusting from the maximum ABC, but to better describe the rationale when such changes are warranted.*

The Plan Teams completed risk tables for each full assessment and noted any important concerns or issues associated with completing the tables. A summary table of risk rankings for each stock was provided in the Joint Plan Team Minutes with detailed tables provided in the SAFE Reports. The SSC recognizes that this was a substantial effort and appreciates the authors' and Teams' diligence. We request that the Plan Team, as time allowed, does this again for the 2020 full assessments as the SSC found this exercise to be very helpful.

The summary table provided proposed reductions below maxABC for sablefish, EBS pollock, GOA pollock ABC and brought elevated risks for the EBS Pacific Cod, AI Pacific cod, and GOA Pacific cod stocks to the attention of the SSC but deferred potential specific ABC reductions to the SSC's judgement.
The Team's minutes noted that summarizing the concerns listed in the risk tables was helpful as a decision framework for potential reductions from maxABC and that the risk table approach fostered increased

collaboration between scientists with different expertise and more formally brought ecosystem considerations into assessment deliberations. The SSC was encouraged by this and indicated it was exactly what we were hoping for.

The SSC provided direct responses to 10 specific requests raised by the Teams.

1 - Whether an overall elevated risk level (>1) mandates a reduction in ABC, and, more generally, the relationship of the risk level to the amount of reduction (if any);

No. The intention was to organize, report and clarify risks that are not addressed in the assessment or the tier system to promote transparency and consistency among assessments. Based on the PT minutes and this year's SAFE report, risk tables suggests this is happening. As we outlined in the December 2018 report, the risk tables are intended to be informative rather than a prescriptive regarding potential reductions from maxABC.

2 - How to document changes that may not warrant higher levels of precaution, specifically when an overall elevated level of risk (>1) does not lead to a reduction in ABC (e.g., BSAI northern rockfish, GOA POP, GOA arrowtooth flounder);

Notation in the table along with associated explanation of the rationale in the SAFE reports is sufficient.

3 - The appropriateness of the overall level of risk being based on the maximum value across the categories, such that scores of 4, 4, 4, and 4 would be the same as a score of 1, 1, 1 and 4;

This approach is consistent with between-category variability in risk meaning and serves to elevate stocks with any max risk concerns for further review (but see comments below regarding the over-all rating).

4 - Whether to state a default level of no risk (=1) or an unknown level of risk when there is no information to evaluate the risk level for a given category (this was of particular concern for Tier 5 and 6 stocks);

"No risk" versus "no information" determinations are different and should be specified (GOA Atka mackerel and BSAI Alaska plaice provide good examples). Further, a rating of 1 does not necessarily mean no risk, but instead may reflect that the risks are dealt with in the assessment directly or via the Tier system and that no *additional, unaccounted for* risk was identified.

5 - How to determine the relative influence of stock-specific versus indirect ecosystem indicators for setting the risk level (e.g., EBS Pacific cod, BSAI northern rockfish);

This is at the discretion of the author/team. No between-category "influence" is likely to be consistent between assessments and attempts to establish category weights is likely to cause as many issues as it might address.

6 - How many direct or indirect ecosystem indicators would constitute an elevated concern;

This is left to the judgement of the assessment author and the team on a case-by-case basis.

7 - How evaluations of fishery performance indicators determine risk to stock productivity;

As indicated in the SSC's December 2018 report, this additional column should include indications of fishery concern, such as inability to catch the TAC, large changes in CPUE (when not accounted for in the model), or dramatic changes in spatial or temporal distribution that could indicate anomalous biological conditions. If and how this is the case is left up to the assessment author and team on a case-by-case basis.

8 - Delineating issues that fall under more than one category;

This is at the discretion of the author and plan team. Categories are not mutually exclusive, and risks can be attributed as deemed most appropriate by the author/ team.

9 - Whether every item, positive or negative, listed in the context of the risk table necessarily constitutes a "concern" (e.g., for Alaska sablefish, is an unusually large year class necessarily a "concern" simply because it is unusual?);

No. The tables are intended to promote transparency and prompt further discussion as appropriate. Whether or not an unusual event (e.g. large year class) merits notation in the table is at the discretion of the assessment author and the team.

10 - The Teams noted that risk table discussions were time consuming and could be simplified if the process to determine levels of risk was decoupled from the decision to propose a reduction and the associated amount.

As stated in our December 2018 report, it is the intention the SSC that these be decoupled but developed in concert.

The SSC endorsed the Teams' request that the authors continue to fill out the risk tables for full assessments and affirmed the Teams' recommendation that adjustment from maxABC in response to levels of concern should be left to the discretion of the author, the Team(s), and/or the SSC, but should not be mandated by the inclusion of a >1 level in any particular category. The SSC encourages authors or Teams to provide recommendations on reductions and rationale for those reductions when appropriate. The SSC also requests authors to note changes in risk scoring from one assessment to the next, along with the rationale.

The SSC reminds the authors that the tables are intended to capture risks and uncertainties that are NOT addressed in assessment and/or the application of the Tier system. In cases where these concerns are partially addressed, the SSC requests that the authors clearly articulate the extent to which the listed items are not already addressed by the assessment and/or the Tier system.
The SSC considered the Teams' suggestion to develop a decision table for evaluating the potential for a reduction if there were successive designations of elevated risk levels for a given category but concluded that this would be premature at this point.

The SSC recommends dropping the overall risk scores in the tables as these provided no additional information relative to ABC-setting and seemed to cause confusion. They simply report the maximum value of risk for the four factors, which is redundant information.

The SSC noted that the table ranking descriptions (e.g., description of what the scores mean) were not included in the all the SAFE reports. The SSC requests that the table explanations be included in all the assessments which include a risk table for completeness.

The SSC considered the suggestion, provided during public testimony, that the numerical scoring approach be replaced with more qualitative descriptions. We recommend continuing with the current risk ranking approach.

The SSC discussed whether increased risk or uncertainty was meant to compare with previous assessments of the same stock, or in a relative sense to other stocks. Both are relevant and elaboration by the authors or Plan Teams as to what the elevated risk refers to are encouraged. For example, the Golden King Crab stock assessment has an increased risk relative to other assessments associated with the use of fishery CPUE in lieu of of a survey, and the Gulf of Alaska pollock assessment experienced an increased risk owing to the recent divergence of alternative survey indices from each other.

Finally, the SSC notes that the risk tables provide important information beyond ABC-setting which may be useful for both the AP and the Council and welcomes feedback to improve this tool going forward.

GOA – BSAI Sablefish

Dana Hanselman (AFSC) presented results of the 2019 sablefish assessment and Grant Thompson presented the recommendations from the Joint Plan Team. The SSC received public testimony from several attendees. Jon Warrenchuk (Oceana) expressed concerns regarding increased bycatch of young sablefish in the Bering Sea. Karl Halflinger (Sea State) noted high encounter rates of sablefish in groundfish fisheries and showed weight distributions of sablefish bycatch tracking the 2014 and subsequent 2016 cohorts over ages 1-3. Linda Behnken (Alaska Longline Fishermen's Association) described low CPUE in the IFQ fishery, resulting in a failure to attain the 2019 TAC. She supported no increase in the ABC or TAC, and no change to the current area partitions for the OFL. Julie Bonney (Alaska Groundfish Databank) testified that it was difficult for the groundfish fleet to avoid sablefish; she supported combining OFLs across Alaska, noting that there are other tools that the NPFMC could consider to avoid bycatch, such as Maximum Retention Allowances. Jim Johnson (Deep Sea Fishermen's Union) testified that CPUE was very low during the 2019 sablefish fishery and that catching a larger quota in 2020 would be very difficult.

The SSC wishes to thank Dr. Hanselman for his years of contributions to sustainable management of sablefish. His dedication to providing the NPFMC with high-quality assessments provided the foundation for sound management of this valuable fishery. The SSC looks forward to working with the new author in the future.

This year's assessment was an update of the previously accepted Model (16.5) with new data. The new data in the assessment model included: relative abundance and length data from the 2019 longline survey, relative abundance and length data from the 2018 fixed gear fishery, length data from the 2018 trawl fisheries, age data from the 2018 longline survey and 2018 fixed gear fishery, updated catch for 2018, and projected 2019 - 2021 catches. Estimates of killer and sperm whale depredation in the fishery were updated and projected for 2019 - 2021. In 2019, there was a NMFS Gulf of Alaska trawl survey. Biomass estimates and length compositions from this survey were also added.

The SSC accepts the authors' and Plan Team's recommendation to use model 16.5 and continued management under Tier 3a.

Key outcomes of the updated assessment included a marked reduction (down 56%) in the estimated strength of the 2014 year class from the 2017 assessment to the 2019 assessment. The updated model also estimated a strong 2016 year class. The 2019 model continues to fit index data poorly, predicting more rapid increases in the bottom trawl and longline surveys than observed in the indices, and does not reconcile the opposing downward trend in the domestic longline CPUE series. The author described the potential sensitivity of

projected spawning biomass estimates to time-varying maturity schedules and skip spawning, and the uncertainty in the sizes of the 2014 and 2016 year classes and their maturity schedule. These issues are critically important to short term-projections as these two year classes are predicted to comprise the majority of the spawning biomass.

The author identified 12 concerns using the risk table and concluded that a reduction from the maximum permissible ABC is warranted. The 12 concerns are listed below.

1. *The estimate of the 2014 year class strength declined 56% from 2017 to 2019. A decline of this magnitude illustrates the uncertainty in these early recruitment estimates.*
2. *Fits to abundance indices are poor for recent years, particularly fishery CPUE and the GOA trawl survey.*
3. *The AFSC longline survey Relative Population Weight index, though no longer used in the model is still only just above average.*
4. *The retrospective bias is positive (i.e., historical estimates of spawning biomass increase as data is removed).*
5. *Mean age of spawners has decreased dramatically since 2017 and continues a downward trend, suggesting higher importance of the contribution of the 2014 year class to adult spawning biomass; however, age-4 body condition of this year class was poor, and much lower than during the last period of strong recruitments.*
6. *The very large estimated year classes for 2014 and 2016 are expected to comprise about 33% and 14% of the 2020 spawning biomass, respectively. The 2014 year class is about 50% mature while the 2016 year class should be less than 15% mature in 2020.*
7. *The projected increase in future spawning biomass is highly dependent on young fish maturing in the next few years; results are very sensitive to the assumed maturity rates.*
8. *Evenness in the age composition has dramatically declined, which means future recruitment and fishing success will be highly dependent on only a few cohorts of fish.*
9. *Spatial overlap between sablefish returning to adult slope habitat and the arrowtooth flounder population may have increased resulting in potentially higher competition and predation*
10. *Another marine heat wave formed in 2018, which may have been beneficial for sablefish recruitment in 2014 - 2016, but it is unknown how it will affect fish in the population or future recruitments.*
11. *Fishery performance has been very weak in the directed fishery with CPUE at time-series lows in 2018.*
12. *Small sablefish are being caught incidentally at unusually high levels shifting fishing mortality spatially and demographically, which requires more analysis to fully understand these effects.*

Of the 12 concerns listed, concerns 5, 6, 7, and 8 are already addressed to some degree in the assessment. Concerns 5 and 8 highlight the reliance of the future spawning stock on in incoming year classes and their condition. In a population that relies on episodic recruitment events and the storage effect (longevity) as a survival strategy, conditions like those currently observed will occasionally arise. These events are not of particular concern unless one can demonstrate a specific benefit of age diversity in the spawning stock. If age evenness in the spawning population is considered as a metric of population health, this criterion should be formally evaluated for potential incorporation into future recommendations for ABC. For example, is there evidence that older females are more effective spawners? Is there evidence that genetic diversity is

preserved through multiple year-classes? With respect to concern 6, the maturity schedule is included in the assessment and the harvest control rule specifically protects the future reproductive potential of the stock. Concern 7 highlights the sensitivity of the future reproductive potential of the stock to changes in juvenile natural mortality rates. This issue is not unique to the sablefish assessment. The SSC recommends that the authors utilize the excellent information provided in the ESP to develop an ecosystem-linked formulation of natural mortality for young ages of sablefish.

Concerns 1, 2, and 4 all suggest that there are structural problems with the assessment. The inability of the assessment to accurately track incoming year classes when they have been modeled in the assessment for several years suggests that natural mortality or selectivity may be misspecified. The lack of fit to survey and domestic CPUE are also a concern, and suggests that either catchability or selectivity may be misspecified. The SSC reiterates is recommendation for the authors to explore time-varying fishery selectivity and/or catchability, and their effects on estimated year-class strengths. To the degree that the fishery has shifted selectivity toward older sablefish in response to increased numbers of young fish there may be important effects on the estimated population dynamics created by the assumption of constant selectivity.

The estimated maximum permissible ABC for 2020 is 57% higher than the 2019 maximum permissible ABC. Despite model results that indicate future increases in sablefish abundance, the SSC agrees with the authors and Joint Plan Team that a substantial reduction in ABC is merited. In particular, concerns regarding the current uncertainty in the incoming 2014 and 2016 year classes and the poor fishery CPUE in 2019 suggest that added precaution is necessary. The authors and the Joint Plan Team recommended a 25% increase from the 2019 ABC, which corresponded to a constant fishing mortality rate from 2019 to 2020. The SSC notes that there is no biological reason to pick the 2019 reference mortality rate over other possible rates. In addition, the method used to project the 2020 ABC did not utilize the updated model nor its revised estimates. **Therefore, the SSC recommends calculating the ABC based on a 25% stairstep whereby the 2019 ABC is increased by 25% of the projected step between the 2019 ABC and the 2020 maxABC and then that estimate is corrected for whale depredation to provide the final 2020 ABC.** This process was repeated to estimate the 2021 ABC. The 2020 ABC represented a 50% reduction from the 2020 maxABC from the 2019 projected ABC for 2020.

The authors included an analysis of the area allocation of the ABC as an appendix to the SAFE chapter. The SSC appreciates the author's responsiveness to SSC comments. Based on the results of this work, the author recommended no change to the allocation scheme. The SSC accepted the authors' and the Joint Plan Team's recommended sub-area allocations of ABC. The SSC notes that the distribution of sablefish has changed considerably since 2013 and there remains and need to resolve how ABC allocations will be derived in the future. The SSC requests that the author finalizes the allocation process no later than September 2020.

The SSC accepts the authors' and Joint Plan Team's recommended OFLs for 2020 and 2021. The SSC reviewed the information available regarding area partitions for the OFL. **The best scientific information available regarding stock structure for sablefish supports an Alaska-wide stock designation. Therefore, based on biological considerations, the SSC recommends adoption of a single combined area OFL for sablefish.** The SSC recommends consideration of alternative spatial management approaches to address sablefish bycatch concerns.
The SSC noted that, although the stock biomass is projected to increase due to the strong 2014 and 2016 year-classes, these cohorts will also affect the calculation of reference points. Specifically, as the 2016 year class is included in the $B_{40\%}$ calculation, that reference point will increase. This has been the case as the 2014 year-class has affected both the biomass and the reference points.

The SSC recommends that the coefficients determining the degree of whale depredation be re-evaluated in the near future (and perhaps on a 3-5 year interval) in order to determine whether the relative effect of depredation may have changed over time, and/or to update existing coefficient estimates with additional available data since the previous analysis.
The SSC supports the ongoing efforts to examine sablefish dynamics including Alaska, Canada, and the US west coast. The SSC encourages continued efforts to reconcile potential differences in ageing criteria among these regions and among laboratories with respect to asynchrony in recruitment.
The SSC appreciates the excellent continued work of the authors on the ESP. This ESP provides a strong example for authors of other SAFE chapters. The SSC encourages the authors to focus on explaining the mechanisms underlying the observed declines in the estimated size of the 2014 year class.

The SSC appreciates the author's effort to identify fishery performance indicators that provide relevant insight into stock status. The SSC encourages the authors to continue to explore community related socioeconomic indicators and suggest that they focus on substantially engaged and/or substantially dependent communities recognizing that in small communities, even a low level of engagement in absolute terms can result in a relatively high level of dependence on that fishery. Further, communities selected for inclusion in the analysis should not be based on commercial landings alone, as engagement in the relevant commercial fishery(ies) can and does occur based locally owned vessel activity, crew employment and income, locally occurring processing activity, and support service activity; dependency can usefully be measured via vessel and processing diversity and annual round activity and spatial variations, among other factors (recognizing that data availability will vary widely across communities, especially for support service activity). Additionally, as noted in public testimony, it is important to recognize that sablefish are economically important to community fleets across a variety of gear types.

To be useful in an ESP application, community engagement in and dependency on the relevant fishery(ies) need to be tracked with indicator time series data to allow for the recognition of trends that could serve as ecosystem "yellow flags" or "red flags," consistent with other indicators. Indices such as Regional Quotient and Local Quotient are particularly useful in a report card context for a variety of reasons, including the ability to provide information where data confidentiality considerations would be otherwise be a major analytic constraint, but they need to be clearly defined.

BSAI Walleye Pollock

Bering Sea

The SSC received a presentation of the 2019 stock assessment from Jim Ianelli (AFSC) and a summary of the Bering Sea Plan Team comments from Grant Thompson (AFSC). Public testimony was provided by Karl Halflinger (Sea State), who provided graphical summaries of spatial fishing patterns, and expressed concern that newly developed spatial fishery metrics may not be capture the complicated dynamics of the fishery, which balance searching and travel time, bycatch encounter rates, and many other factors in addition to the distribution of the pollock stock. Mr. Haflinger also suggested one of the reasons for the delay in the pollock fleet reaching the allowable catch limit during the 2019 "B" season was the fact that some vessels remained on the West Coast longer to pursue Pacific whiting fisheries.

The 2019 pollock assessment included new data from the following sources:

- The 2019 NMFS bottom-trawl survey biomass and abundance at age estimates.
- The 2018 NMFS acoustic-trawl survey age composition data were updated using samples from the ATS survey.
- The 2019 opportunistic acoustic data from vessels conducting the bottom trawl survey was used as an added index of pollock biomass in mid- water.

- Observer data for catch-at-age and average weight-at-age from the 2018 fishery were finalized and included.
- Total catch as reported by NMFS Alaska Regional office was updated and included through 2019.

Data from 2019 indicated a highly concentrated fishery during the "A" season, and very dispersed fishing during the "B" season. Coincident with these spatial patterns, the time required to harvest the allowable catch in 2019 was the quickest in history for "A" season, and among the slowest for "B" season (similar to 2011). Bottom trawl survey biomass substantially increased from 2018 to 2019. Of note in the age-composition information, in recent years there appears to have been a shift from a dominant 2012 year class, to a mix of two consecutive strong year classes in both 2012 and 2013, which is unusual for this stock.

Modelling efforts focused on improvements to existing data sources. An investigation into the degree of constraint applied to time-varying bottom trawl survey catchability/selectivity revealed that current constraints are consistent with model fit and that additional constraint may not be conservative with regard to the estimated scale of the biomass. To account for increasing abundances of pollock outside the standard survey area, a spatio-temporal index for the combined EBS and NBS bottom trawl survey biomass was developed using the VAST approach and included a cold-pool covariate. A spatio-temporal model for deriving age-composition estimates from the bottom trawl survey showed relatively minor differences with standard design-based age compositions. An exploratory model-based approach was developed for creating a combined index for the acoustic and bottom trawl surveys, reflecting the overlapping nature of both the vertical and spatial sampling of each survey, although not included in this year's assessment. In addition to modelling efforts, the SSC commends the author for detailed investigation of spatial and temporal patterns in fishing behavior (including a new index of effort dispersion) and weight at age.

The author provided two models for consideration, including last year's base model (16.1) updated with new data and an alternative model (16.2) using the VAST-based bottom trawl survey index of biomass. Both models appear to perform well. Both models indicate a declining stock since 2017, projected to continue at least through 2021. Current spawning biomass is estimated to be above both B_{MSY} and $B_{40\%}$.
The SSC appreciates the extensive required to generate VAST estimates of biomass based on both the NBS and EBS surveys for both pollock and Pacific cod. In light of changing stock distributions for both species it has become necessary to include the full spatial extent of the Bering Sea shelf in deriving indices of abundance. This process has been aided by the extensive testing and development of the VAST modelling framework. Including the extent of the annual cold-pool as a covariate in the model helped to inform biomass estimates in years in which there was no survey sampling in the NBS. The author and Plan Team recommended waiting for new genetic data on EBS and NBS pollock before adopting the new VAST model. **The SSC differed from the author and Plan Team and recommended adopting model 16.2, including the VAST-based bottom trawl survey index, as the basis for 2020-2021 specifications.** The SSC further recommends that the PTs consider defining a standard reporting format for VAST model application, including a description of the parameterization, mesh complexity, covariates, model fit diagnostics and all other components necessary for review.

The SSC has long categorized EBS pollock as a Tier 1 stock, which dictates that it include a reliable probability density function for Fmsy. However, in recent years the ABCs have been reduced from the maximum through the use of the Tier 3 ABC calculation. For 2020, this corresponds to a 43% reduction from the maximum ABC. **The SSC recognizes the risks associated with the application of Tier 1 specification for the ABC when productivity estimates are uncertain, and therefore recommends a highly elevated level of concern for pollock in the assessment/tier-system category of the risk table, and a commensurate reduction from the maximum ABC. As a temporary solution for this year, the SSC recommends using the Tier 1 OFLs and reducing ABC from the maximum ABC from Tier 1 to**

an ABC level based on the Tier 3 calculation. However, the SSC recommends a detailed review of the support for retaining the EBS Pollock assessment in Tier 1 versus reclassifying it as Tier 3 in the 2020assessment.

The SSC had a number of recommendations for additional research supporting this assessment:

- The SSC encourages further investigation of the apparent shift between a clear 2012 year-class to mixed 2012-2013 year classes in the data, suggestive of potentially variable ageing bias.
- Noting the work in deriving an external estimate of temporal variability in catchability for the bottom trawl survey (relative to the acoustic survey) due to vertical availability, the SSC noted that catchability would logically also vary for the acoustic survey. The SSC encourages further work to develop the simultaneous modelling of these two surveys, accounting for vertical and distributional shifts (including into the NBS). When sufficiently explored, the SSC looks forward to assessment model configurations that explore the use of a time-series from this method.
- The SSC supports ongoing genetic studies to determine the relationship between pollock in the NBS and EBS, as well as other surrounding regions (AI, GOA).
- The SSC supports the continued use of a formal decision table to illustrate risks of alternative harvest strategies.
- The SSC supports the Plan Team's recommendation to revisit the treatment of all variance parameters in the next assessment, particularly those that are set at fixed values (e.g., the value of 0.2 for the acoustic survey). The senior author indicated these efforts are currently planned for the coming year.
- The SSC also looks forward to estimates of movement and abundance along the U.S.-Russia EEZ boundary based on echosounders fixed to moorings in this area. Noting the increased concern over trans-boundary fishery and population dynamics for pollock (as well as Pacific cod, and potentially other species) the SSC requests an update on current collaborations with Russian scientists with regard to data-sharing, cooperative survey efforts, and the potential for joint assessments and management such as those used for shared fish stocks in the Barents Sea. It may be worthwhile to hold a workshop on this topic if and when appropriate participants can be identified.

Aleutian Islands

For 2019, this was a partial assessment with only updated 2018 and 2019 catch added to the previous analysis. The stock remained in Tier 3a. **The SSC concurs with the authors and the Plan Team to use maximum ABC for 2020 and 2021 and to calculate OFLs using the standard Tier 3a approach.**
The SSC looks forward to a full assessment in 2020, including a response to the 2018 recommendation to reconsider the time period over which recruitment estimates are used to estimate biological reference points. The SSC requests that a time-series of survey biomass estimates be provided for evaluation for this and other partial assessments, where available.

Bogoslof

No assessment was conducted for 2019, leading to a roll-over of specifications developed in 2018. **The SSC supports these specifications for the ABCs and OFLs for 2020 and 2021**.

BSAI Pacific Cod

Bering Sea

The SSC received a presentation on the PT report and a summary of the Pacific cod stock assessment from Grant Thompson (AFSC). Public comment was provided by Chad See (Freezer Longline Coalition), who indicated a preference for a single model over the current ensemble and specifically recommended model 19.12, or an ensemble representing only hypothesis #2. Mr. See further reiterated that reductions from maxABC are intended to be infrequent and that the current level of risk is not sufficient to justify a reduction, and given that the presence of Pacific cod remains high from the perspective of the fishery. Public comment was also received from Scott Hansen (F/V Beauty Bay) suggesting that fishery CPUE has remained high throughout the fishing grounds, and that both fish condition and abundance appear good in the northern Bering Sea. Finally, the SSC received public comment from Kenny Down (representing himself) highlighting that the crucial question is whether to utilize the proposed ensemble or model 19.12 and registering concern that the current ensemble includes models about which little is known. Mr. Down further indicated that Pacific cod bycatch in directed halibut fisheries has remained high.

The SSC thanks the author for his excellent and extensive work on this assessment again this year; the document provided a comprehensive analysis of a 3x3 factorial ensemble model that included 9 models in addition to the base model from 2019 (16.6i).

The models explored two axes of structural uncertainty, one exploring alternative stock structure hypotheses and one exploring levels of model complexity. The stock structure hypotheses were: 1) Pacific cod in the NBS are insignificant to the managed stock, so the assessment should include data from the EBS only, 2) Pacific cod in the EBS and NBS comprise a single stock, and data from the EBS and NBS surveys can be modeled in combination to generate a single model-based biomass index, and 3) Pacific cod in the EBS and NBS comprise a single stock, but the EBS and NBS surveys should be modeled separately. The three levels of assessment complexity were: "basic" (model 16.6i); "simple" specifying alternative input sample size calculations for composition data, alternative selectivity functions for survey and fishery catches, size-based maturity, and new methods for tuning recruitment deviations and; "complex" which estimated a multitude of time-varying processes including catchability, selectivity, and growth.

The models presented at this meeting differed from those presented in October to reconcile comments from the SSC and Plan Team related to Hypothesis #1 and retrospective performance. The updated models reduced the retrospective patterns by removing fishery age composition data and reducing the average input N for fishery size compositions. The SSC was pleased that the authors were able to resolve some of the bad retrospective patterns seen in September. However, the SSC was disappointed that the focus on ensemble modeling precluded determining how to appropriately use these critical data without inducing strong retrospective patterns.

All of the nine ensemble members used VAST model estimates of total survey biomass. The SSC considers this an appropriate improvement over the design-based estimates, as the VAST model uses all available data from both the NBS and EBS bottom trawl surveys and provides an efficient method to address large gaps in temporal coverage in the NBS. The SSC also supported the use of a cold-pool covariate and bias correction. The SSC was comforted that the design-based and VAST indices are quite similar. The SSC supports the idea of cross-validating the results by selectively removing areas and seeing how well the VAST model can predict missing areas. In the interest of transparency and reproducibility, the SSC recommends that assessment authors include a specific description of VAST model settings in future assessment documents.

The nine models provided reasonable fits to the data and retrospective patterns. As expected, the complex models with their many more parameters provided the best overall fits to the data. Values of Mohn's rho, an indicator of retrospective bias, were within the acceptable range for all models except 19.4, for which Mohn's rho was very large. The SSC continues to disagree with the Plan Team regarding the use of Mohn's rho. Its primary function is a measure of model misspecification, and not including portions of a population in the model would be an important misspecification.

Two different ensemble averages were presented, an unweighted and a weighted average. The weighted ensemble was determined using a set of nine criteria with different emphasis factors. These criteria were developed by extracting various comments from the PT and the SSC as to what are important features or hypotheses to include in the model. Factors that were given an emphasis of 3 were deemed to be ones that the PT or SSC has explicitly used for criteria to reject or express strong concern about a model (plausibility). Lower emphasis (factors 2 and 1) was given to criteria that generally were more related to technical model specifications. **The SSC thought this part of the weighting scheme was transparent and a reasonable step forward**. However, the choice of an exponential average instead of the arithmetic average is a much more influential choice than the *ad hoc* 3:2:1 choices. For example, Model 19.12 is given over 7 times more weight than the next candidate, despite emphasis-weighted scores of 15 and 13, respectively. The SSC suggested that it may be more transparent to use a more intuitive arithmetic mean, recognizing that all weighting systems will have subjective decisions and that assessment authors are likely best suited to identify relative model weightings.

The SSC expressed two primary concerns with use of the ensemble: (1) that all ensemble model members may not receive the appropriate level of review compared to reviewing a single recommended model, and (2) that the effort required to bring forward a 9-member ensemble may preclude progressive model development and testing. The recommended weighting gives most of the weight to model 19.12, which represents a substantial increase in complexity and deserves more review in future assessments. The purpose of an ensemble model is to include a diversity of models that "capture structural uncertainty" or represent alternative states of nature for which valid hypotheses exist. While the stock structure axis in the current 3x3 factorial design represents alternative states of nature, it is less clear whether the progressive changes in model complexity reflect an appropriate range of structural uncertainty. In spite of shortcomings, the SSC was encouraged by the author's structured approach to constructing a matrix of alternative models for consideration. However, in addition to the increased workload for the assessment authors, it is unclear at this point whether the ensemble model is more transparent or more opaque to stakeholders or review bodies. Finally, the SSC notes that although the ensemble model highlights some of the additional uncertainty associated with this stock, our current harvest control rule precludes explicit consideration of this added uncertainty.

In previous years there was considerable discussion whether it was appropriate to average ABC after the control rule was applied rather than determining stock status first than applying it to the average full ABC. One SSC member calculated the results for this particular ensemble doing it both ways and was satisfied that it made very little difference.

The assessment authors' efforts represent substantial progress towards using an ensemble modeling approach to address continued large uncertainties in the Pacific cod assessment. The SSC suggests that a broader discussion is needed between the Plan Teams, AFSC, and the SSC on the consequences of accepting an ensemble model for Pacific cod on the direction of other groundfish and crab assessments, and guidance on whether consistent sets of models should be required to be brought forward in subsequent assessments. It needs to be determined whether ensemble models, particularly if applied to multiple stocks, are sustainable given limited review and assessment staff resources. If an appropriate ensemble can be developed and adopted for a number of years, it may actually save time. However, the SSC expressed concern that the burden of maintaining an ensemble of this many models might preclude necessary progress in model development. This tradeoff was confirmed by the lead assessment author with respect to exploring alternative methods for successfully incorporating fishery age compositions. One advantage of an ensemble may be the inclusion of members that incorporate environmental, ecosystem, or socioeconomic data as appropriate.

The SSC appreciates the progress toward an ensemble but was hesitant to adopt either the weighted or unweighted ensemble at this time. A major discussion point was whether all three hypotheses should be retained going forward. Hypothesis #2, combining the EBS and NBS surveys, was considered the most likely given the observations of Pacific cod in the NBS and the lack of genetic differences between these

areas. There was general support for removing the models related to Hypothesis #1 (19.7-19.9) altogether, given our understanding of stock structure. As currently weighted, the ensemble added complexity, but seemed to offer little benefit compared with adopting a single model from the Hypotheses 2 group. There was concern that accepting an ensemble this year would require the authors to bring the entire ensemble forward as the base case in next year's assessment, which would be a substantial workload and would likely preclude progress on other issues. There was some support toward adopting a simpler model like 19.10 (which is essentially the base model + VAST) or 19.11 as an intermediate step in complexity, but ultimately the SSC determined that the author's weighting choices clearly showed the authors' preference for Model 19.12, **and the SSC endorsed Model 19.12 as the new base model for 2020**.

There was considerable discussion about whether an additional reduction in ABC was warranted due to the ecosystem risk level of 2, reflecting uncertainty associated with a mixture of positive and negative trends. There were lingering concerns about migration of Pacific cod outside of the EEZ and whether the large portion of the stock now located in the NBS may be subject to higher mortality or reduced reproductive success. These concerns were similar to the prior year, but because of the considerable assessment uncertainties evident in the ensemble models, the SSC elevated assessment considerations in the risk table to level 2.

Thus, the SSC selected Model 19.12 for setting OFLs for 2020 and 2021, but reduced the ABCs from maximum permissible by adopting the ABCs resulting from the weighted ensemble model, due to assessment and ecosystem concerns. Model 19.12 encapsulates the preferred hypothesis as all recent evidence suggests that the NBS has become an important habitat for a large part of the stock.

The SSC recommends that the authors focus on continuing to improve Model 19.12 and attempt to resolve problems with using fishery age compositions. The authors should consider whether 19.12 could be "overfitting" as the Plan Team suggested.

The SSC recommends that if the authors bring an ensemble model forward in 2021, that it consists of a reduced set of models that still reflect adequate diversity in model structure and hypotheses about stock structure.

The SSC encourages further investigations into fish movement, both analytically and through tagging studies.

The SSC requests that the use of VAST, including its assumptions, are clearly documented in next year's assessment. The SSC notes that development of an ESP for EBS Pacific cod would be advantageous.

Aleutian Islands

The SSC received a presentation from Grant Thompson for Aleutian Islands Pacific cod. There was no survey of the Aleutian Islands for 2019 so there were no changes to this Tier 5 assessment. **The SSC supported the authors' and PT's recommendation for a Tier 5 status determination and the associated OFL/ABC as well as the use of the random effects model for apportionment.** The SSC noted that there may be other apportionment methods if smoother outcomes are desirable such as multiple survey averaging or the use of a VAST model.

There were several age-structured models presented in an appendix and we appreciate these efforts. It appears that the models were almost viable for consideration this year. We look forward to seeing a vetted alternative in September 2018 that takes in to account current GPT and past SSC recommendations**. In addition to those recommendations the authors should consider fitting the two maturity curves inside the model similar to some of the GOA rockfish assessments.**

There was a risk-table overall score based on ecosystem concerns of 2. Unlike the EBS, the condition factor for the AI is quite low and continues to be low. However, given the Tier 5 estimates are more conservative than what was estimated for all of the Tier 3 models presented, the SSC concluded that no ABC reduction was necessary.

The SSC also recommends exploring the barefoot ecologist online tool for developing an appropriate prior distribution when estimating natural mortality in next year's age-structured model.