

SCIENTIFIC AND STATISTICAL COMMITTEE
Report to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
October 1st – 3rd, 2018

The SSC met from October 1st through 3rd at the Hilton Hotel, Anchorage, AK.

Members present were:

Gordon Kruse, Co-Chair <i>University of Alaska Fairbanks</i>	Anne Hollowed, Co-Chair <i>NOAA Fisheries—AFSC</i>	Sherri Dressel, Vice Chair <i>Alaska Dept. of Fish and Game</i>
Chris Anderson <i>University of Washington</i>	Robert Clark <i>Alaska Dept. of Fish and Game</i>	Mike Downs <i>Northern Economics</i>
Ron Felthoven <i>NOAA Fisheries—AFSC</i>	Jason Gasper <i>NOAA Fisheries – Alaska Region</i>	Dana Hanselman <i>NOAA Fisheries—AFSC</i>
Brad Harris <i>Alaska Pacific University</i>	George Hunt <i>University of Washington</i>	Dayv Lowry <i>Washington Dept. of Fish and Wildlife</i>
Franz Mueter <i>University of Alaska Fairbanks</i>	Terry Quinn <i>University of Alaska Fairbanks</i>	Heather Renner <i>U.S. Fish and Wildlife Service</i>
Ian Stewart <i>Intl. Pacific Halibut Commission</i>	Alison Whitman <i>Oregon Dept. of Fish and Wildlife</i>	

Members absent were:

Amy Bishop <i>Alaska Sea Life Center</i>	Kate Reedy <i>Idaho State University Pocatello</i>
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B-1 Plan Team Nominations

The SSC reviewed the Social Science Planning Team (SSPT) nominations of Courtney Carothers (UAF), Davin Holen (Alaska Sea Grant, UAF), Catherine Moncrieff (Yukon River Drainage Fisheries Association), Brenden Raymond-Yakoubian (Kawerak Inc.), Lauren Sill (ADF&G), Erica McCall Valentine (The Scholar Ship), and Phillip Zavadil (City Manager for the City of Saint Paul).

In June 2018, the Council announced a call for nominations for additional membership on the Social Science Planning Team (SSPT) to add expertise in Local Knowledge (LK) and Traditional Knowledge (TK). Specifically, the Council sought to include those who work directly with rural and Alaska Native coastal villages and/or tribal organizations in the fields of anthropology, human geography, and sociology. The SSC was pleased to see the broad applicant interest in participating on the SSPT, which reflects the important role this group can play in improving the use of social science in understanding how federal fisheries policy affects resource and human outcomes throughout the region.

The SSC sought to identify candidates whose affiliations allow independence (i.e., generally speaking are employed by state or federal agencies, or universities), who had experience and a broad understanding of social systems and issues throughout the North Pacific region, and who had experience with marine fisheries under federal jurisdiction. The SSC examined nominees' record of advancing the frontiers of their field, and experience applying qualitative metrics, or LK and TK, within regulatory processes. This experience is critical for the nominee to support the SSPT in providing guidance to the SSC and the Council.

For this task, considering the criteria described above, the SSC finds two nominees qualified for participation: (1) Dr. Courtney Carothers, Associate Professor with the College of Fisheries and Ocean

Sciences at the University of Alaska Fairbanks (UAF); and (2) Dr. Davin Holen, a Coastal Community Resilience Specialist with Alaska Sea Grant, UAF.

As key research areas for the application of LK or TK, in particular, and the data required to address them are better identified, it may be desirable to strengthen the connection with ADF&G's Division of Subsistence. Establishing a future seat on the SSPT for an ADF&G Subsistence representative is one way to coordinate federal priorities with that division's capacity and extensive experience with people and communities throughout Alaska.

B-1 SSC Subcommittee on AFSC Surveys

At the June 2018 meeting, the SSC received a report from AFSC Deputy Director, Mr. Jeremy Rusin, about funding concerns that could lead to only three vessels for groundfish surveys in 2018, rather than the standard five vessels. Mr. Rusin requested the assistance of the SSC to help the AFSC explore and prioritize alternatives for survey deployment based on Council needs in FY19 and FY20. The SSC nominated the following sub-committee to assist the AFSC in this effort: Dana Hanselman, Dayv Lowry, Alison Whitman, George Hunt, Anne Hollowed, and Gordon Kruse.

The SSC Subcommittee met with AFSC staff at the AFSC facility at Sand Point, WA, on September 10th. The SSC Subcommittee provided a written report of their efforts (see Appendix of this SSC report). That subcommittee report also includes two appendices: AFSC background document and terms of reference for AFSC-SSC Working Group, and slides from an AFSC PowerPoint that were presented by Jeremy Rusin at the meeting. Dr. Gordon Kruse presented an overview of the SSC Subcommittee report to the full SSC.

The full SSC endorses the report prepared by the SSC Subcommittee. **The full SSC wishes to reemphasize that surveys are a very high priority currently designated as *Critical Ongoing Monitoring*, and reiterates that securing funding for a full complement of five vessels to conduct annual bottom trawl surveys is fundamental to successful fisheries management in the North Pacific.** In addition to the direct connection between assessment surveys and annual catch specifications, surveys yield other important data on species distribution, life history, and biology, information needed for high-quality determinations of essential fish habitat and many other purposes that contribute directly and indirectly to sustainable fishery management.

General Comments

C-1 BSAI Crab Specifications

General SSC Comments to Crab Plan Team

The SSC reminds authors to use the model numbering protocols that allows the SSC to understand the year in which a particular version of the model was first introduced.

The SSC recognizes that several authors are considering applications that include model-based (VAST) estimates of survey biomass. The SSC notes that the CV for model-based estimators is generally lower than for design-based estimators. The SSC encourages authors to consider whether or not this apparent reduction in uncertainty in survey biomass is appropriately accounted for within their models. The SSC continues to encourage research on how VAST models treat stations that border islands to ensure that the models are appropriately accounting for land.

2018 Survey

The 2018 NMFS bottom trawl survey was conducted from June 3 – July 31, 2018. Bottom temperatures were warm. Based on the unusual ocean conditions observed in 2018, NMFS conducted an off-cycle, scaled

back survey of the northern Bering Sea (NBS). The warm bottom temperatures observed in the survey continued the general trend of higher temperatures since 2014. **The SSC thanks the AFSC for its rapid response to anomalous ocean conditions, which facilitated the successful completion of the scaled-back survey in the NBS survey.**

Four special studies on Bering Sea crab were conducted in conjunction with the 2018 survey: a) bitter crab syndrome; b) annual vs. biennial egg production in snow crab; c) genomic structure of EBS Tanner crab; and d) genetics and mating dynamics of snow crab.

The SSC received very brief updates on three other studies. Cory Lescher (APU) applied for an EFP for a study of crab handling mortality in the yellowfin sole fishery. ADF&G is deploying pop-up tags on Tanner crab to measure the utilization of regions surrounding the Pribilof Islands to assess whether this region is operating as a refuge from fishing. In addition, the Bering Sea Fisheries Research Foundation is funding Madi Shipley (UW, NRC) who is conducting a management strategy evaluation of alternative TAC setting procedures for Tanner crab.

Catch Estimates

The SSC was reminded that State observers will cease collecting information on legal retention status in the near future. The topic of calculating discards using alternative methods (such as the “subtraction method”) is to be discussed during the January CPT meeting.

Off – Cycle Assessments

This was the first year of “off years” resulting from stock prioritization. The CPT adopted a triennial assessment cycle for PIGKC and WARKC, and a biennial assessment cycle for PIRKC and PIBKC.

Norton Sound Red King Crab

The SSC includes, by reference, its comments on NSRKC from the February and June 2018 SSC report. The SSC agrees with the CPT recommendation that the author should provide a discussion paper on Tier 3 vs. Tier 4 management for the January 2019 CPT meeting. The SSC supports the CPT’s recommendation that the authors should examine the assumed knife-edge cutoff for maturity and evaluate whether data are available that could inform the appropriateness of assumptions about maturity.

Aleutian Islands Golden King Crab

The SSC includes, by reference, its previous comments on AIGKC.

BSAI Crab SAFE and Harvest Specifications

The SSC reviewed the SAFE chapters and information provided by the CPT with respect to the stock status information from 2017/2018 and relative to total catch during the 2017-2018 season (Table 1). In addition, Table 2 contains the SSC recommendations for 2018/2019 catch specifications, with maximum permissible ABCs for 2018/2019 shown in Table 3. **The SSC endorsed all OFL and ABC recommendations of the CPT except that the SSC selected a 25% buffer for the ABC calculation for St. Matthew Island blue king crab, as it did last year, instead of the 20% buffer recommended by the CPT.** The rationale for this change is reported in the St. Matthew Island blue king crab section of this SSC report (below). St. Matthew Island blue king crab is below MSST which would place this stock in an overfished condition. Based on this finding, the SSC anticipates that NMFS will make an overfished determination. Pribilof Islands blue king crab is overfished; none of the other crabs stocks were overfished or approaching overfished status. None of the crab stocks were subject to overfishing.

Table 1. Stock status of BSAI crab stocks in relation to status determination criteria for 2017/18 as estimated in May and September 2018. Values are in thousand metric tons (kt). Note, diagonal fill indicates parameters not applicable for that tier level.

Chapter	Stock	Tier	MSST ^[1]	B _{MSY} or B _{MSY proxy}	2017/18 ^[2] MMB	2017/18 MMB / MMB _{MSY}	2017/18 OFL	2017/18 Total catch	Rebuilding Status
1	EBS snow crab	3	71.40	142.80	99.60	0.70	28.40	10.50	
2	BB red king crab	3	12.74	25.50	24.86	0.97	5.60	3.48	
3	EBS Tanner crab	3	15.15	30.29	64.09	2.12	25.42	2.37	
4	Pribilof Islands red king crab	4	2.30	4.60	3.36	0.73	0.48	0.00028	
5	Pribilof Islands blue king crab	4	2.05	4.11	0.23	0.06	0.00116	0.00033	overfished
6	St. Matthew Island blue king crab	4	1.85	3.70	1.29	0.35	0.12	0.01	below MSST
7	Norton Sound red king crab	4	1.09	2.19	2.33	1.06	0.30	0.24	
8	AI golden king crab	5	6.04	12.09	14.21	1.18	6.05	2.94	
9	Pribilof Islands golden king crab	5					0.09	Conf.	
10	Western AI red king crab	5					0.06	< 0.001	

[1] As estimated in the 2018 Assessment

[2] For stocks 1-6 MMB on 2/15/2017 is estimated using the current assessment in September 2018. For Norton Sound red king crab MMB on 2/1/2017 is estimated using the current assessment in January 2017.

Table 2. SSC recommendations for October 2018. Note that recommendations for stocks 7, 8 represent those final values from the SSC in February and June 2018 while 4, 5, 9 and 10 represent the October 2018 assessment. Hatched areas indicate parameters not applicable for that tier. Bold indicates where SSC recommendations differ from Crab Plan Team recommendations. Values are in thousand metric tons (kt).

Chapter	Stock	Tier	Status (a,b,c)	F _{OFL}	B _{MSY} or B _{MSYproxy}	Years ^[1] (biomass or catch)	2018/19 ^[2] MMB	2018/19 MMB / MMB _{MSY}	γ	Mortality (M)	2018/19 ^[3] OFL	2018/19 ABC	ABC Buffer
1	EBS snow crab	3	b	1.04	142.80	1982-2017 [recruitment]	123.1	0.86		0.36 (females) 0.27 (imm) 0.26 (mat males)	29.70	23.80	20%
2	BB red king crab	3	b	0.25	25.50	1984-2017 [recruitment]	20.80	0.82		0.18	5.34	4.27	20%
3	EBS Tanner crab	3	a	0.74	30.29	1982-current [recruitment]	35.95	1.19		0.32 (females) 0.23 (imm) 0.27 (mat males)	20.87	16.70	20%
4	Pribilof Islands red king crab	4	b	0.13	4.60	1991/92-2016/17	3.36	0.73	1	0.18	0.48	0.36	25%
5	Pribilof Islands blue king crab	4	c		4.11	1980/81-1984/85 & 1990/91-1997/98	0.23	0.06	1	0.18	0.00116	0.00087	25%
6	St. Matthew Island blue king crab	4	c	0.04	3.70	1978-2018	1.31	0.35	1	0.18	0.04	0.03	25%
7	Norton Sound red king crab	4	b	0.15	2.19	1980-2017	1.85	0.84	1	0.18	0.20	0.16	20%
8	AI golden king crab	3	a	EAG (0.64) WAG (0.60)	12.09	1987/88-2012/13	17.95	1.48		0.21	5.51	4.14	25%
9	Pribilof Islands golden king crab	5				See intro chapter					0.09	0.07	25%
10	Western AI red king crab	5				1995/96-2007/08					0.06	0.01	75%

[1] For Tiers 3 and 4 where B_{MSY} or B_{MSYproxy} is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years upon which the catch average for OFL is obtained.

[2] MMB as projected for 2/1/2018 for Norton Sound red king crab, 2/15/2018 for AIGKC, and 2/15/2019 for other stocks.

[3] AIGKC OFL and ABC calculated by author outside the chapter for using the Approach 2 combination of EAG and WAG and 25% buffer between OFL and ABC.

Table 3. Maximum permissible ABCs for 2018/19 and SSC recommended ABCs for stocks where the SSC recommendation is below the maximum permissible ABC, as defined by Amendment 38 to the Crab FMP. Bold indicates where SSC recommendations differ from Crab Plan Team recommendations. Values are in thousand metric tons (kt).

Stock	Tier	2018/19	2018/19
		<i>Max</i> ABC ^[2]	ABC
EBS Snow Crab	3	29.7	23.80
Bristol Bay RKC	3	5.13	4.27
Tanner Crab	3	20.87	16.7
Pribilof Islands RKC	4	0.48	0.36
Pribilof Islands BKC	4	0.00116	0.00087
Saint Matthew BKC	4	0.04	0.03
Norton Sound RKC	4	0.20	0.16
Aleutian Islands GKC	3	5.49	4.14
Pribilof Islands GKC ^[1]	5	0.09	0.07
Western Aleutian Islands RKC	5	0.06	0.01

[1] For Pribilof Islands golden king crab, this is for the 2018 calendar year instead of the 2017-2018 crab fishing year.

[2] For Tier 5 stocks this is 0.90 while all other stocks P*.

EBS Snow Crab

This assessment was presented by William (Buck) Stockhausen (AFSC). The current snow crab stock assessment uses a size- and sex-structured model in which crabs are categorized into immature or mature and new or old shell. The basic model structure remains unchanged from last year's accepted model, but the author developed several alternatives to explore the influence of different priors on natural mortality (fixed female maturity, loose prior on all Ms, very loose prior on all Ms), separate recruitment deviations for males and females, and two combinations of separate recruitment deviations with loose or very loose priors on M. A final model added a linear relationship between growth increment and pre-molt size to the model with a loose prior on M and separate recruitment deviations by sex, rather than modeling growth with a segmented regression.

Unfortunately, uncertainty about model structure increased in this year's assessment compared to the 2017 assessment, in spite of the addition of growth data. With the use of jittering, this was most evident in serious model instability. The 2018 survey observed large increases in biomass of mature males and females, as well as juveniles. The increase was due to the large influx of small crab into the population, beginning in 2014/15, that is expected to support strong recruitment over the next few years as well. None of the models could fully account for observed increases in biomass, which might be due to immigration from outside the survey area.

Selecting among the alternative models was difficult because many of the models, including some of the better-fitting models, had serious convergence issues. The SSC had a lengthy discussion on appropriate

priors, separate recruitment for males and females, and estimating growth. With regard to less informative priors, the SSC ultimately agreed with the CPT that sufficient justification was provided for the current, informative priors in the document and that the large increases in mortality, in particular for mature females, that resulted from less restrictive priors appear unrealistic based on current knowledge of snow crab. The SSC also agreed with the CPT to use a model with separate recruitment deviations for males and females, which improved the model fit and reduced retrospective bias. However, improvements in model fit came at the expense of a large number of additional parameters and the SSC is concerned about adding additional model complexity. While we ultimately accepted the model with separate recruitment deviations, we request that the author provide a stronger biological rationale for separate recruitment deviations in the next assessment. With respect to growth, while the SSC was pleased that additional growth data were incorporated in the model, we note that most of the data points were for crab smaller than the minimum size included in the model and others were largely within a very narrow size range (pre-molt size) and had highly variable growth increments. Therefore, the new growth data were not very informative and may have contributed to the observed model instability.

Based on these considerations, the SSC agreed with the CPT to select the model with separate recruitment deviations but without relaxing the priors on M (Model “Sep Devs”) for specifying snow crab reference points. Given the continued structural uncertainty and convergence issues, the SSC also agreed with the CPT to keep the 20% buffer in place. The stock remains in Tier 3b. The resulting OFL and ABC are summarized in the introduction section of the SAFE and in the Table in this report.

The SSC had several recommendations on future research to help improve the stock assessment model, most of which reiterate CPT recommendations.

- While the SSC accepted the model, we believe that using separate recruitment deviations that are independent between males and females is not the best approach for addressing differences in mortality and it requires a large number of additional parameters. Male and female crab are expected to be produced in relatively equal ratios but abundances may diverge owing to sex-specific mortality as young crab grow. Therefore, the model should try to capture possible biological mechanisms that result in divergence and constrain the divergence, rather than allowing for completely independent recruitment deviations by sex.
- We reiterate earlier recommendations to reexamine catchability for snow crab, given the large number of snow crab that occur outside the standard survey area. We note that the snow crab assessment is a prime candidate for including available NBS data in the assessment in the future.
- We recommend research on the relationship between shell condition and time since last molt.
- We encourage efforts to collect additional growth information because the new observations that were added this year were concentrated within a narrow range of pre-molt sizes so the new growth information was not as informative in the assessment as expected.
- The SSC also encourages the author to revisit appropriate weights for different data sources included in the model. We note that a recent working group made useful recommendations on data weighting that should be assessed for implementation in the snow crab assessment.
- Although the short model names used in this assessment were informative, the SSC requests that the author follow standard guidelines on model naming.
- To quantify retrospective patterns in the assessment, the author should use Mohn’s rho, rather than mean relative error.

Bristol Bay Red King Crab

Robert Foy (AFSC) presented this assessment. The authors updated this assessment with new data and modeling using ADMB. A related effort is being undertaken to use this stock as an illustration of the generic GMACS modeling approach by Andre Punt that may be used with multiple crab stocks. A comparison of

model runs using both approaches revealed programming (coding) errors in both approaches. (Parenthetically, this shows the advantage of using multiple platforms in strengthening the reliability of stock assessments, which is not done very often). The coding errors in the previously accepted model resulted in larger weights on NMFS survey length compositions than intended.

Other features or issues of the updated assessment are:

- It was decided not to use terminal recruitment (in the last year) for specifications because it was too variable. The SSC would like the authors to elaborate on the rationale for this decision and notes that this issue is on the agenda for the January Crab Workshop.
- Catchability was estimated at 0.91 versus fixing it at 1.0.
- Observers will no longer make an estimate of retained catch, which will be obtained from fish ticket information instead. Therefore, the catch data component was reformulated as total catch instead of retained catch.
- A breakpoint analysis done in 2017 was not repeated this year.
- Jittering of initial conditions to investigate model convergence was not done this year. The authors indicated that jittering would be done next year.
- Six model scenarios were examined: two base models 2b-old and 2b from the 2017 preferred model 2b, without and with coding error corrections; 18.0 based on total rather than retained catch, and three variants: (1) 18.0a which set effective sample size for male and female length compositions to be equal as is theoretically correct, (2) 18.0b which used only one logistic curve for retained proportions, and (3) 18.0c which used only one logistic curve for male total selectivity in the directed fishery.

All models fitted the data well, except that the predicted 2018 survey biomass was higher than the 95% confidence interval of observed survey biomass. This may be due to changes in either M or Q in 2018. Recent recruitments have all been low but the most recent are highly variable and possibly biased. Retrospective analysis suggests that recent recruitment has also been over-predicted in the recent past. Current male mature biomass is about 82% of B35%, placing the stock in Tier 3b. There was no overfishing, the stock is not overfished, and the stock is not approaching an overfished condition.

The SSC agrees with the Team's choice of Model 18.0a based on correctly weighting sample size and for parsimony. The SSC also agreed with the Team's recommendation that the buffer be raised from 10% to 20%. Justification for this raise is: (1) the over-prediction of 2018 observed survey biomass; (2) possible distributional shifts due to the absence of the cold pool in 2018; and (3) 20% is the buffer recommended for other crab stocks with similar uncertainty.

The SSC notes that a reduction of structural fauna providing protection for small crabs and increase in mobile predators of small crabs was reported from current ecosystem studies. The SSC encourages the author to investigate whether these ecosystem changes are linked to changes in natural mortality or reproductive success.

EBS Tanner Crab

William (Buck) Stockhausen (AFSC) presented the final Tanner crab assessment. The assessment author originally provided twelve assessment models (the 2017 final model and 11 new models), some of which had been selected at the May 2018 Crab Plan Team (CPT) meeting for consideration, and others that were new to this assessment. Revised total catch estimates (abundance and biomass) for Tanner crab in the directed fisheries, the snow crab fishery, and the BBRKC fishery were provided by ADF&G based on at-sea crab observer data for 1992/93-2017/18. The revised estimates of total catch in the directed fishery and the bycatch in the snow crab fishery were nearly the same as the estimates previously used in the assessment

after 1995, but there were much larger changes in 1992-1995. Inclusion of these revised catch estimates in the assessment had a large impact on estimated Tanner crab mature male biomass for the entire time series, shifting it upwards by approximately 70%.

The additional catch in the early 1990s resulted in a much lower estimate of survey catchability and a large change in reference points in the 2017 stock assessment model. It was suggested that there was not a lot of information on the scale in the survey information itself. Therefore, the authors provided a model that fixed catchability and selectivity to values estimated by Somerton and Otto (1999).

All of the new models that were included used the revised catch data, which had not been previously reviewed by either the CPT or the SSC. The CPT was reluctant to consider any models that incorporated the revised catch data. The SSC agrees with the CPT and did not recommend using the revised catch history until the new catch history and the methods for survey catchability receive additional review. We also support the plan to review the methodology for the revised catch estimates at the January CPT meeting and the author's plans to investigate the sensitivity of the model to just a few early years of catch data.

The assessment author also attempted to estimate annual male maturity ogives within the model. This is a good approach for propagating uncertainty in the model, but the data appeared sparse in some years and produced unreliable maturity ogives in those years. The SSC recommends that the authors attempt to pool all of these years, or use time blocks to improve estimation.

The CPT requested that the assessment author run a new model at the meeting that was the same as the 2017 assessment model, updated with new data (but not the revised catch data). Because of some of the concerns about the revised catch data and model uncertainty, the CPT recommended this model be used for specifications in 2018. The SSC endorses the CPT recommended model. We also agree with the CPT to continue use of the 20% buffer for reducing ABC from OFL because of considerable uncertainties in the model, including some poor fits to retained catch and size compositions and estimated parameters stuck on bounds.

The SSC continues to recommend that the authors try to resolve the parameters on the bounds issue by either simplifying the model or experimenting with removing the bounds. In addition, the author should either justify fitting both abundance and biomass indices in the model or fit to only one index. The Team also looks forward to seeing the BSFRF work included in the future. If the catchability study is to be used to inform selectivity and catchability estimates in the model, it could be used as a prior instead of as fixed inputs, and the SSC would like to review the results and methods of that catchability work before it is incorporated.

Saint Matthew Island Blue King Crab

The St. Matthew Island blue king crab assessment has used a three stage catch survey analysis since 2012. This assessment has been conducted in GMACs since 2016. The 2018 assessment considers 6 modeling scenarios: (1) The 2017 model with no data updates; (2) the 2017 model revised to include 2018 trawl survey data; (3) the 2017 model, referred to as the "reference case," which includes both the 2018 trawl survey and ADFG pot survey data; (4) an application of the VAST delta-GLMM model to the NMFS trawl survey data; and (5) the reference case with upweighting on the trawl and pot surveys.

This is a rather data-limited stock assessment. There are several significant issues concerning all model scenarios. These include a spatial mismatch between the survey locations and the geographic distribution of females and juveniles, which results in poor model estimates of recruitment. Moreover, survey sample sizes are small and highly variable, and historical biomass and uncertainty in those estimates are driven by

a single anomalous survey station (R24). The fits to the trawl survey data do not capture recent survey trends in trawl biomass 2008-15, and declines in pot survey CPUE 2013-17.

The SSC supports the author's and CPT's recommendation to use the reference case model for this year's Tier 4 stock assessment and specifications. The author and CPT recommended a 20% buffer on the OFL to determine the ABC. The SSC disagrees. **Rather, the SSC recommends use of a 25% buffer (also used in 2017) to determine this year's ABC for the following reasons:** (1) spatial mismatch between trawl and pot surveys, distribution of recruited crab, and the commercial fishing grounds; (2) historically large uncertainty in survey biomass estimates, which are in part due to the large contribution of survey catches from one hotspot station; (3) the lack of fit to recent declines in pot survey CPUE, and historically poor fits to the trawl survey; (4) this is a data-limited stock assessment compared to the relatively data-rich EBS snow crab and EBS Tanner crab stocks, both of which use a buffer of 20% for calculations of ABC, and (5) Tier 4 assessments for Pribilof Islands red and blue king crab also use a 25% buffer.

The reference case model results in a MMB/Bmsy ratio of 0.35, which is below $\frac{1}{2} B_{msy}$, resulting in an overfished condition. As a result, a rebuilding plan is to be initiated for the stock. The SSC agrees with the CPT that rebuilding scenarios and assessment model developments should be discussed at the January 2019 modeling workshop and CPT meeting. In addition, results from the dynamic B0 analysis suggest the depletion below MSST was not caused by fishing mortality, which may suggest variability in survival rates and/or changes in stock range. The SSC recommends that future assessments consider different parameterizations of catchability that incorporate environmental covariates; specifically, whether bottom temperature and/or survey timing might be important covariates. The methodology used in the BSAI yellowfin sole assessment might be a reasonable starting point.

Application of the VAST model for the trawl survey index is a new approach presented in this assessment. The SSC encourages continued development of the VAST model given its ability to capture spatial processes associated with crab distribution around St. Matthew Island, particularly the R24 station. The SSC concurs with the CPT minutes, which provide direction on future development of this model. Additionally, the SSC recommends that uncertainty in the VAST estimate versus the design-based method be explored in future iterations of the VAST analyses to provide context when the SSC is considering transitioning between the approaches.

C-2 Groundfish Plan Team Report and Harvest Specifications

The SSC received a series of presentations from Grant Thompson (NMFS-AFSC), Jim Armstrong (NPFMC), and Jim Ianelli (NMFS-AFSC) that included all items from the September 2018 Joint, BSAI, and GOA Groundfish Plan Team (GPT) meetings.

The SSC recommends approval of the preliminary 2019/2020 BSAI and GOA specifications as provided by the Plan Teams. Items where the SSC had comments or recommendations in addition to, or different from, the Plan Teams are listed below.

The SSC wishes to recognize the contributions of Dr. Jon Heifetz, who retired this summer, to the Gulf of Alaska Plan Team. Jon's service to the NPFMC both as a Plan Team member and a stock assessment author contributed to the Council's legacy of sustainable fishery management.

General recommendations: Joint Plan Team report

The SSC received a summary from Dr. Grant Thompson (AFSC) of the Joint and Bering Sea PT reports, as well as the June workshop on ensemble modelling and basis for ABC reductions from the maximum

ABC. The SSC received written public testimony from Elizabeth Reed (Westward Fishing Company) on ABC reductions, and from Gerry Merrigan (Freezer Longline Coalition) on the 2018 PT reports including the Bering Sea Pacific cod assessment, Northern Bering Sea survey, stock assessment frequency, ensemble modelling, and reductions from the maximum ABC.

Plan Team Assessment Workshop on Ensemble Modeling and ABC Adjustment

In June 2018, the BSAI Groundfish Plan Team convened a workshop on ensemble modeling and ABC adjustments. The SSC recognized the Team's excellent progress on both topics, and thanks the workshop attendees, other contributors, and PTs for their work. The workshop report as well as the PT summary and recommendations provided a clear overview of the salient conclusions from the workshop.

ABC reductions from the maximum ABC: Reductions from the maximum ABC are an infrequent action prompted by extraordinary circumstances, or considerable uncertainty, in attempt to respond to substantial unquantified risk. Importantly, adjustments from the maximum ABC are based on uncertainty and risk that is not already accounted for in the tier-system approach to reducing the maximum ABC relative to the OFL: these should not overlap. However, despite a previous SSC comment in regard to BSAI Pacific cod, evidence in support of a reduction does not have to be "unequivocal."

In the absence of a clear recommendation from the PT on the inclusion of socio-economic factors as a basis for ABC reductions, **the SSC recommends that economic considerations should NOT contribute to ABC reductions, but should instead be considered during the TAC setting process.** Stock assessment authors and others may have important information to contribute to this step (e.g., potential for foregone yield when large young year classes are present in the stock) and should be given an opportunity to convey this information in a manner that is timely and conducive to use by the Council for setting TACs. The SSC should review the scientific basis for this information.

Several avenues for structuring future consideration of ABC reductions and increasing transparency were explored through the workshop and subsequent efforts. These included a summary of historical reductions, the use of a probability distribution approach (P^*), and a risk matrix.

The SSC recognized the considerable effort expended in summarizing and characterizing reasons for the large number of historical ABC reductions. This summary provided not only an evaluation of the coherence and consistency of these reductions, but also a tool to make sure any new approach would include all previous cases. The predictability of these reductions was then tested through a multivariate logistic modelling approach. Although it provided a valuable historical perspective, **the SSC recommends not pursuing this analysis further.**

A distribution-based approach to risk (P^*) fundamentally relies on all sources of uncertainty (including structural) being explicitly captured in the distribution. While this may be possible in some cases, it is rare that the factors influencing ABC reductions are completely quantified in an assessment model (ensemble modelling may be an avenue for development, but no model or set of models can fully account for all the uncertainties). **The SSC supports future consideration and development of distribution-based approaches, but not as a priority for 2018.**

The risk matrix approach (i.e., Table 1 of the workshop report) includes four increasing levels of concern crossed with three types of contributing factors: assessment, population dynamics, and ecosystem. This framework provides a clear classification of degree and basis for any potential reduction. Although assignment to a specific cell in this matrix will be subjective, clearly delineating the categories should improve transparency and help the PTs and SSC structure future decisions. **The SSC recommends that**

this approach be used qualitatively (not from the example percentages presented in Table 2) in December if any reductions to the ABC are recommended (but please drop the emojis).

Ensemble modeling: The SSC is encouraged by the progress made during the workshop and generally agrees with the list of PT recommendations for continued development of ensemble methods. The SSC highlighted the important conclusion that the results of ensembles can be treated in the same manner as the results of individual models. The SSC noted that, although there were several PT comments regarding the increased workload associated with ensemble modelling, this may not be the case in the long run. The SSC agrees with the PT that the first few applications will involve a (potentially steep) development curve and associated time and effort, this may not be the case once the reporting methods are established and where an ensemble of models is based on a subset of models already being developed by the author and considered by the PTs and SSC. A larger goal is to reduce the continued evaluation of large sets of models on an annual basis, which could ultimately reduce the workload for the author, not increase it. **The SSC requests that the PT clarify its comment regarding the difficulty in determining status from an ensemble relative to the determination from a single model, in light of the conclusion that results of an ensemble could be treated in the same manner as a single model (e.g., ABC and OFL).** The SSC recognized that there may be surmountable technical considerations to work out for the projections to satisfy the standard groundfish scenarios to determine “overfished” and “approaching overfished” conditions.

The SSC recommends that candidates for ensemble modeling should be chosen judiciously where stocks appear to have important structural uncertainty. The SSC looks forward to seeing test cases brought forward for 2018, possibly Pacific cod and/or rock sole.

Ecosystem Socioeconomic Profiles and Ecosystem Status Report

The SSC supports the PT list of development avenues for the Ecosystem and Socioeconomic Profile (ESP) process and encourages continued work on these efforts. The SSC looks forward to the planned ESP workshops and hopes there may be some level of SSC participation.

The SSC also supports the rewording of the binary ESR and assessment information to “current and future ecosystem condition” and “current and future stock condition”. This rating and reporting approach are definitely “OK”, as is the proposed calendar. It may also be beneficial to instead make a designation of “OK” after the complete year’s data is assimilated into the ESR, perhaps at the February or April Council meeting. The SSC noted that for species with an extensive body of research and some understanding of the mechanistic processes could be excluded from this process as the relevant information regarding the role of ecosystem change on current and future stock condition could be quantitatively assessed. In cases where a mechanistic link is proposed in the ESP but the impact has not been fully incorporated into the assessment, the authors should provide links behind a binary categorization to summary tables of detailed information available in the ESPs and other places. **The SSC recognizes that because formal criteria for these categorizations have not been developed by the PT, they will not be presented in December 2018.**

Stock assessment prioritization

The SSC supports the PT’s two primary criteria to trigger a new assessment: major changes in either catch (magnitude or distribution) or the survey biomass index, and the larger list of optional criteria (7 items).

The general approach to accounting for costs and benefits of this prioritization during the initial four years seems to be a reasonable response to the SSCs request. However, specific benefits (e.g., ‘additional’ analyses completed) may be difficult to assign unambiguously to reduced assessment frequency. The SSC recognizes these challenges in light of its previous requests. **The SSC also noted that, in order to save**

resources, authors should not conduct additional assessments beyond the prioritized schedule unless they specifically trigger one or more of the criteria identified.

Model-based survey estimates

The SSC encourages further exploration to determine the utility of the Vector-autoregressive spatiotemporal (VAST) model estimation methods as an alternative to design-based estimates of survey biomass. **The SSC supports the PT recommendation to make the use of model-based survey estimates at the individual author's discretion for 2018.** The SSC did note that model-based indices may not be appropriate for application to all species/stocks, but encourages further exploration and use of this method where possible and warranted. The SSC noted that in some cases the variance estimates associated with model-based indices may differ from design-based estimates, and that this may have important implications for use in stock assessments, which should be considered along with the alternative indices. It is the SSC's understanding that analysts at the AFSC are developing simulation models to explore this issue. **The SSC encourages authors to consider the outcome of these simulations when considering whether or not to apply the method for their stock.**

Sablefish

Three topics in relation to the sablefish stock assessment were presented: (1) alternative modeling approaches for fishery selectivity; (2) explorations for developing a prior on natural mortality; and (3) an update on ongoing apportionment analyses. **The SSC agreed with the PT recommendation to retain time-invariant selectivity for 2018, but encouraged further work to improve the poor fit to the compositional data. The SSC also supports the use of the new and more objective prior distribution for natural mortality (M).** The SSC noted the recommendation to continue the static apportionment using 2013 values in light of continued analysis and the conclusion from the CIE review that extremely high migration rates remove any appreciable biological concern. **The SSC agrees with the authors continued use of the static apportionment for 2019, but continues to request progress be made.**

Pacific Sleeper Sharks

An update on Pacific sleeper shark (PSS) projects was given, including: a pilot study on age determination methods, a spatial analysis to examine catch location/time/depth/temp/haul duration, an examination of discard mortalities through tagging and blood work, and an examination of data limited analysis methods.

The SSC supports the JGPT recommendation for continued exploration of utilizing data limited methods for this assessment. The SSC further recommends that, in addition to sharks, it would be helpful for the PTs and other authors of Tiers 5 and 6 stocks to explore the increasing number of methods available for data-limited situations.

Halibut DMRs

The SSC agrees with the PT recommendation to use the reduced time-frame for calculation and adopt the updated DMRs tables. The SSC encourages further refinement of the use of electronic monitoring data for DMR estimation, particularly with regard to the reliability of injury/viability assessment.

BSAI Plan Team Report

General comments

The SSC noted that a common interpretation of 'jitter' analyses (overdispersed starting points) treats high rates of convergence to be a positive outcome with regard to model behavior. However, high rates of convergence may not represent a solid test of convergence. A strong test is achieved when overdispersed starting points cause most of the runs to fail to converge, as long as those that do converge do not find a better solution (higher likelihood). Even a very reliable model can have low convergence if the test is

aggressive enough. However, this is a one-sided test: failure to identify a better solution does not mean a model has necessarily converged to the globally best estimate. Failure to converge from overdispersed starting points indicates a problem if the results of unconverged runs are relatively close (in likelihood units) to the maximum likelihood solution and therefore may be misleading when comparing alternative models.

Policy for off-cycle assessments

The Team discussed their previous policy not to take up any assessments brought forward in an off-year for reasons other than “an immediate conservation concern.” The Team chose to rescind its policy for off-cycle assessments in light of the JGPT discussion on this topic and instead refer to the new JGPT policy (see Joint Plan Team Report).

The SSC discussed that it will be difficult to assess the costs or benefits of the assessment prioritization if the schedule is not followed, but agree that if authors have a strong conservation or modeling concern, they should bring that forward for consideration at the September Plan Team meetings.

Flatfish CIE review

There was a Center for Independent Experts (CIE) review of the assessments for BSAI yellowfin sole, northern rock sole, and Alaska plaice.

For yellowfin sole, many of the recommendations were related to catchability and its relationship with temperature. A recent manuscript in review suggested that also including survey start date in that relationship explained much of the variation in annual catchability because of spawning migration timing. **The SSC agrees with the PT that yellowfin sole models should incorporate some of the CIE suggestions, and that the start date and interaction term be included in the catchability relationship, for November. The SSC also looks forward to any information on the proposed mechanism that underlies the inclusion of the start date and the interaction term in the model.**

For northern rock sole, there were some exploratory models responding to CIE suggestions. In addition, the authors have been considering an ensemble model for northern rock sole for several years. The 2018 June Plan Team assessment workshop on ensemble modeling recommended going forward with an ensemble. An ensemble of the base model and two additional models was presented. The two new models made different assumptions about natural mortality and catchability. Despite accounting for increased structural uncertainty, there was no appreciable change in the size of the buffer from OFL to ABC. **This example may be a good candidate for a first test of using an ensemble through the specifications process and the SSC looks forward to seeing this come forward in November and December.**

BSAI Atka mackerel

Model explorations conducted for BSAI Atka mackerel included: the causes of the retrospective bias, the use of the 1986 survey age composition, input sample sizes for compositional data, fishery selectivity time blocks, and age-dependent natural mortality. During exploration, no substantial improvements were found, except that the author recommended dropping the 1986 survey age composition, both because there was no associated survey and the general practice of not using Aleutian survey data prior to 1991.

The SSC appreciates the many explorations by the author, but the SSC agrees with the authors and the PT that the base model should continue to be used (without the 1986 survey age data).

Blackspotted/Rougheye rockfish

Options for modeling the BSAI blackspotted/rougheye (BS/RE) stock complex were presented. The options are provided in response to an SSC request to reevaluate the spatial area for the modeled stock; currently, the model is applied to a BSAI-wide stock with a single fishery and two survey indices (Aleutian Islands survey and eastern Bering Sea slope survey). Data were presented that showed significant population differences between the EBS and the AI, including differing age compositions, different growth, and different population trajectories. In addition, the AI part of the complex is mostly blackspotted rockfish, while the EBS portion is a mixture of the two species. There was some discussion of attempting a two-area spatial model, but it was generally concluded that this would unlikely be a useful exercise given the paucity of data for the complex.

The SSC agrees with the Plan Team and recommends that the author move forward with these suggested approaches for the November assessment. The SSC encourages assessment authors of this and other mixed-species assessments to continue research on novel methods.

EBS Pollock

A brief summary of the plans for the full EBS pollock assessment was presented. There were two primary topics of concern.

- 1) This year's survey data are somewhat compromised due to a lag in middle part of survey, and missing an important subarea
- 2) The substantial proportion of pollock that now appears to exist in the NBS in the last several years.

Several methods were suggested as possibilities to fill in the missing areas in the EBS standard survey including using the Acoustic Vessel of Opportunity data, the 2018 acoustic trawl, or merely using it as is and inflating the variance.

Assessment plans for this year focus on configuring the model to deal with the NBS component of the stock. The NBS component is implicitly included in the model now as a random effect on EBS survey catchability, without linking to the NBS data themselves, but the author plans to explore a model with explicit movement between areas, which would require inclusion of the NBS data. During discussion, it was suggested that one model could be included that simply adds the NBS and SBS biomass together for 2010, 2017, and 2018 and assuming there were no pollock in the NBS in any other year. Another option is applying a separate catchability coefficient for the years where there was an NBS survey. There was additional discussion on whether there should be an attempt to estimate a different natural mortality for fish found in the NBS; however, it was suggested that there were not sufficient data to estimate a separate M.

The SSC agrees with the Plan Team that the authors should explore their suggested solutions to dealing with the missing areas in the SBS survey and try to include models that account for the NBS.

Greenland turbot

There were two items presented for Greenland turbot. First, the stock structure template was completed for the first time for this assessment. The available data do not suggest differentiation between the eastern Bering Sea and the Aleutian Islands, although genetics are not available to confirm this. The length and age compositions are similar across areas as are trends in biomass. **The SSC agrees with the Plan Team rating of "little or no concern" for Greenland turbot stock structure.**

Second, new models exploring the use of the ABL longline survey were developed. Because the length compositions in that survey are not differentiated by sex, estimation of selectivity is challenging. There were questions about the stability of the base model and discussion about whether it was appropriate to estimate stock recruitment relationships for a Tier 3 stock. **The SSC concurs with PT recommended**

models for November, and that the authors inquire with the AFSC longline survey coordinators whether obtaining sex-specific length compositions could be initiated. Efforts to improve model stability by reducing parameters that are not well estimated is encouraged for future assessments.

Alaska skate catch estimation

A brief description of the uncertainty in skate identification by observers on longline vessels, primarily in the Pacific cod fishery was presented. Most skates are categorized as “other skate” because few skates are physically identified by observers. A new method was proposed for estimating skate catches using the skates examined to create a species composition for application to the entire observed catch. The method uses stratification by vessel type (CP vs CV) and gear type in an effort to account for depths where the skates are caught. **The SSC agrees with the Team and recommends that, although this method appears to be an improvement, further investigation of how species composition is affected by depth should be examined before the method is adopted.**

Stock structure evaluation requests

The SSC agrees with the Team that stock structure templates be completed for the following BSAI assessments: in 2019 – octopus; in 2020 – forage fish, Bogoslof pollock, and flathead sole.

Eastern Bering Sea shelf bottom trawl survey

The SSC received a presentation from Bering Sea Groundfish Assessment Supervisor Bob Lauth (AFSC) that detailed preliminary results of the 37th annual Bering Sea bottom trawl survey conducted in 2018. Public comment was received from Gerry Merrigan (Freezer Longline Coalition).

While only the Eastern Bering Sea (EBS) shelf was scheduled to be surveyed in 2018, low catches and anomalous environmental conditions including minimal sea ice extent and an unprecedented reduction in the cold pool (1% of its average extent) led to a “rapid response” survey being implemented in the Northern Bering Sea (NBS). This survey covered the western two thirds of the NBS region surveyed in 2010 and 2017 (i.e., did not include Norton Sound) and stations were more broadly spaced (30 NM² grid rather than 20NM²). Total effort was less than half that of these prior surveys (49 total station rather than ~110), but critical biomass estimates, over 200k fish lengths, over 4,500 ageing structures, and numerous other biosamples were successfully obtained nonetheless. The SSC commends AFSC staff and leadership for their efforts to complete this survey.

The SSC notes that there is evidence of substantial changes in the connectivity of the EBS and NBS regions with respect to the distribution and abundance of a number of groundfish species based on our 2010, 2017 and 2018 NBS surveys. The plan team report details evidence of several sub-Arctic species expanding northward while Arctic species are becoming less prevalent in the southern portion of the survey region consistent with range shifts or contractions. Of particular concern are substantial spatial changes in the distribution and abundance of pollock, Pacific cod and northern rock sole observed in the 2010, 2017 and 2018 NBS surveys.

While the causes underlying noted fluctuations in biomass, abundance, and distribution are complex and poorly understood, they are likely related to changing environmental conditions such as the lack of the cold pool. Whether such conditions represent the new normal or not is a question of significant concern. If the distribution and abundance of fish and crab stocks of fishery, ecological, and cultural importance exhibit spatial non-stationarity, there will be substantial implications for assessment and management. Bearing this in mind, **the SSC strongly supports the recommendation of the AFSC and the joint Plan Teams that the NBS be surveyed in parallel with the EBS on an annual basis.** The AFSC has indicated

that this will occur in 2019. Public testimony from Gerry Merrigan indicates public support for these efforts.

Genetic analysis of Northern Bering Sea Pacific cod

The SSC received a presentation from Dr. Ingrid Spies (NMFS) about a newly completed project on genetic stock structure of Pacific cod in the Northern Bering Sea (NBS). The presenter noted that the work was motivated by the recent large apparent changes in abundance and distribution of Pacific cod in the BSAI and GOA, as well as changes detected in the NBS trawl surveys between 2010 and 2017. The project sought to determine whether Pacific cod in the NBS were genetically similar to fish in other populations with existing genetic baseline data, which would support the hypothesis that changes in localized abundance are the result of a directed northward redistribution of fish.

Tissues samples were collected from 68 individuals in the NBS west of Norton Sound from several locations corresponding to relatively high cod catches in the survey. Samples were taken from a range of lengths and ages (38-73 cm, as young as 2 yrs old) and several thousand single nucleotide polymorphisms (SNPs) were identified for consideration. The analysis used restriction-site associated DNA (RAD) sequencing to compare the relative occurrence of SNPs with previously determined genetics baselines from 6 spawning populations gathered between 2003 and 2017, including Prince William Sound, Kodiak, Unimak Pass, Adak, the Pribilof Islands, and Pervenets Canyon.

The SSC appreciated the thorough analyses of the genetics data including Principal Components Analyses, followed by Discriminant Analysis, an exploration of sample assignment probability, and Fst analyses. The results from all of these approaches were consistent and indicated that the NBS samples were indistinguishable from the samples collected at the other Bering Sea locations (Unimak, Pribilofs, and Pervenets), but distinct from the Gulf of Alaska (GOA); Prince William Sound, Kodiak) and Aleutian Islands (Adak) areas. To examine the potential for a substantial contribution of fish from another unknown spawning location, the analyst conducted sensitivity analyses. Her findings indicated a low likelihood of influence from another unknown group of fish, like an unidentified Russian stock, but the analyst noted that if such a group of fish had genetic similarity to one of the EBS stocks this contribution might not be detectable with the current data. The analyst indicated that she was working with industry collaborators to acquire samples from Russian waters.

Dr. Spies indicated additional tissue samples had been collected in 2018 and analyses were underway to complete whole genome sequencing of Pacific cod. Having this information available for multiple populations would provide complete and definitive characterization of relationships among those stocks.

The SSC discussed the sensitivity of genetic methods to concluding similarities as opposed to differences and asked about the likelihood and implications of large scale Pacific cod movements. The analyst indicated that published work on Pacific cod movement suggests support for the distinction between NBS and the AI and GOA samples observed in the genetics samples. Further she suggested that the results of her work to date are consistent with longer-term residency rather than recent large-scale movements. The SSC noted that the estimates of distance between the sampling locations might need to be re-calculated and that existing estimates of Pacific cod movement distances based on tagging studies represent minimum values that do not account for non-linear movement while at large.

The SSC appreciated the author's excellent work, in particular given the importance and timeliness of the information it is providing. The SSC also noted that this work further underscores the importance of the NBS survey going forward and looks forward to further exploration of Pacific cod genetics in the future.

Preliminary Ecosystem Report

The SSC received a report on anomalous conditions in the Northern and Eastern Bering Sea during 2018 by Stephani Zador and Elizabeth Siddon (AFSC). There was no public testimony.

Conditions in the Bering Sea during 2018, and in particular, the Northern Bering Sea (NBS) have been extraordinarily different than in past years as observed by scientists visiting the region or by local residents. In response to a number of these observations, two ad-hoc workshops were convened (in August and September 2018) at the AFSC to synthesize the available information and alert the assessment authors for Pacific cod and walleye pollock. The information assembled in these meeting, as well as new information provided to the Ecosystem Status Report authors, informed the presentation to the SSC. The SSC is particularly pleased to see the extent stock assessment authors were involved early on in these discussions.

There was little or no sea ice present in the NBS and Chukchi in winter 2017/2018, and what there was arrived late in the season (March) and departed early (April). There were significantly more southerly winds in the NBS. Water temperatures, particularly at depth, were warmer than usual, and there was no cold pool on the eastern Bering Sea shelf. The reduced extent, quality, and duration of sea ice and the warm ocean temperatures were unprecedented.

The warm winter of 2017/2018 was the result of two factors: residual heat in the Chukchi Sea and Bering Sea that delayed freeze up, and a high pressure atmospheric system that was centered over the NBS. This high pressure resulted in the displacement of the Aleutian Low northward to Siberia and the presence of warm southwesterly winds over the NBS that prevented sea ice formation until late in the winter.

The lack of sea ice meant that ice algae were not available in winter and early spring to support the production of zooplankton, particularly large, lipid-rich species that are important for fish and seabirds. Sampling of zooplankton in summer 2018 showed these species to be scarce, while small copepods were abundant. Corroborating this zooplankton sampling, seabirds dependent on the large lipid-rich copepods and euphausiids showed delayed or failed reproduction.

Unusually high numbers of starved seabirds washed ashore from Bering Strait southward through Norton Sound, and along the shore of St. Lawrence Island. The majority of these were murre. In addition, most murre colonies in the region had low or no nesting success, as was also true of kittiwakes. The widespread breeding failure of murre was exceptional in the experience of both the coastal communities and visiting scientists. There were also reports of dead or dying shearwaters.

Ice seals, in particular ribbon seals, were unusually scarce, and spotted seal pups weighed less and were thinner than in recent years. Several mass stranding events that involved apparently starved ice seals (bearded, ringed, spotted) were reported/documentated at Wales and St. Lawrence Island. In July, an exceptionally large number of humpback whales were present north of St. Lawrence Island.

Fish showed variable responses to the warm conditions in the NBS in 2018. Pollock abundance increased, while their biomass decreased, and age-1 pollock were scarce. In contrast, Pacific cod increased in both abundance and biomass. There was a sharp, notable drop in herring biomass as measured by the BASIS survey.

Because time series were not available for many of the data reported above, there are challenges interpreting how unusual/unprecedented some of these observations may be.

The anomalous conditions observed in the NBS in 2018 have implications that are relevant to future fisheries management. It is expected that winter 2018-2019 will have sea ice cover, although freeze-up may come late. When freeze-up occurs, cooling of the entire water column is likely to be rapid, which may result in the freezing of some fish if they remain in the NBS over winter or delay movement south. Assuming that the large biomass of cod and pollock continue to occupy the NBS, even if only in summer, there is likely to be a reorganization of the NBS food webs due to the increase in predator biomass. How this increase will affect crab, forage fish, salmon stocks, seabirds and marine mammals is not known. **The SSC emphasizes the critical importance of the NBS bottom trawl surveys, as well as the near-surface BASIS surveys, for the management of the Bering Sea fisheries.**

Further, the SSC appreciated the responsiveness of the Ecosystem Status Report authors and contributors, and the bottom trawl survey teams, in providing this preliminary briefing in October. **The SSC would like to suggest that an abbreviated October briefing on ecosystem conditions be provided in years where highly unusual or unprecedented conditions are observed.**

BSAI Pacific cod

The SSC received a presentation on the PT report and a summary of preliminary Pacific cod stock assessment analyses from Dr. Grant Thompson (AFSC). Public comment was provided by Gerry Merrigan (Freezer Longline Coalition) on the spatial distribution of the longline fleet since 2015.

The SSC thanks Dr. Thompson for his extensive preliminary work and thorough evaluation of a range of new models intended to address emerging hypotheses about Pacific cod distribution and life history. This additional work greatly enhanced the ability of the PT and SSC to select a subset of models for further development and presentation in November and December.

The SSC noted that more than half of the biomass in the 2018 bottom trawl survey was observed in the Northern Bering Sea, outside the geographical range that has been historically included in the index of abundance used in the Pacific cod stock assessment. A presentation from Dr. Ingrid Spies (AFSC; see section above) suggested no genetic evidence that the cod in the Northern Bering Sea are distinct from those in the Eastern Bering Sea. It appears that the stock distribution now includes a region north of the line that has proven useful for stratifying historical survey effort, but may not be useful moving forward. The SSC noted that if a comprehensive time-series of annual surveys for the entire area was available, standard design-based survey calculations would be sufficient to summarize the biomass index and would not require any additional biological or model complexity.

A focus of preliminary modelling efforts has been the inclusion of the northwestern strata in the trawl survey index of abundance (previously excluded from the Pacific cod index due to missing observations in the period 1982-1986). Although it is an improvement to include the northwestern strata in the assessment survey index (as is already the case for most other assessments), the major issue for the 2018 assessment is accommodating the biomass in the rest of the Northern Bering Sea. The region to the north of the northwestern strata comprised 84% of the total Northern Bering Sea biomass in 2017. The author and PTs efforts have correspondingly focused on developing models that can accommodate both the northwestern strata and the remainder of the Northern Bering Sea.

The author provided several entirely new models for 2018, including models with environmental covariates to growth and mortality, as well as a two-area model with migration. **The SSC supports the PT recommendation to suspend development of these models (18.x) for 2018, but encourages future investigations.** This choice was made pragmatically, to focus efforts on the treatment of the Northern Bering Sea data, and to reduce the workload on the assessment author, recognizing the importance of

improved understanding of the environmental and ecosystem drivers on life history and movement. These models represent helpful exploratory analyses to identify linkages and how they might be included in stock assessment models. Some additional vetting of covariates using model output to refine mechanistic hypotheses might also be an avenue for future work.

The SSC discussed the set of seven models recommended by the PT (five primary, and two “if time permits”) for development and presentation in November and December. The SSC agreed with the PT’s approach, bringing forward a subset of models built around models 16.6 and 17.2, and including the addition of the northwestern strata with a change in catchability in the early years of the survey, and the addition of the NBS data. Of the models recommended by the PT, four included the simple assumption to ignore the Northern Bering Sea trawl survey data (north of the northwest strata). The SSC identified the need for an additional model making a simple but contrasting assumption that all survey data (EBS, northwest strata, and Northern Bering Sea) be used ‘naively’ as if the entire cod biomass had been sampled in each year. In order to accommodate this request, the SSC suggested that two of the PT recommended models be dropped: 16.6b (which represents a ‘bridging’ model between 16.6 and the third PT requested model) and the first additional PT requested model (16.6 with the northwest strata with time-varying catchability).

To summarize: the SSC requests that six models be prepared for presentation in November and December, four of those requested by the PT, one that was modified from the PT recommended model, and one additional model:

1. 16.6: the base model, including 2018 data (PT).
2. A variant of model 16.6g, which includes the northwestern strata in the EBS survey index and models the 1982-2018 expanded survey series with time-varying catchability, and the Northern Bering Sea survey observations with estimated selectivity and time-varying catchability (modified from PT).
3. Model 17.2 as it was structured and parameterized in 2017, but with 2018 data included (PT).
4. Model 17.2 but including the northwestern strata in the EBS survey index and modeled with time-varying catchability, and the Northern Bering Sea survey observations with estimated selectivity and time-varying catchability (PT).
5. Model 16.6 but adding the NBS survey estimates to the EBS survey estimates (with the northwestern strata) and model catchability as time-varying. Size compositions should be combined by weighting by the abundance estimates from each area (if available; PT).
6. **Additional SSC request:** Model 16.6 including the northwestern survey strata and the NBS biomass estimates added to the EBS estimates and treated as a single survey index without changes in selectivity or catchability.

The SSC acknowledges that there may be an additional model that seems important to bring forward identified during investigation of the requested model, and leaves this to the author’s discretion, noting that this is not specifically requested.

The SSC supports exploration of a geospatial model that includes all of the survey data (and perhaps environmental covariates), generating a single index that can be used in the assessment with little technical ‘overhead’ invested in time-varying catchability.

Given the importance of the biomass distribution in the Northern Bering Sea for the 2018 assessment, **the SSC notes that there are many other previously identified uncertainties in the structure of this assessment (in both models 16.6 and 17.2) that will require continued exploration in the future.**

The preliminary analysis included several options for ensemble weighting, including effective sample size, model diagnostic criteria, and cross validation. The cross-validation approach is consistent with weighting approaches applied in other fields, but is highly dependent on data weighting, particularly the treatment of the survey index variance; in this case assumed to be the simple design-based estimate for all comparisons. In the example provided, the weighting strongly favored a single model to the near-exclusion of all others. A survey variance inflated to match the root-mean-squared-error (RMSE) of the fit of these models to the time-series may produce less pronounced differences in weighting commensurate with increased uncertainty in the time-series. This may be a promising avenue for further investigation. The weighting approach based on model diagnostic criteria included retrospective behavior, model convergence, and plausibility of model estimates. These criteria represent a broad range of options from which to select a weighting consistent with criteria often used to select a single base case model. In the case of the selection of a single model, there are generally no strict quantitative formulae used to objectively determine the ‘best’ model, and so this is challenging for selecting weights in an ensemble.

Similar to the presentation of a base (or reference) case model, the SSC requests that future presentations of a model ensemble include a preferred model set and weighting approach recommended by the author, including a rationale for these choices, rather than solely an array of alternatives. **The SSC leaves the further development of an ensemble of Pacific cod models for 2018 to the author’s discretion: if some or all of the requested models seem reasonable for use in an ensemble in December, and a weighting scheme is identified, the SSC will consider it in December. A set of base case results from a single model should also be presented.**

Additional SSC comments:

- Because stock structure and migratory connectivity between the U.S. waters of the Bering Sea and the western regions of the Bering Sea (Russian waters) are poorly understood, the SSC recommends not changing the name of this assessment to the “Bering Sea” Pacific cod assessment, but retaining “Eastern Bering Sea”, for the time being.
- A regression analysis of ecosystem indicators correlated with historical spawning biomass was presented in response to the SSC’s request for a method to predict the likelihood of impending stock decline. The SSC cautions that testing a large number of indicators (as was done in this case) is likely to produce a statistically significant relationship even if one does not exist. Stock assessment authors are encouraged to work with ESR analysts to identify a small subset of indicators prior to analysis, and preferably based on mechanistic hypotheses.
- If a migration-based model is pursued in the future, the SSC suggests that a more mechanistic approach to incorporating migration in the model would be fruitful. For example, migration is most likely linked to the size and location of the cold pool, which used to impede the northward migration of Pacific cod, as well as to the size of the cod stock.
- The SSC had a lengthy discussion on the potential for a winter mass-mortality event affecting the biomass of Pacific cod observed in the Northern Bering Sea (more than half of the total in 2018). Due to the anomalously warm bottom waters and reduced stratification in the fall of 2018, winter cooling is projected to be rapid, and may result in atypically strong mixing throughout the water column. In tandem with historical reports of winter cod mortalities associated with ice formation in the Northern Bering Sea, there may be an impending risk. Options to track fishery CPUE, observer data, and anecdotal observations from local communities were discussed in order to provide for a potential in-season response if such a mortality event were suspected. It was noted that planned tagging efforts could help elucidate movement patterns relative to temperature, but that these would not begin until the summer of 2019. The SSC was unable to identify specific recommendations for action on this topic.

BSAI Flathead sole

This assessment was authored by Carey McGilliard (AFSC). It is a herculean effort to transfer the stock assessment from ADMB (hereafter referred to the 2016 model) to Stock Synthesis for increased flexibility and versatility. The author carefully made sequential changes to the Stock Synthesis code until she got a good match between the two approaches. It was not possible to get an exact match, because the ADMB model started at age 3, while the Stock Synthesis model started at age 0, and because of other differences in model features. These differences are clearly laid out in one table, and the greater ability of Stock Synthesis to handle modeling of features is described in another table. **The SSC commends the author for the clear description of the transition and approves the Stock Synthesis model for stock assessment this year.** The author intends to include some age data that are available.

The best matching Stock Synthesis model was a “hack” to mimic the 2016 model by setting catchability to 0.7, the average selectivity for ages 7 to 21 in the 2016 model. The author wanted to free up this value. Model 18.0 was created with survey selectivity being a function of sex and age but constant over time. Model 18.0b was a variant of Model 18.0 with survey selectivity varying by time using three time blocks: 1964-1988, 1989-2007, and 2008-2016, corresponding to changes in management of the fishery. Results appear to show that the 18.0b model fits the data somewhat better than 18.0. Models 18.0 and 18.0b have nearly the same biomass estimates over time, but these are much different than the 2016 model.

The Plan Team recommended bringing forward two models in December: the 2016 model and Model 18.0b. **The SSC would also like Model 18.0 brought forward with additional comparison and elaboration of model differences; perhaps calculating AIC would be useful. Further elaboration is also requested for the large difference between the 2016 model and the 2018 models.**

GOA Plan Team Report

Jim Ianelli (AFSC) and James Armstrong (NPFMC) presented the GOA Plan Team report.

Groundfish Specifications

The GOA PT recommended rolling over all fishery specifications with the exception of squid, which have been reclassified as an ecosystem component. **The SSC concurs with this determination.**

Northern rockfish

The stock assessment author compared three alternative models. Model 15.4 used design based survey biomass estimate. Models 15.5 and 15.6 incorporated the VAST model based estimates of survey biomass. Model 15.5 maintained the same likelihood weighting (1) as 15.4. Model 15.6 reduced the likelihood weight to 0.5. Reducing the weight on survey biomass estimates produced very similar results, indicating that the assessment model’s ability to fit the index was rather insensitive to the likelihood weight. This suggests that the model-based index does not provide information that is in conflict with another data source.

The SSC agrees with the GOA PT recommendation that the author should bring forward models using design based survey estimates and an alternative with survey biomass estimates from the VAST model, for consideration in December.

Walleye pollock

The SSC received a summary of on-going research on the impacts of size selectivity in the winter acoustic trawl survey, an update on research plans for the development of a multispecies model CEATTLE application for the GOA, and the author’s plans for introducing alternative models to explore random-walk time-varying values of natural mortality. The SSC agrees with the GOA GPT’s concern that the

method does not account for size selectivity of the predator. The SSC encourages further exploration of this modeling approach and recommends that results are compared with the CEATTLE model.

Pacific cod

The SSC received an update on the author's analysis of otolith age determinations, his exploration of a suite of models to explore the implications of the marine heat wave on stock dynamics, and a response to the CIE review. The SSC will provide a full analysis of proposed model changes in December 2018. The Team commended the author for responding clearly to the CIE reports.

Thornyheads

The assessment author presented a new method to combine the AFSC longline survey Relative Population Weight (RPW) index with the AFSC bottom trawl survey biomass index within the random effects model. Preliminary results based on this method appear promising and therefore, the SSC agrees with the CPT that the combined index should be brought forward for consideration in this assessment cycle. Additionally, it was noted that while observers have been collecting otoliths from as many as 500 thornyheads annually in the GOA, reading these otoliths has not been a priority. **The SSC supports the PT's recommendation to process these otoliths in a timely manner such that an age-structured model can be incorporated into future assessments.**

Sharks

In September, the author introduced an alternative method for management of spiny dogfish. This method would use VAST to combine longline and bottom trawl datasets. If adopted, the stock could potentially be moved from tier 6 management to tier 5 management. **The SSC encourages further exploration of this method. The SSC also supports further exploration of data poor assessment methodologies.**

Stock structure templates

The PT has been working to complete stock structure templates. In 2019 templates will be completed for Pacific cod, flathead sole, and northern rockfish. In 2020 rex sole, demersal shelf rockfish, and sculpins are schedules for consideration. **The SSC supports this ongoing work.**

C-3 Observer Program 2019 Annual Deployment Plan

The SSC heard a presentation from Craig Faunce (NMFS-AFSC), Phil Ganz (PSMFC), and Jennifer Ferdinand (NMFS-AFSC) providing an overview of the draft 2019 Annual Deployment Plan (ADP) for observers in the BSAI and the GOA to support the estimation of groundfish catches, discards, PSC, and related biological attributes. Public testimony was provided by Dan Falvey (ALFA) and Molly Zaleski (Oceana).

The SSC thanks the analysts and authors of the draft 2019 ADP for their hard work and diligence in preparing the report. It is concise and well written, resulting in an easy-to-understand, readable document. The appendices were very helpful in providing technical background for the analyses and recommendations made in the report. Since initiation of the restructured observer program in 2013, the analysts have been very responsive to SSC comments and recommendations for improving the ADP and the observer program. The SSC greatly appreciates the tremendous amount of work that has been done to develop and implement these improvements. The newly revised program has matured significantly in the last two years with respect to current use of trip-based selection, gear-based stratification, and standardized methods of ADP development and observer program performance evaluation. These enormous improvements reflect the hard work and dedication of the analysts, observers and their supervisors, and reviewers of the program.

The SSC has the following comments and recommendations concerning the draft 2019 ADP:

- The agency recommendation to continue use of the five strata for partially observed trips in 2019 is a good one, with the choice of strata reflecting differences in catch and PSC characteristics of gears and whether trips are tendered or not. **The SSC agrees with the recommendation for continued use of these five strata for partially observed fleets.**
- Despite the continued positive evolution of this program and responsiveness to requests from the SSC, several aspects of the draft ADP continue to have unresolved issues that the SSC has discussed in prior years. All of the issues are related to use of available funds, the assumptions made in analysis of allocation of trips, and the breadth of various allocation scenarios available for review by the Council. Although discussed by the analysts in consultation with the Fishery Monitoring Advisory Committee (FMAC) and in the analysts' presentation at the SSC meeting, these items are not contained in the written draft ADP that the SSC received. Specifically:
 - The analysis of optimization in the draft ADP is not all that helpful to reviewers because of the assumption of effort levels anticipated in 2019. The most recent year available is 2017 and there is good reason to believe that effort in 2019 may not be at the levels observed in 2017. Using 2017 effort in the allocation analysis expends all available funds in exerting the 15% sample rate across all strata, so that optimization could not be used to adjust sampling rates beyond 15%.
 - Although use of gear-specific hurdles was suggested by the SSC last year and graphics were supplied to investigate gear-specific hurdles in this year's draft ADP, no scenarios were developed for review to look at how a reduction in hurdle of one gear might benefit the sampling rates and estimation of discards and PSC, particularly of Chinook and halibut in the other gear strata. Gains in precision of PSC might be made if these tradeoffs could be brought forward for review in the draft ADP. For example, a scenario with one stratum set to 10% instead of 15% (pot gear would probably be best based on the graphical analysis) to see how a reallocation of trips would affect sampling rates and probabilities of adequate coverage and PSC estimation. The SSC notes that the FMAC saw an example of such a scenario at their recent meeting and the analysts also presented this information to the SSC at the meeting.
 - While the draft ADP recommends allocating any additional trips (either due to additional funds or lower effort, or both) with optimization based on discards, and Chinook, halibut, and crab PSC, it does not provide any scenarios of what the realized sampling rates could reasonably be if additional trips were made available. For example, scenarios of 10% or 20% less effort than 2017 could be provided for review with respect to changes in sampling rates among strata. The FMAC received an example of such a scenario at their recent meeting and we saw an example of such a scenario in the presentation by the analysts at the SSC meeting.
 - Based on the trip allocation analyses in the draft ADP, **the SSC suggests that optimization be based on Chinook and halibut PSC, those PSC species that are subject to constraining limits in fisheries, rather than optimization based on Chinook, halibut, and crab.** While the SSC requested that crab be looked at in the optimization, in the end the SSC doubts that adding crab to the optimization will change the realized sampling rates very much for the most critical strata if additional trips are made available for allocation. To this end, the draft ADP should include a comparison of scenarios that utilize additional trips, as this could help reviewers in assessing the tradeoffs in sampling rates among strata involved with optimization based on just Chinook and halibut PSC, or Chinook, halibut and crab PSC. We saw such an example in the presentation given to the SSC.
 - **The SSC recommends adding the aforementioned types of allocation scenarios to the draft ADP.** Adding these to the draft ADP report would provide more information to the

reviewers and provide more context for the agency-recommended allocation approach. The SSC greatly appreciates the work of the FMAC in requesting these additional scenarios and the analysts for bringing these additional scenarios forward for review by the SSC.

- The SSC remains concerned about funding levels for the observing program as these data are foundational to the stock assessments and PSC analyses that utilize these estimates, as well as Council decision making. If funding levels were to be reduced, it is likely that many of the PSC estimates that are critical to Council actions that have occurred for Chinook and ongoing Council actions on halibut would be negatively impacted.
- The SSC notes that when a trip is designated to be observed via ODDS, but is then canceled, the subsequent trip for that vessel inherits the “observed” status. This systematically shifts sampling effort later in the season, generating temporal bias. Recognizing this, a Trip Inheritance Group has been formed by NMFS. The SSC looks forward to the Trip Inheritance Group’s recommendations to resolve this issue.
- In previous minutes the SSC encouraged consideration of vessels under 40 feet to be in the Electronic Monitoring pool. We had requested to see some deployment options brought forward for discussion at this meeting. Acknowledging the Council’s priority for EM research on trawl vessels, the SSC would still like to highlight this as a sampling gap and hopes to see further discussions about that in the future.
- Another item in the June 2018 SSC minutes that has not yet been addressed was fleet-wide training of crew on the necessity of the observer program. The SSC reiterates that compliance and enforcement issues remain a problem within the observer program that are contributing to bias, fluctuate substantially among years, and may be substantially underreported for a variety of social and safety reasons. This was highlighted as a critical need to be addressed immediately.

C-5 Bering Sea Fishery Ecosystem Plan

An initial review draft of the Bering Sea Fishery Ecosystem Plan (BS-FEP) was presented by Diana Evans (NPFMC) and Kerim Aydin (AFSC). Public testimony was received by Steve Marx (Pew Charitable Trusts), Julie Raymond-Yakoubian (Kawerak, Inc.) and Lauren Divine (Aleut Community of St. Paul Island). The SSC recognizes the great deal of thought and effort from the BS-FEP Team in preparing this draft BS-FEP, including the extensive scoping process that clearly informs much of the current document. In addition, the SSC appreciates the substantive and important public testimony today, and the public’s participation in the BS-FEP development process.

The general intent of this FEP is to advance Ecosystem Based Fisheries Management (EBFM) within the Council. The BS-FEP is intended to function as a living, strategic document that can provide measurable improvements to fishery management in the Bering Sea by building upon the Council’s current Ecosystem Approach to Management (EAFM). The BS-FEP (Section 3) details goals and specific objectives for the Council’s management of the Bering Sea and provides a framework for the initiation and execution of specific Action Modules. Public involvement, particularly the use of traditional and local knowledge, is forefront in the goals and objectives of the BS-FEP, and also in the Action Modules themselves, with a requirement for a public involvement plan. Five initial Action Modules are presented, and draft working plans for their continued development are included in an appendix.

Overall, the FEP Team has been responsive to the comments provided by the SSC in their April 2017 minutes. Additionally, a series of objectives that directed the development of the BS-FEP and tried to clarify its priorities for the continued incorporation of ecosystem-based fishery management were developed. **The SSC would like to reiterate strongly its support for the development of the Bering Sea FEP** and for continuing to advance EBFM in the North Pacific.

The SSC would like to commend the Team for attempting to move beyond a relatively static, reference document to a document that provides functionality. The document clearly acknowledges that EBFM is an ongoing process without an end. The scoping process was also a great undertaking and deserves recognition for bringing in new stakeholders and constituencies that can contribute to fisheries management in the North Pacific. In particular, the ecosystem workshop in February 2018 was very well received and useful. The document does an excellent job of moving forward the consideration of local knowledge and traditional knowledge (LK and TK) in the Council process, not only by including it formally as an Action Module, but also by reiterating throughout the document how important the inclusion of these forms of knowledge are to the continued implementation of EBFM in the Bering Sea ecosystem. The Bering Sea ecosystem summary in Section 6 was presented at an appropriate level to provide context for the management process without overwhelming the reader in detail. Finally, the SSC would like to note its appreciation of the appendix that detailed the work plans for most of the Action Modules. This appendix clearly conveyed the large amount of thought given to these action modules and to the document in general.

However, the SSC registers concern upon reviewing this draft BS-FEP and does not recommend releasing this initial draft for public review at this time. The primary issue the SSC found with this BS-FEP draft was the scope of the purported impact of the BS-FEP and the unclear role of the BS-FEP team within the existing NPFMC process. The inability to reconcile whether the BS-FEP would be working on tactical, short-term questions or tackling strategic, long-term goals was a key issue for the SSC. Although the document states multiple times that the BS-FEP was designed to build on existing processes, many of the BS-FEP components seem to duplicate other management processes already undertaken by Council components, such as the process to develop and rank Research Priorities, by other committees under the Council umbrella and through Council partnerships. Avoiding duplication of effort is a top priority for the SSC. The BS-FEP should not duplicate the research underpinning the Ecosystem Status Reports and the ESPs, which are making clear progress in continuing to integrate ecosystem knowledge into the management process. **The SSC recommends that the action modules of the BS-FEP focus on strategic issues, such as cross-FMP fishing impact assessments, evaluations of trade-offs in current and alternative management strategies, and the identification of proactive actions that could be taken to avoid irreparable harm.**

To clarify the role of the BS-FEP in the broader context of the NPFMC management process, **the SSC suggests that the role of the BS-FEP team be more strategic and long-term, proactively addressing gaps in management and knowledge, rather than overlapping with existing processes.** The BS-FEP could be a conduit for information that can advance the decision-making capability of the Council, its advisory bodies, and in particular, to the Plan Teams and assessment authors. The SSC believes that this role is more aligned with the current needs within the NPFMC management process and a review of the BS-FEP objectives may be warranted to accomplish this. Additional guidance and feedback from the Ecosystem Committee and the Council would be beneficial in this regard. Moreover, the SSC recommends that there should be shared membership between the BS-FEP PT and the Groundfish, Scallop, and Crab Plan teams, at least at the beginning. This will assist in clearly partitioning strategic and tactical issues to minimize the overlap in the activities of these advisory bodies. Finally, recognizing the fact that the Bering Sea ecosystem does not exist in isolation from the Aleutian Islands, the Gulf of Alaska and communities in the Pacific Northwest, **the SSC suggests that the plan team resulting from this BS-FEP could have a much broader geographical focus than the Bering Sea. Therefore, the SSC recommends that the authors consider the pros and cons of forming a North Pacific FEP Plan Team.**

The Team did a good job of acknowledging the roles of humans in the ecosystem, particularly with respect to LK and TK. This type of information and input can be accommodated through the Council's recent

request to add additional representation and expertise with respect to LK and TK on the newly formed SSPT. The SSC appreciates that document does not relegate this type of work to the SSPT and is attempting to bring in relevant information and stakeholders in this FEP process all along the way. That said, the SSC believes it is important that the FEP team collaborate with the SSPT on human dimensions-related research, both to be responsive to Council Action Modules developed in the BS-FEP, and to utilize the expertise of the SSPT to get more pointed recommendations on how to undertake the work required to achieve the Council objectives, and to prioritize field work. It would be unfortunate to see a disconnect between the two teams or redundancy of effort, given the relatively scarce resources available for social science work.

The primary utility of the BS-FEP, as perceived by the SSC, is in the Action Modules. Conceptually, these modules represent a novel approach to working across FMPs and different components of the ecosystem. The SSC agrees that the primary activity of the BS-FEP would focus on studies targeting strategic issues that would: a) help to inform the NPFMC of the implications of the current harvest strategy on the long-term sustainability of the ecosystem; and b) to identify proactive actions that could be considered by the NPFMC to avoid undesirable ecosystem outcomes associated with a given fishing strategy. Upon reading the working plans, there seems to be a great deal of redundancy with existing processes and effort, and perhaps again, an exercise where these modules are reviewed and re-focused into more strategic, long-term applications would be beneficial before moving forward with any of them. Further, the SSC notes the substantial overlap with the research priorities and its review process, which are mandated at a national level. The connections between these two should be enhanced within the BS-FEP and updated to include the recently implemented top ten list developed by the SSC in June 2018. **The SSC requests an opportunity to review the research design and analytical methods that would be applied in these Action Modules.**

The SSC had many comments and suggestions for improvement and requests an additional initial review, to take place in February 2019, as follows.

1. The presenters and the document emphasized that the BS-FEP is not a regulatory document. Therefore, on Page 10 the phrasing, “guides policy”, should be changed to, “informs policy”.
2. Chapter 7 recognizes that the NPFMC’s management approach already incorporates elements of ecosystem-based fisheries management. The SSC recommends that this section is referenced in Chapter 2 to describe more accurately the baseline for EBFM implementation in the Bering Sea.
3. The SSC recommends that the analysts carefully review the figures. In general, the SSC requests that the authors clarify that information will continue to flow through the NPFMC’s existing scientific review bodies.
 - a. Figure 3-3 and 3-5: The BS-FEP focus on providing real-time data for stock assessments in Figure 3-5 should be changed. The ESR already provides timely delivery of ecosystem information to the Plan Teams and authors. This data stream is a central element of the NPFMC’s FMPs and is now embodied in the developing ESP process.
 - b. Products from the BS-FEP should complement the existing information streams that support the FMP. The ESR informs the assessment of overall ecosystem status and the assessment authors utilize ecosystem data to assess species-specific implications of ecosystem change on the current and future distribution and production of fish, scallops, and crab. The SSC supports an annual workshop. However, we recommend that it be a joint meeting as it primarily contributes to tactical decision making. Both the Plan Teams and the BS-FEP Team need to

be involved. If such a workshop is convened, it should be in late August (before the groundfish assessment authors receive in-year survey data).

c. The SSC recommends that Figure 3-7 be dropped or redrawn. This figure suggests that the BS-FEP will tackle issues pertinent to every element of Council activities. This broad depiction of the research activities of the BS-FEP is not useful to the reader. As noted in Chapter 7, the NPFMC's management system is working well now. The BS-FEP is intended to supplement the existing EAFM approach of the NPFMC by providing cross-FMP research products that inform strategic decision making, as well as informing the medium to long-term implications of current harvest strategies.

d. Figures 6-8 (Map of communities within the BS-FEP ecosystem area) and associated discussion should be revised to illustrate that Bering Sea human networks can be usefully mapped in different ways for different analytic purposes (e.g., CDQ areas to map a particular type of fisheries engagement; ANCSA regions to map other aspects of cultural, socio-political, and economic cohesion; or ADF&G subsistence regions).

i. Importantly, these Bering Sea human networks may extend into adjacent FMP areas and into other states, especially if encompassing communities substantially engaged in, or substantially dependent on, Bering Sea fisheries, per National Standard 8).

ii. Given that TK exists within a cultural context, some of the mapping should illustrate the spatial dimension of various indicators of cultural continuity (e.g., Indigenous language maps) as well as reflect groupings of communities defined by regional residents.

4. The SSC does not understand why there is an Action Module focused on the development of conceptual models of the EBS. The EBS ecosystem is a well-studied, information-rich region. Knowledge of ecosystem linkages is very high in this region, and a number of models have been or are being constructed and tested. Therefore, the SSC questions the utility of focusing energy on depicting conceptual linkages. NMFS, the SSC, and the groundfish Plan Teams are all challenging assessment authors to test the utility of formally (through mechanistic linkages) incorporating ecosystem considerations into their assessments (see recommendations regarding the ESP). If a conceptual modeling Action Module goes forward, the SSC suggests that this Action Module should be refocused on "ecosystem components" (grenadiers, squid, forage fish) that are not well understood.

5. There is also a need to cross-walk the BS-FEP team with groundfish, scallop, and crab PTs with respect to impacts of fishing on habitat. The regulatory requirements for review of EFH focuses on maintaining habitat necessary to sustain fisheries for specific species (an issue best addressed by the Plan Teams). However, assessment of the overall effect of fishing on habitats (living marine structure, benthic epifauna, benthic infauna, etc.) is a synthesis activity that could be considered by the BS-FEP. This illustrates the potential for overlapping tasking if the NPFMC does not carefully scope the activities of the BS-FEP.

6. Regarding the statement "Indigenous communities are distinct from non-Indigenous communities in their longstanding connections to subsistence lifestyle and cultural systems," (Section 6.3.1) the SSC cautions that the TK held by Indigenous populations within communities that have become demographically heterogeneous over time (e.g., Unalaska) should not be overlooked because of their residence in a "non-Indigenous" community.

7. NOAA quantitative indicators of reliance and engagement referenced in the BS-FEP, developed for use across multiple NOAA regions, may have limited utility in the context of small, rural, and/or

Indigenous Alaska communities. The BS-FEP team should coordinate with the SSPT on the application, modification, and/or development of quantitative and/or qualitative social indicators.

C-6 BSAI Halibut Abundance-based Management PSC Limits

The SSC received an overview from the Halibut Working Group of the preliminary review of the BSAI Halibut Abundance-based management of PSC limits. Diana Stram (NPFMC), Carey McGilliard (AFSC), and Jim Ianelli (AFSC) provided a presentation. Public testimony was received from Steve Martell (Sea State Inc.), Gerry Merrigan (Freezer Longline Coalition), John Gauvin (Alaska Seafood Cooperative) and Linda Behnken (ALFA).

The SSC appreciates the large amount of work that has gone into developing this analysis as described in Table 1-1. This includes a workshop, many iterations of discussion papers, and the draft preliminary review in the current document. The SSC was tasked with reviewing and refining draft Alternatives for an initial review draft EIS/RIR that is to be completed in October 2019 (Figure A-1). The review draft provided an overview of the Alternatives and options considered, a description of the simulation model, an overview of migration and recruitment issues, and fishery descriptions. The review draft builds on past discussion papers and workgroup activities.

The preliminary analysis did not provide adequate information from which to refine the alternatives beyond workgroup recommendations. The workgroup suggested revisions (discussed below) were based on technical changes to control rules, and not based on relevancy to the Council objectives and Purpose and Need statement. During SSC discussion, there was general concern about the status of work and timeline for completion.

Since the first discussion paper in 2016, the workgroup has spent considerable time developing control rules and focusing on index development. These are all critical elements in the PSC evaluation, and the workgroup has provided details of these elements (with SSC input) throughout the process. However, development of the simulation model (a focus of this draft) has lagged behind these other critical elements, and there has been limited opportunity for SSC review of the simulation model.

A simulation model is central to the ABM analysis. Tradeoffs can be evaluated by using the model to make predictions about the impacts of the Alternatives on performance metrics that are related to the objectives. The preliminary draft document describes a two-area simulation model, with a good overview of the sensitivities to both recruitment and migration assumptions. However, substantial development work is still required before the model can be used to assess PSC scenarios. Some examples of work include integrating movement rates by age class, characterizing uncertainty associated with movement rates, parametrizing area-specific recruitment and uncertainty, and evaluating size-at-age and natural mortality assumptions. Additionally, the modelling team should consider explicitly separating the probability of capture from the probability of retaining an individual of a given age/size by gear and fishery. The draft document did not provide details on how these issues would be handled.

Proper handling of the model assumptions and further development of the model is a substantial technical lift and will take time to develop. **The SSC is concerned that the October 2019 initial review schedule is too ambitious given the need for development of the two-area model, specification of economic and community models and performance measures, and other analytical needs highlighted below:**

· *Simulation model:* The current alternatives cover a range of control rule scenarios; however, what is missing for preliminary review is the context required to consider how Alternatives align with the Council's Purpose and Need Statement and Objectives. The initial review EIS/RIR should explicitly make these

linkages. The SSC appreciated the retrospective look at the ABM alternatives using previous fishing years but found this exercise of limited value for comparing alternatives owing to the lack of feedback loops between years.

The SSC recommends the next iteration of the analysis put results directly in context with the Purpose and Need statement and Objectives, and provide a description of limitations/assumptions associated with the model, as appropriate.

· *Fishery descriptions:* The SSC appreciates the fishery descriptions as an important starting point for the economic analysis. It directly involves industry in building the narrative understanding of the response processes that will serve as a starting point for modeling of economic and social impacts. It reflects an important recognition of the heterogeneity of the fleets, differences in annual harvest planning and available responses to halibut bycatch policy that may give rise of differences in the costs of halibut avoidance. However, **the SSC notes that the directed halibut fishery is not yet reflected in the analysis and must be included based on the Purpose and Need statement.**

· *Fleet impact workplan:* The June 2018 minutes indicated “The other components of the proposed plan for the October 2018 meeting should proceed as outlined in the discussion paper; moving forward with the initial components of an environmental impact statement and social impact assessment will likely result in additional ideas of what may be needed in the refinement of the outputs of the modeling effort.” This version does not provide sufficient progress on the EIS and social impact assessment components to allow for further refinement of the methods and outcome measures for the SSC to provide guidance.

The SSC recommends the analysts articulate how the economic analysis will be developed from the narrative information that has been collected. This should include a plan for how subfleets will be identified for analysis, and how changes in fleet behavior be mapped into social and community impacts. Importantly, the plan should identify outcome measures that will be modeled to facilitate comparison among ABM alternatives, including average outcomes and interannual variance in outcomes. These choices will be particularly important to understanding potential distributional effects of ABM. **The SSC again requests to review a work plan that includes details on these important elements of the analysis prior to an initial review draft.**

The SSC interprets the currently specified set of alternatives as bookend scenarios intended to provide guidance to the modelers as they develop the simulation tool needed to understand which features of the control rules affect biological, economic or social outcomes. This information will inform further refinement of the alternative set at initial review (given current schedule), and the potential for substantial revisions to alternatives should not be ruled out. Given the lack of analysis and results from applying the current Alternatives, and detail on the simulation model, the SSC finds that further refinement of alternative control rules beyond the workgroup proposals is not supported at this time. The SSC recommends focusing effort on developing the simulation model and demonstrating that ABM is capable of meeting its objectives

under any control rule, rather than further narrowing the policy parameter space without additional information.

Specific Alternative and Model-Related Items

The workgroup had several suggested revisions to the Alternatives in the table on page 13 of the document.

The SSC supported the following revisions to the Alternatives:

- Combining Alternatives 3 and 4: the appendix provides overview showing how these alternatives are equivalent given a slope= 1. The SSC supports combining these Alternatives under the slope=1 scenario;
- Adding Alternative 6: the workgroup recommended adding this alternative given it provides for a smoothed control rule when indices are above and below minimums, which is currently not the situation for Alternatives 3 and 4.
- Moving Element 1: This is not a requirement for formulating the control rule, and is a simplification of the current Alternative set.

The SSC also has model-specific recommendations:

- Include the most up to date information on movement at-age in the simulation model (as staff presented).
- Integrate movement rates by age class,
- Characterize uncertainty associated with movement rates,
- Parametrize area-specific recruitment and uncertainty,
- Evaluate size-at-age and natural mortality assumptions, noting that the 2-5 year old halibut captured as bycatch are already as large as many of the other small flatfish inhabiting the Bering Sea, and that natural mortality may not be substantially higher at younger ages than the rates for those other species.
- Additionally, the modelling team should consider explicitly separating the probability of capture from the probability of retaining an individual of a given age/ size by gear and fishery.

SSC Discussion on Workload

At the conclusion of the meeting, the SSC had a wide-ranging discussion about meeting workloads. Topics discussed included timeliness of receipt of documents prior to meetings, length and focus of staff oral presentations, SSC meeting length, allocation of agenda items among meetings across the year, and urgency to deliver the SSC report on agenda items to the Council before the SSC write-ups on those items are completed.

SSC members reiterated their strong desire to continue to meet as a full SSC and not to split into two bodies as do some other Councils. It was suggested that meeting load could be more evenly distributed throughout the year, recognizing that the meetings when specifications are made for crab (October) and groundfish (December) are particularly busy. It was noted that better screening of agenda items and better allocation of time for agenda items is needed. The possibility of longer meetings was discussed, including the potential need to consider 4-day meetings in October and December. One option was to start on Sunday afternoon, though it was recognized that this could pose problems for staff and public participation. Another option is to run later, for example, through Wednesday afternoon. It was noted that the longer the SSC meeting runs, the greater the overlap with the Council meeting and the more difficult it is to complete work on agenda items before the Council needs to hear the SSC report. A third option that was raised after the SSC discussion is the possibility that the Council could start its meeting one day later. SSC members raised the need to schedule some time slots for report preparation during the SSC meeting, so that the write-up of pressing agenda items can be completed sooner. Options to improve the efficiency of SSC operations may

include assignment of one SSC co-chair for preparation of Council presentation slides or tasking the SSC leads on agenda items to prepare bullets for the SSC chair to go along with their section of the report.

After the conclusion of the SSC meeting, these issues were discussed by the SSC co-chair and Council Chair, Executive Director, and Deputy Director. There was broad recognition of these concerns. Initial actions include a teleconference to better plan the next meeting and scheduling of dedicated time for report preparation during the course of the SSC meeting. The SSC will discuss approaches to improve its internal operations at its December meeting.

**Report of NPFMC SSC Sub-Committee Meeting with AFSC on Trawl Survey
Options and Priorities**

September 10, 2018

AFSC, Building 4

SSC: Gordon Kruse (chair), George Hunt, Dana Hanselman (phone), Anne Hollowed, Dayv Lowry,
Alison Whitman (phone)

NPFMC staff: Diana Evans (phone)

AFSC: Stan Kotwicki, Jeremy Rusin, Stephani Zador, Michael Martin, Maggie Mooney-Seus

Public: Craig Cross, Ron Feeney, Susan Robinson, Mark Fina

At the June 2018 Council meeting in Kodiak, Mr. Jeremy Rusin, Acting Science and Research Director for the AFSC, briefed the SSC regarding the FY19 budget. At that time, it appeared that sufficient funding would not be available to fully support the typical five vessels for trawl surveys in the Alaska region, which inform stock assessments for many groundfish and BSAI crab stocks. Funding was projected to be available for only four vessels: two on the Bering Sea shelf, and two in the Gulf of Alaska. There was also a substantial chance that only three vessels would be supported. Contracting issues, the increasing cost of rent for AFSC facilities in Sand Point, and uncertainty with regard to the final FY19 budget were identified as root causes for this potential reduction in survey effort. Mr. Rusin requested that a sub-committee of the SSC be established to meet with AFSC staff and develop recommendations for actions in FY19, and beyond, to minimize the impact of survey reductions on long-term abundance time series and the collection of biological samples used for stock assessment.

On September 10th an SSC sub-committee made up of Gordon Kruse, Anne Hollowed, George Hunt, Alison Whitman, Dayv Lowry, and Dana Hanselman met with NMFS staff at the AFSC in Seattle. Center staff in attendance included Jeremy Rusin, Stan Kotwicki, Michael Martin, Stephani Zador, and Maggie Mooney-Seus. AFSC staff provided a background document for the meeting (Appendix 1), and gave a presentation (Appendix 2). The meeting opened with a general discussion of the value of trawl surveys and their importance to management. It was noted that these surveys have been identified in the Council's research priorities as Critical Ongoing Monitoring, and, as such, are considered to be the highest priority level for the NPFMC. These priorities create and maintain indispensable data that substantially contribute to our understanding and management of fish populations, fisheries, and the communities dependent upon those fisheries. Discontinuation or diminishment of the research that provides these datasets would leave a significant gap in the science needed to support sustainable and successful fisheries management in the North Pacific. Recent rapid changes in environmental conditions and fish abundance and distribution in response to the marine heat wave accentuate the need to maintain current effort levels, if not *increase* them. Evidence of spatial shifts to the northern Bering Sea in warm conditions raises the question of whether this is a new phenomenon or has occurred in the past, without being previously observed due to limited survey coverage north and west of the standard EBS shelf trawl survey. In addition, a time series is needed to understand the importance of transboundary regions to harvested stocks, and international cooperation with Russian and Canadian managers will be critical for ensuring adequate sample coverage for the entire distributions of stocks.

Next, Mr. Rusin provided an update on the funding outlook for FY19, which has improved since June. The slope survey did not occur in FY18 due to contracting difficulties, and these funds will be carried over to support survey work in FY19. Projected facility costs for the AFSC are also estimated to stay stable in FY19, rather than increasing as originally anticipated. Vacant job positions and other minor cost savings have also been realized, further shoring up FY19 funding. Finally, \$700K of temporary funding from the Office of Science and Technology was provided to the Center to support at-sea sampling efforts. All of these factors combined to mean that in FY19 the AFSC will almost certainly be able to afford four survey vessels. However, under a one-year ahead funding strategy, funding a fifth vessel in FY19 could compromise the ability to fund a fourth vessel in FY20. Members of the SSC sub-committee indicated that a minimum of four vessels is critical, and that dramatically impacting FY20 to maximize vessels in FY19 is not advisable.

Sub-committee members noted that fully funding five vessels in each fiscal year is the status quo, and that current research needs indicate *more* sampling is needed rather than less. While members were relieved to hear that the budget picture had improved, they found it troubling that obtaining even this reduced level of support required a series of events that are unlikely to be repeated in future years. A reliable and stable funding source is needed to fully fund these Critical Ongoing Monitoring activities. The SSC sub-committee notes that reducing these funds could compromise long-term data series and introduce additional uncertainty into stock assessments. At current cost levels, the funding required to annually cover surveys in three regions of the Bering Sea (shelf, slope, and northern), the Aleutian Islands, and the Gulf of Alaska is \$5.3-6.1M – though different regions are sampled in odd and even years. Given the value of Alaskan fisheries to the economy and food security of the nation, and the relatively small cost of surveys relative to the value of these fisheries, securing a stable source of funding should be a national priority.

The NPFMC enjoys an excellent track record with regard to stock assessment throughput and sustainable management of the valuable fisheries off the coast of Alaska. A high priority should be placed on maintaining current funding to ensure continuation of surveys to continue this high level of performance. A thorough evaluation should also be performed to determine the impacts of reducing sample size during surveys, including dropping depth strata (as has been frequently done in the Gulf of Alaska), before modifications to the standing survey schedule are implemented.

The SSC sub-committee noted that changes in the frequency or station density of AFSC trawl surveys could impact several NPFMC management decisions. The NPFMC's recent adoption of stock assessment priorities was based on an analysis that aligned stock assessment frequency to the current survey frequency. If this frequency is changed, decisions regarding stock assessment priorities would have to be revisited. In addition, it is possible that a reduction in survey frequency or station density could lead to tier changes for some stocks in Tiers 1-5 (for groundfish). Stocks managed in these Tiers require a "reliable biomass estimate," and biomass estimates derived from stock assessments that utilize infrequent, and/or uncertain, survey biomass estimates may be deemed insufficient to meet this standard. It should also be noted that, the NPFMC is considering alternatives under consideration for abundance-based management of Pacific halibut bycatch caps that would rely on annual EBS trawl surveys.

Stan Kotwicki noted that four research projects were recently started that could provide helpful information for deciding which surveys impart the greatest benefit. Specifically, these studies will: 1) derive model-

based estimates of abundance for key species using subsets of existing data, essentially mimicking reductions in survey frequency; 2) statistically evaluate thinning of samples on a systematic basis; and 3) develop spatial temporal models (e.g., VAST) for the Gulf of Alaska, Bering Sea, and Aleutian Islands. Longevity, recruitment variability, patchiness, growth rates, and other life history characteristics will need to be considered when looking at individual stocks. **Until results from such studies are available, the SSC sub-committee lacks the ability to objectively defend why a specific level of survey frequency and sampling density is needed. The SSC sub-committee strongly recommends maintaining current levels of survey effort until the analyses are completed.**

Recent monitoring of oceanographic and biological parameters indicate that unprecedented ecological conditions are currently being observed, especially on the Bering Sea shelf and in the northern Bering Sea. If survey frequency were to be reduced, it is possible that rapid changes in fish abundance in response to these conditions could be missed. If the underlying ecosystem state is rapidly changing, it is important to document how the system is changing to assess whether the underlying assumptions of the models are still reliable. A national climate assessment is just being released, which will contain information on the rate of climate change in Alaska and the Arctic. **The SSC sub-committee recommends that the findings of this climate assessment are considered as an additional rationale for maintaining the current status quo of at least five ships annually.**

Responses to Questions:

A series of questions were provided to focus discussion and prioritize input from the sub-committee. The sub-committee noted that these surveys are explicitly multispecies, and there are important stocks to be considered beyond pollock and Pacific cod. These include rockfish, flatfish and crabs, among others. The surveys obtain not only data on abundance and distribution of fished stocks, but also the specimens needed for age composition, weight-at-age, and other metrics used in assessment models. The surveys also provide important information on the ecosystem, including environmental conditions, and provide a platform for investigations of food habits and other additional research on target species.

In attempting to answer the questions below, the sub-committee questioned whether the goal of a limited set of surveys would be to maximize accuracy, or to minimize the likelihood of missing a significant change in a stock. Skipping years may allow for funding of better coverage within a year, but leaves the Council vulnerable to missing a major change in a stock, such as the sudden decrease in the Gulf of Alaska Pacific cod stock, or the apparent sudden shift of Pacific cod and pollock into the northern Bering Sea. With climate change and warming occurring much faster than initially expected, recent experience supports the notion that frequent surveys may be the only way to monitor the impacts of these events on fish stocks. **The sub-committee did not have an answer to the question of maximizing accuracy or minimizing risk of disaster, but felt that it should be addressed in the justification of whatever survey schedule evolves.**

Question 1. What are the ranked order of priorities for our present suite of bottom trawl surveys: the eastern Bering Sea shelf, eastern Bering Sea slope, northern Bering Sea shelf, Gulf of Alaska, and Aleutian Islands?

Response:

The sub-committee suggested the following priority list: 1) eastern Bering Sea shelf; 2) Gulf of Alaska; 3) Aleutian Islands; 4) northern Bering Sea; and 5) Bering Sea slope.

All of these surveys are of critical importance to the management of fish stocks in the federal waters off Alaska. That said, it may be possible to reduce the frequency of some surveys, though at the potential cost of increased uncertainty. Recent experience in the Gulf of Alaska and the Bering Sea has shown that very large changes in the biomass or distribution of large, highly-valued stocks can take place in a short time. Failure to detect and respond to large, rapid changes could lead to overfishing or foregone yield.

Rationale:

Based on the monetary importance of the fisheries, the eastern Bering Sea shelf was seen as a top priority, followed by the Gulf of Alaska, and then the Aleutian Islands. While the dollar value of the fisheries in the GOA and AI are not as high as the EBS fisheries, many communities are dependent on the fisheries in those regions. These two surveys support a number of commercially and ecologically important stock assessments (e.g., GOA and AI POP, GOA pollock, and BSAI Atka mackerel). The northern Bering Sea shelf survey was seen as more important than the slope survey because of the issues pertaining to the connection between the biomass of pollock and Pacific cod in the northern and southern portions of the Bering Sea shelf. However, the SSC sub-committee recognizes that data from the northern Bering Sea surveys were only recently considered within assessments for these stocks. The EBS slope survey is used in several assessments and there was concern that some stocks, such as Greenland turbot that are below target reference points, rely on the EBS slope survey. Stocks in poor condition need to be regularly monitored so that fishing effort can be appropriately adjusted.

If large portions of the eastern Bering Sea pollock and Pacific cod stocks continue to occupy the northern Bering Sea, the survey of that area will rise in priority. If the northern segments of Pacific cod and pollock populations are contributing to the overall production of eastern Bering Sea pollock and Pacific cod, then it will be essential to determine the environmental factors governing movement into the northern Bering Sea. Time series of reliable biomass estimates and assessments of fish condition will be needed to estimate environmentally linked movement and growth parameters. Therefore, the SSC sub-committee concludes that it is critical to develop time series (10 – 12 years) of trawl surveys for these northern components. In addition, it is possible that the northern components of these stocks may be impacted by: 1) interannually varying exposure to fishing mortality due to fish captured in Russian waters; 2) interannually varying emigration into the Chukchi Sea; and 3) higher over-winter mortality from freezing in cold winters if northern stocks don't migrate south in the fall. Thus, if planned surveys in the next few years find that the northern components of Pacific cod and pollock stocks remain large, it will be critical to conduct surveys in the north if optimal exploitation of their overall eastern Bering Sea populations are to be maintained.

Question 2. If the Center has four, rather than five charter vessels on contract in FY19, we propose to put two vessels on the eastern Bering Sea shelf and two in the Gulf of Alaska. If additional funds are available, then these will be used to support a northern Bering Sea survey. Do you agree?

Response:

For all of the reasons noted in Question 1, the SSC sub-committee agrees with the plan put forward by the AFSC. If sufficient resources are available, the sub-committee recommends conducting as complete a survey as possible in the northern Bering Sea.

The sub-committee was relieved that the Center has a reasonable prospect to have four vessels available for surveys in FY19, although dependence on the present sources of funds for these surveys is not sustainable in the long run.

Rationale:

Although the Bering Sea slope survey scheduled for 2018 had to be canceled, given the other priorities for surveys in 2019 and the relatively stable stocks on the slope, it was agreed that a slope survey could be postponed until 2020, when the next slope survey was scheduled. The sub-committee was clear that further postponement of the slope survey beyond 2020 would not be wise given the somewhat diminished state of the Greenland turbot stock there.

The possibilities of using only one vessel in the Gulf of Alaska was discussed. There were safety concerns about a single vessel operating in isolation. Moreover, it was agreed that the station density or areal coverage under a one-boat scenario would be so thin that the results would be unreliable for stock assessment. A Gulf survey with only two vessels is already a reduction from the standard three-vessel surveys and will result in less precise estimates and perhaps some deeper depth strata going unsampled. Thus, the expected reduction of survey effort from five vessels to four vessels, as planned, still has serious implications for the required stock assessments.

The use of only a single vessel was considered for the Aleutians, but, again, safety concerns about having a single vessel operating in isolation caused that possibility to be rejected. Safety concerns are heightened in the Aleutians.

Question 3. Given the answer to Question #2, which surveys should we prioritize for FY20 under a four-boat scenario?

Response:

The SSC sub-committee was reluctant to answer this question until more information on the consequences of changing survey frequency or decreasing sample density in time or space became available. The sub-committee also additionally noted the fluidity of the funding situation between now and 2020.

Rationale:

As noted above, the SSC sub-committee was informed of a number of analytical projects that are funded and underway to examine how changing the frequency of surveys or the density of stations within surveys would affect the variance of stock estimates. These studies should provide information necessary to make more informed decisions about how altering the present design of surveys might affect stock assessments, and thus waiting for their results seems prudent.

That said, the eastern Bering Sea shelf survey (two boats) would remain the top priority for FY20, and the Bering Sea slope survey (one boat) would need to be on the schedule. The Gulf of Alaska would not be a priority, given what we know now, as it would normally be off-schedule in an “even” year. It was noted that Aleutian Islands’ survey, due in FY20, needs two boats because of safety reasons. Together, this set of surveys will need five boats. Depending on what we learn in 2018 and 2019, there may also be a need for a northern Bering Sea survey (one boat).

Question 4. If the Center is only able to fund 3 charter vessels in FY19, which survey(s) should we attempt?

Response:

The sub-committee was glad to hear that four vessels are likely to be available in FY19 so that an answer to this question may not be necessary. With only three vessels, the least bad option seem to be to pick either the EBS or the GOA and do a very thorough survey in one region only. Another alternative would be to change the survey frequency to triennial, although this time step proved to be problematic in the past in the GOA and AI. If the focus was the eastern Bering Sea, it might be possible to conduct a survey of the northern Bering Sea as well with the third vessel. If the Gulf is the focus, it might be useful to conduct a full 3-boat survey there or an eastern Bering Sea slope survey might be possible. There is no good choice between the eastern Bering Sea shelf and the Gulf of Alaska surveys. The sub-committee very reluctantly supported the option of surveying the Gulf of Alaska with two boats and the Bering Sea slope with one boat under this hypothetical scenario.

Rationale:

The Gulf of Alaska and the eastern Bering Sea have major fish stocks that are experiencing unusual mortality (GOA Pacific cod) and/or major movements that have not been observed before (Pacific cod and pollock in the eastern Bering Sea). Additionally, in the eastern Bering Sea, there are three crab stocks all of which need annual assessments to avoid overfishing. If the Gulf of Alaska or the eastern Bering Sea were not both surveyed in 2019, it would dramatically impact assessment quality and index reliability in these critically important regions.

If the Gulf of Alaska was not surveyed in 2019 but conducted two years later, it would mean a break of four years in the time series. With Pacific cod down severely in the Gulf and getting close to B20 and the closure of the fishery to protect sea lions, a strongly precautionary approach would be required. Likewise, with both pollock and Pacific cod missing from the southeastern Bering Sea, and the failure to have a strong pollock recruitment since the 2014 year-class, there needs to be concern about running into the B20 limit on pollock fishing in the Bering Sea and Aleutian Islands because of sea lion protective measures. However, in view of the recent survey of the eastern Bering Sea in 2018, the survey of the Gulf of Alaska may be the greater priority.

Question 5. Given the answer to Question #4, which surveys should we attempt in FY20 under a three boat scenario?

Response:

Similar to Question 3, the sub-committee felt that it was unable to answer this question with the available information.

Rationale

The sub-committee understood the need to give the best advice possible for FY19, as finalizing planning and contract negotiations cannot be put off. The sub-committee looks forward to the provision of the results of the ongoing efforts to assess the implications of decreasing the present level of spatial and temporal resolution in the survey program.

Additional items:

Given the importance of these ongoing research projects, the sub-committee requests a presentation at the North Pacific FMC meeting in February 2019 on progress/results of the three research projects outlined by Stan Kotwicki. The sub-committee also encourages the AFSC to investigate the implications of survey reduction using an MSE-based approach. In any of the discussions of reducing the spatial density of survey effort, it should be remembered that the areas to be covered are extremely large (the area of the EBS shelf is about the same as the areas of the states of California and Oregon, combined), and increasing the distance between stations may not result in significant cost savings because of the added transit times between stations.

If NOAA is unable to provide sufficient funds for at least four boats annually, it may be necessary to examine ALL field and laboratory activities to assess their contributions to the basic requirement of providing assessments of fish stocks to the North Pacific Fishery Management Council. The sub-committee recognizes that the basic science will promote more robust management in the long run, but if the survey program falters, high quality assessments may not be possible. The sub-committee felt it was not in its remit to go into the ranking of projects and surveys specifically, but the sub-committee feels that the AFSC may need to have a broader programmatic view of where cuts happen.

Appendix 1: AFSC background document and terms of reference for AFSC-SSC Working Group, provided in advance of September 10 2018 meeting

FY19 & FY20 Survey Priorities: Three & Four Boat Scenarios

Basic Assumptions:

- Bottom trawl surveys are multi-species surveys and should continue to be so.
- Continuation of standard survey coverage requires five boats.
- In the absence of information on survey impact, it is critical to complete the entire eastern Bering sea shelf survey without eliminating stations or increasing the distance between stations.
- Present multi-species assessments require the entire geographic extent of the Bering Sea slope, Gulf of Alaska and the Aleutian Islands survey area. The only options available to cut these surveys involve removing depth strata and/or occupying fewer stations in each stratum.
- Current assessments assume that either our present surveys encompass entire spatial extent of the fish populations (Tier 5 assessments), or that the fraction of the fish population remains constant within the survey area. Neither of these assumptions are met for some important commercial species. To meet these assumptions in the Bering Sea, it is necessary to conduct the NBS survey. However, without knowledge of the movement of fish across the international border with Russia, our survey may still not meet the basic assumption. Initiating cooperation with Russia (for the Bering Sea) and Canada (for the Gulf of Alaska) to address the movement question is advised.
- The FY19 three boat scenario discussed with the Council does not include the summer and winter GoA acoustic-trawl surveys for pollock/rockfish. We assume these surveys will proceed as planned, although the Shumagin survey may be delayed due to dry dock maintenance and repairs scheduled for winter 2018/2019.

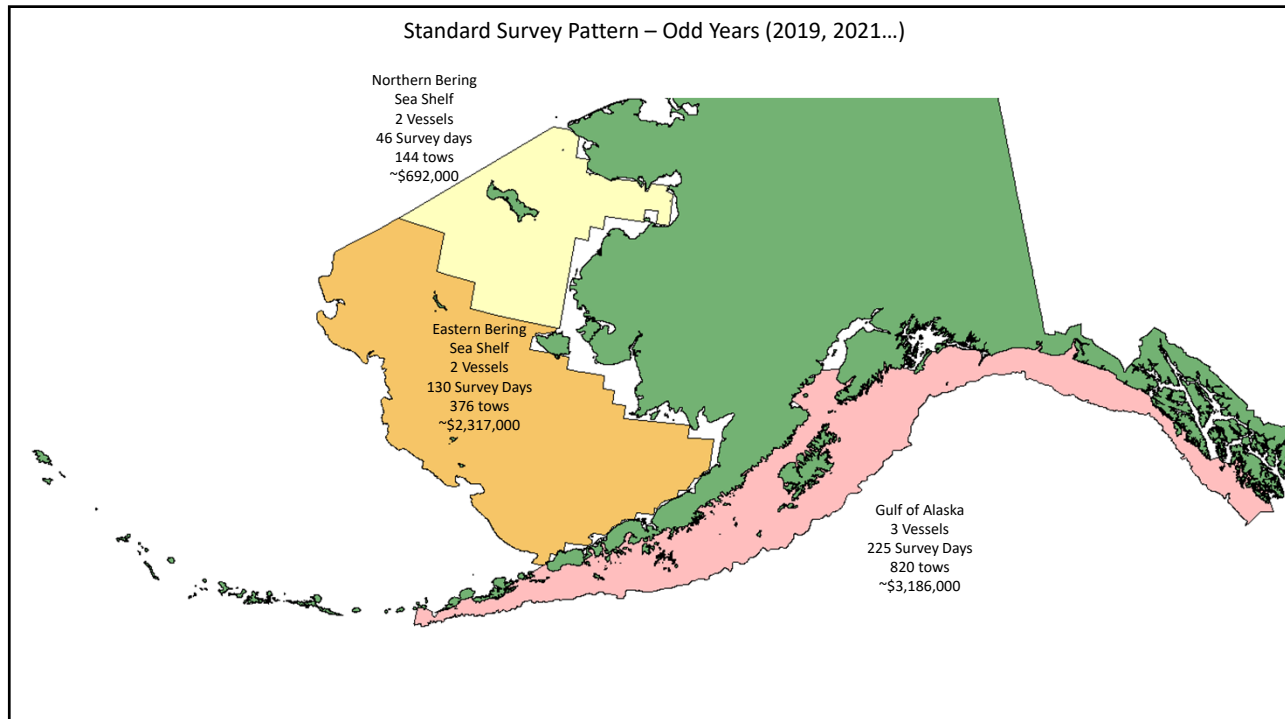
“Terms of Reference”

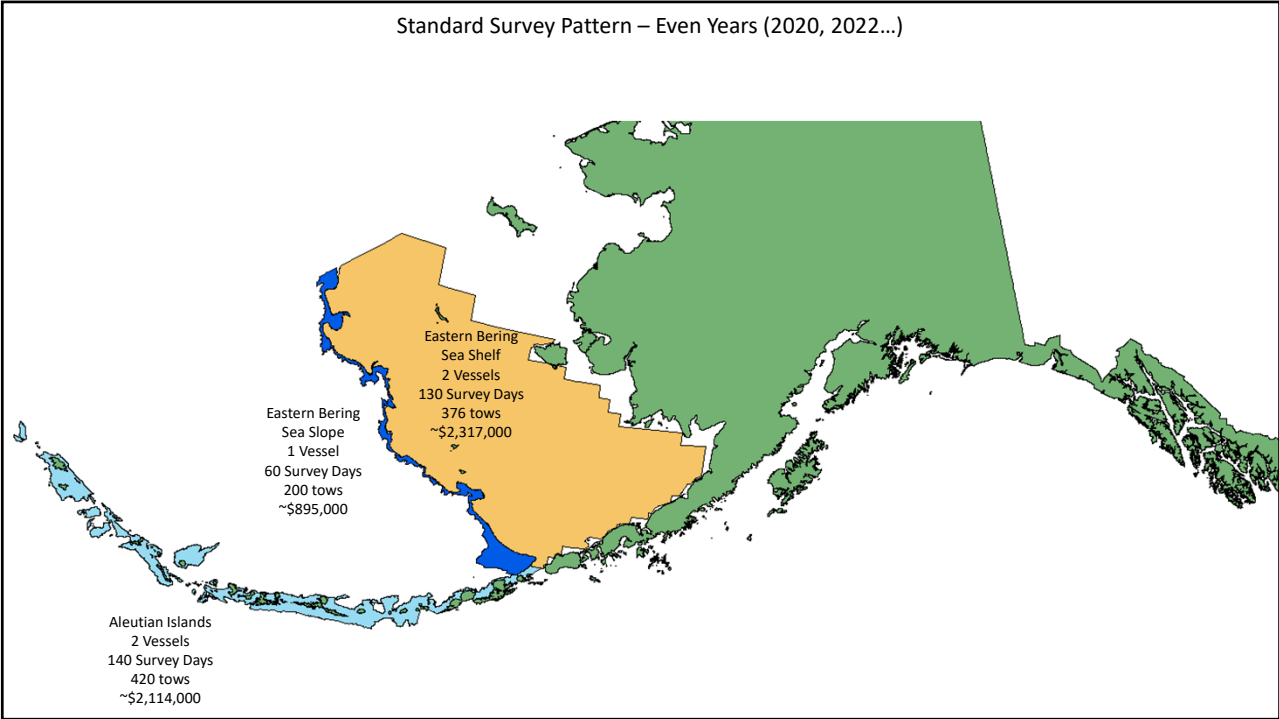
The questions we would ask you to address are:

1. What are the ranked order of priorities for our present suite of bottom trawl surveys: the eastern Bering Sea shelf, eastern Bering Sea slope, northern Bering Sea shelf, Gulf of Alaska, and Aleutian Islands?
2. If the Center has four, rather than five charter vessels on contract in FY19, we propose to put two vessels on the eastern Bering Sea shelf and two in the Gulf of Alaska. If additional funds are available, then these will be used to support a northern Bering Sea survey. Do you agree?
3. Given the answer to Question #2, which surveys should we prioritize for FY20 under a four-boat scenario?
4. If the Center is only able to fund 3 charter vessels in FY19, which survey(s) should we attempt?
 - a. Eastern Bering Sea shelf (2 boats) + slope (1 boat)
 - b. Gulf of Alaska (all three boats)
 - c. Gulf of Alaska (2 boats) + eastern Bering Sea slope (1 boat)
5. Given the answer to Question #4, which surveys should we attempt for FY20 under a three boat scenario?

Questions

1. What are the ranked order of priorities for our present suite of bottom trawl surveys: the eastern Bering Sea shelf, eastern Bering Sea slope, northern Bering Sea shelf, Gulf of Alaska, and Aleutian Islands?
2. If the Center has four, rather than five charter vessels on contract in FY19, we propose to put two vessels on the eastern Bering Sea shelf and two in the Gulf of Alaska. If additional funds are available, then these will be used to support a northern Bering Sea survey. Do you agree?
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5. Given the answer to Question #4, which surveys should we attempt in FY20 under a three boat scenario?





Survey Costs by Year

Odd year Costs (2019, 2021...)	
Eastern Bering Sea Shelf	~\$2,317,000
Northern Bering Sea Shelf	~\$692,000
Gulf of Alaska	<u>~\$3,186,000</u>
TOTAL	~\$6,195,000
Even Year Costs (2020, 2022...)	
Eastern Bering Sea Shelf	~\$2,317,000
Eastern Bering Sea Slope	~\$895,000
Aleutian Islands	<u>~\$2,114,000</u>
TOTAL	~\$5,326,000

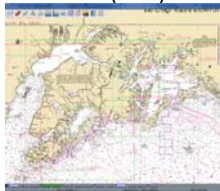
Most Abundant Commercial Species by Survey Area

Survey	Year	Most Abundant Commercial Species	Biomass (mt)
Eastern Bering Sea Shelf	2018	walleye pollock	3,143,381
		yellowfin sole	1,964,687
		northern rock sole	1,064,719
		Pacific cod	521,182
		flathead sole	503,575
Eastern Bering Sea Slope	2016	POP	357,000
		walleye pollock	116,000
		shortspine thornyhead	35,900
		Greenland turbot	23,600
		flathead sole	19,300
Northern Bering Sea Shelf	2017	walleye pollock	1,315,374
		yellowfin sole	426,117
		Alaska plaice	324,264
		Pacific cod	283,479
		snow crab	230,785
Gulf of Alaska	2017	POP	1,570,359
		walleye pollock	315,116
		Pacific halibut	298,407
		flathead sole	236,588
		northern rockfish	150,326
Aleutian Islands	2016	POP	982,503
		Atka mackerel	448,166
		northern rockfish	253,217
		Pacific cod	95,734
		walleye pollock	93,117

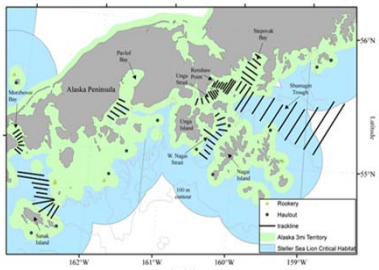
Acoustic – Trawl Surveys
 (Odd Years)

Winter Surveys

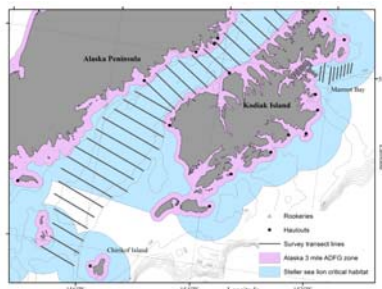
Kenai (GoA)



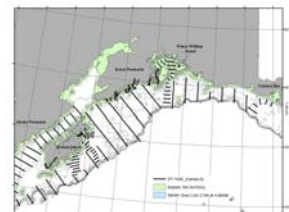
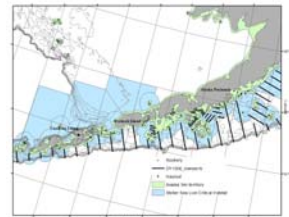
Shumagin (GoA)



Shelikof Strait (GoA)



Summer Gulf of Alaska Survey



Acoustic – Trawl Surveys (Even Years)

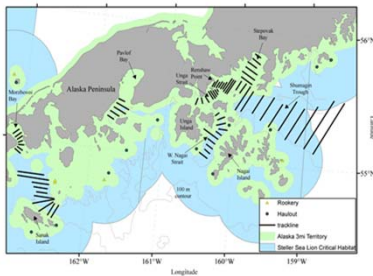


Winter Surveys

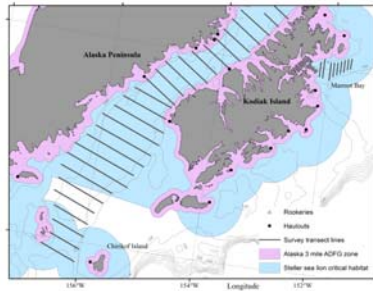
Bogoslof (EBS)



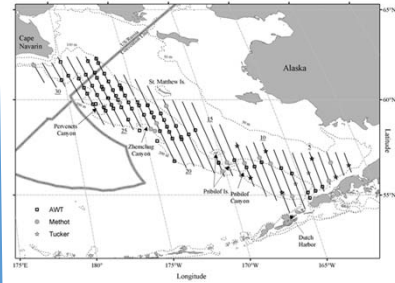
Shumagin (GoA)



Shelikof Strait (GoA)



Summer Eastern Bering Sea Survey



Questions

1. What are the ranked order of priorities for our present suite of bottom trawl surveys: the eastern Bering Sea shelf, eastern Bering Sea slope, northern Bering Sea shelf, Gulf of Alaska, and Aleutian Islands?
2. If the Center has four, rather than five charter vessels on contract in FY19, we propose to put two vessels on the eastern Bering Sea shelf and two in the Gulf of Alaska. If additional funds are available, then these will be used to support a northern Bering Sea survey. Do you agree?
3. Given the answer to Question #2, which surveys should we prioritize for FY20 under a four-boat scenario?
4. If the Center is only able to fund 3 charter vessels in FY19, which survey(s) should we attempt?
5. Given the answer to Question #4, which surveys should we attempt in FY20 under a three boat scenario?