North Pacific Fishery Management Council

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SCIENTIFIC AND STATISTICAL COMMITTEE
FINAL REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
January 31st – February 4th, 2022

The SSC met remotely from January 31st to February 4th, 2022.
Members present were:

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

SSC Election of Officers

The SSC re-elected Sherri Dressel (ADF&G) and elected Franz Mueter (University of Alaska Fairbanks) to serve as co-chairs for 2022. The SSC also re-elected Alison Whitman (ODFW) to serve as vice chair.

General SSC Comments

The SSC extends a warm welcome to new members Dr. Kailin Kroetz (Arizona State University) and Dr. Robert Foy (AFSC). The SSC is grateful for their offering of time and expertise and the SSC is appreciative to the Council for their appointments.

SSC Administrative Discussion

SSC Handbook

The SSC reviewed proposed changes to the SSC handbook. The SSC thanks Council staff for their work to continually update and revise the SSC handbook. Significant proposed revisions presented to the SSC included language added to clarify when SSC members should recuse themselves (pg. 4) and updated links

in the reference section (pg. 14). **The SSC is supportive of these changes and additions.**

As the Statement of Organization, Practices, and Procedures for the North Pacific Fishery Management Council (Council SOPPs), cited in Section 3 of the SSC handbook (pg. 4), has not been updated since February 2021, **the SSC refers to its recommendation from February 2021 regarding the description of SSC membership**. Specifically, the SSC suggests changing "sociology" to "anthropology/sociology" to reflect both the accepted distinction among social scientists between an economic and non-economic focus and the particular value of anthropological methodologies and perspectives for SSC review of community/social impact assessments and work related to the Council's stated commitment to the incorporation of local and/or traditional knowledge (LK/TK) to the Council process.

Reflection on Council process and ideas for change

The SSC reviewed the staff discussion paper, "Reflections on Council process and ideas for change" and noted some initial thoughts for Council consideration (sections not listed had no SSC discussion). Ideas noted below included support by one or more SSC members but do not represent SSC consensus:

1. Reduce the number of annual Council meetings from 5 to 4, and drop the February meeting

SSC members acknowledged and agreed with the difficulty in planning and addressing Council topics with the short turnaround time between the December and February meetings. A number of SSC members expressed support for reducing the number of annual meetings from five to four, even if the four in-person meetings were four days instead of three. Even if the number of meetings is reduced, some SSC members expressed support for continuing to have an SSC workshop (normally scheduled in February), since it is a valuable opportunity for the SSC to do proactive and strategic thinking. Some SSC members expressed concern over being able to cover the current SSC workload in four meetings. Some SSC members noted that there are bigger projects and longer-term issues for which there has not been sufficient time even with five meetings. If the workload stays the same, some SSC members recommended continuing with five meetings due to the time-sensitive nature of issues, the increased preparation prior to the meeting within the same amount of time, and concern over making the remaining meetings longer than they are.

2. Create a schedule that makes 1-2 meetings per year virtual and the remaining meetings in-person

SSC members did not speak directly to whether one to two meetings per year should be virtual and the remaining in-person, nor to which meetings would be most important to have in person. SSC members did, however, note the value of in-person meetings, which includes fuller conversations, ability to talk amongst SSC members outside of the meeting, ability for SSC members to talk with the public, industry and NGO representatives outside of the meeting, and the loss of that value during virtual meetings. An SSC member also noted that given the high SSC workload, allowing a virtual option for members that could not attend in person would allow additional expertise to be included in the meeting and a greater distribution of workload.

4. Change the timing of the October meeting to avoid government shutdowns

SSC members noted a desire to avoid the impacts of holding a meeting during a time of potential or realized government shutdown. They noted the excessive time required to develop and operate under multiple schedules in an effort to continue meetings under the possibility or reality of government shutdowns. SSC members also questioned whether such excessive efforts should be made in an attempt to do an impossible job or whether the consequences of a government shutdown (inability to either continue or reschedule meetings if a shutdown occurs) should instead be accepted as reality.

5. Reevaluate the timing of crab and groundfish harvest specifications in light of fishery needs and stock prioritization

SSC members supported reevaluating the timing of crab and groundfish harvest specifications due to (1) the tight turnaround for authors between surveys and specifications (particularly for crab), (2) the inability to include some data sources (NBS) and some modeling efforts (e.g., VAST) for crab stocks (e.g., snow crab in 2021), (3) the challenges of obtaining reasonable model runs in short amounts of time if data input values exhibit extreme changes, (4) the tight turnaround for authors between Plan Team/SSC review of groundfish model runs in October and final specifications in December, (5) the excessive workload of authors and review bodies in the fall that is exacerbated by the timing, and (6) limited meeting time to address the high numbers of stock reviews and how that impacts the quality of review. One idea for streamlining specifications that was introduced for exploration by SSC members was to consolidate preliminary model reviews for groundfish into the June or earlier SSC meeting. This could ease the burden on groundfish authors and allow them more time to explore new data and new model options between preliminary model runs and final specifications in December. It might allow more time for SSC review and reduce the SSC review burden in October, as that meeting is heavily focused on final specifications for crab. This would require moving the September Groundfish Plan Team meeting earlier (e.g., April/May).

12. Changes to the nomination/reappointment process for the SSC – timing, recruitment, soliciting SSC input

SSC members indicated support for being able to contribute recommendations to the Council as to areas of expertise needed, as has been done in previous SSC reports.

13. Consider how to reduce SSC workload

SSC members appreciated the consideration of the SSC workload. Some SSC members suggested that one way to reduce the workload would be to limit non-action items. Other SSC members felt that updates on projects in development (e.g., ACLIM), updates on factors that affect fisheries management (e.g., marine mammal and seabird updates) and updates that inform recommendations and harvest specifications (e.g., Ecosystem Status Reports) are critical. One suggestion was to bundle informational topics into one meeting that does not require an SSC report.

Some SSC members suggested reducing the rigor of Plan Team and SSC peer review of assessments and suggested that these reviews occur external to the Council process, such as with more CIE reviews. That way the SSC could focus on strategic discussions and setting OFLs and ABCs, rather than assessment review. Other SSC members were concerned to reduce the SSC's focus on peer review, noting the value of the timeliness of analysis review, the institutional knowledge provided by the Plan Teams and SSC, and the public transparency and communication of the reasons for SSC recommendations.

B-1 Plan Team Nomination

The SSC reviewed the nomination of Danielle Dickson (NPRB) to the Bering Sea Fishery Ecosystem Plan Team. The SSC finds Ms. Dickson to be well qualified and recommends that the Council approve her nomination.

C-1 Economic Data Report Amendments

The SSC received a presentation from Scott Miller (AKRO) and Brian Garber-Yonts (AFSC). Written public testimony was received from Julie Bonney and Heather Mann (Alaska Groundfish Data Bank and Midwater Trawlers Cooperative, respectively). Oral public testimony was received by Mark Fina (US Seafoods) and Chris Woodley (Groundfish Forum).

The SSC appreciates the analysts' efforts to characterize the effects of the proposed changes to the economic data report (EDR) process, and to respond to the impacts of the Alternative 3, which was introduced since this document was last reviewed by the SSC.

The four EDRs in the North Pacific were developed during the implementation of, or consideration of implementation of, catch share programs. Some of the data fields have proven costly to collect and audit and ultimately have been shown to be unresponsive to the original purpose and need. Absent an effective process of updating the EDR forms as catch share program effects have evolved post-implementation and the nature of those effects and how best to capture them has become more clear, the SSC recognizes the difficulty and shares the frustration with streamlining the EDR process. **The SSC is supportive of efforts to increase the efficiency and utility of the EDRs, as some – but not all -- EDR data fields continue to support the Council in science-based management in pursuit of National Standards 1 and 8 and in compliance with National Standard 2.** However, the SSC notes that, even in their current form, estimates of burden to both NMFS and industry remain a very small component of the cost of all data programs when considered among the observer program and fishery-independent surveys.

As this analysis includes new alternatives at Final Action, the SSC discussion highlights aspects for the Council to consider in weighing options.

Third-Party Audits

The SSC finds the analysis provides sufficient information for the Council to determine whether third party audits are necessary: Audits are costly; they have been discontinued in practice; they have never found a violation; and audits are not standard in similar data collections in other regions.

Confidentiality Requirements

The SSC finds the analysis provides sufficient information for the Council to determine whether elevated confidentiality measures are necessary: Such measures are costly; they significantly constrain the utility of the data; and elevated measures are not standard in similar data collections in other regions.

Reduced Collection Frequency

The SSC discussed both the cost savings and consequences of reducing the frequency of EDR collection raised in the analysis:

- The SSC notes that the analysis bases its estimate of the cost savings from reducing the frequency of data collection on the OMB estimate of the amount of time it takes to fill out the forms, such that skipping every other year reduces costs by half. **The SSC expects this significantly overstates the cost savings from a frequency reduction.** Reducing the frequency of collections would likely erode the processes both at NMFS and among EDR respondents that streamline data collection. Further, individuals would likely lose facility and understanding of EDR definitions and conventions. Together, these likely outcomes would significantly increase the time required to respond in years when data is collected. These effects would considerably, though perhaps not

completely, offset the time savings in nonreporting years.

- **The SSC notes that reducing the frequency of EDR data collection will result in a reduction in the best scientific information available on social and economic conditions** required for inclusion in SAFEs under National Standard 2 and in documenting sustained participation of fishing communities under National Standard 8**.** This loss of data will be particularly acute in instances where analysts must try to understand the social and economic effects of annual-scale events in markets or the ecosystem. Recent examples include understanding the effects of COVID or of differences between warm and cold years.

- **The SSC notes that there would be considerable costs in terms of additional analyses required if gaps were created in annual time series of EDR variables.** Uses of EDR data include incorporation into annually produced reports such as Economic SAFEs, and key indicator values currently tracked will need to be omitted or estimates will need to be developed. Estimates of these key indicators will require new models to interpolate between missing years or extrapolate to a present nonreporting year, which will entail additional costs. Furthermore, because these estimates will be replacing values from a full population survey, data quality will be reduced.

Remove EDR Requirements

The SSC expresses concern that the analysis does not completely characterize the current use of subsets of the EDR data collected in the Council process, which is necessary for the Council to evaluate this newly added alternative. While acknowledging that EDRs could be streamlined, some data categories from the EDRs are the best scientific information available on social and economic conditions required for inclusion in SAFEs under National Standard 2, to document sustained participation of fishing communities under National Standard 8, and support Council decisions in a number of specific and programmatic ways:

- EDR data are used in SAFEs, and featured prominently in the Economic SAFE dashboard indices and presentations at this meeting.

- Some types of EDR data are commonly used in required quinquennial reviews of the catch share programs for which they were designed.

- Some types of EDR data are commonly used in required allocation reviews.

- Some types of EDR data are commonly used in analyses of Council actions, including several not named in the analysis.

    - While Council actions are not typically focused on changing EDR metrics, the EDRs nonetheless provide scientific basis to establish that actions do not have unintended consequences. This is particularly true of crew and community data, currently available only through EDRs, showing how proposed actions impact the sustained participation of fishing communities, as required by National Standard 8, and allow an analysis of the efficacy of a variety of different community protections measures which the Council typically builds into such actions.

- EDR data are the basis for research, primarily by AFSC and academic partners, that is broader than a single Council action, but is nonetheless important in supporting the Council in meeting the requirements of the Magnuson-Stevens Act.

    - While not developed in response to a particular Council action, this research informs

scientists' understanding of the mechanisms and effects of alternative management programs. This guides consideration of existing and new management programs; suggests elements to include or avoid in future Council actions to obtain certain positive outcomes or prevent adverse outcomes; and identifies data and mechanisms to include in monitoring and evaluation of new Council actions.

    - Such work using detailed data often requires more time and technical effort than is possible during the policy process for a single Council action.

- The EDRs provide critical data that are being used in the development of the new multiregional social accounting matrix model (MRSAMM), which after further review by the SSC, promises to help translate fishery changes to quantified impacts on economic activity and employment across North Pacific regions.

- The EDRs are currently the Council's primary concrete examples of advancing two of its identified Top Ten research priorities: *Develop framework for collecting economic information* and *Collect socio-economic information*. While the research priorities indicate a need for further examination and development of comprehensive data collection that may include and go beyond the EDRs, the SSC believes that elimination of EDRs without replacement data collection would move away from, not towards, Council-prioritized research.

- EDR data could be used to support emergency declarations and provide an objective basis for determining the value of relief packages.

The SSC notes that, while the Gulf Trawl EDR does not have a catch share program review to which it contributes, the unique data on community engagement provided in this EDR has proven to be helpful for analysis of multiple actions before the Council. The SSC acknowledges that the AM91 EDR has not contributed to these EDR benefits as much as the crab, AM80 and Gulf Trawl EDRs have.

Based on the discussion with presenters **regarding the feasibility of using voluntarily collected survey data in place of EDRs, the SSC is concerned that the roles of EDR data may not be feasibly backfilled through other research programs.** If feasible, discussion with presenters indicated that **alternatives may be more costly than the current EDR process.** Eliminating EDRs would require AFSC scientists to develop voluntary surveys of industry. These surveys would represent similar data reporting costs for participating industry members, but significantly increase the burden of data collection and analysis for the agency. Non-EDR data collection programs require OMB review, which has proven burdensome for agency scientists and so frequently impractical to pursue given the extended time frame required for approval that few data collections requiring it have been initiated. Furthermore, rather than simply reporting summary statistics from EDR survey questions, **if not all entities respond to the voluntary survey, modeling would be needed to estimate indicator values for the full population**.

Next Steps to Consider

If the Council chooses to discontinue some or all EDRs, the SSC has the following suggestion:

- Consider ensuring that high value time series are maintained through a transition to a replacement mandatory economic data program

If the Council chooses to continue some or all EDRs, the SSC has the following suggestions for further refinement. Most recently, responsibility for exploring means to streamline EDRs has been assigned to the Social Science Planning Team (SSPT). The SSPT is balancing developing a unified approach to economic data collection, with the potential for fishery-specific supplements, with investing in refining individual

EDR programs (see SSC recommendations in this regard in the April 2021 SSC report). To accelerate this process, the SSC suggests that the Council:

- Provide additional specific information about EDR variable category use to facilitate evaluation of the extent to which each EDR data category supports the Council in science-based management in pursuit of National Standards 1 and 8 in compliance with National Standard 2. Specifically, develop a clearer mapping of which variable categories (i.e., which EDR form fields) from each EDR have been used: in SAFEs, ACEPO, and other products; in Council analyses; and in other research. In instances where EDR variable categories are used, describe the quality of the EDR data. Also indicate whether alternative data sources are available, and the relative quality of the alternative source(s).

- With knowledge of how catch share programs have evolved, identify specific outcomes and broader questions that have arisen and align EDR data to understand them.

- Explore the use of very small groups of key individuals, including AFSC staff, Council staff and industry representatives, to work out an initial plan to revamp the EDR process in a way that produces the best data feasible while reducing industry and government burden.

The SSC continues to support the collection of social and economic data across all fisheries (see April 2021 SSC report). If the Council chooses to, or not to, continue EDRs, the SSC suggests the Council:

- Consider a mandatory data collection plan with a reduced set of variables collected consistently from all fleets. Based on EDR variables that are most extensively used, and data gaps seen in Council analyses, data on crew, fuel use, and community engagement would be an important starting point. Consistent, comparable data will allow similar measures to be derived for multiple fleets affected by a Council action, enhancing the utility of EDR data.

C-2 BSAI Crab

The SSC received a report on the January 2022 Crab Plan Team (CPT) meeting from Diana Stram (NPFMC), Katie Palof (ADF&G), and Mike Litzow (AFSC). The SSC would like to express its appreciation for the years of CPT service provided by outgoing co-chair Martin Dorn (AFSC) and welcomes Dr. Litzow as the new CPT co-chair. There was no public testimony for BSAI CPT agenda items or the Norton Sound red king crab (NSRKC) assessment. There was public testimony for the C2/C3 snow crab rebuilding plan.

General Crab SAFE Comments

The SSC supports the CPT general recommendations that all stock assessments include results from the currently accepted model with new data (base model) so that changes in model performance can be assessed. Values for management-related quantities for all models that may be recommended by the CPT or SSC should also be available.

BSAI Crab SAFE and Harvest Specifications

The SSC reviewed the NSRKC SAFE chapter and information provided by the CPT with respect to the stock status information from 2021/2022 relative to total catch during the 2021/2022 season (Table 1). In addition, Table 2 contains the SSC recommendations for 2022/2023 catch specifications, with maximum permissible ABCs for 2022/2023 shown in Table 3. The remaining crab SAFEs will be reviewed, and harvest specifications set, at the June and October SSC meetings.

Table 1. Stock status in relation to status determination criteria for 2021/22 as estimated in February 2022. Hatched areas indicate parameters not applicable for that tier. Values are in thousands of metric tons (kt).

Chapter	Stock	Tier	MSST[1]	B_{MSY} or $B_{MSYproxy}$	2021/22[2] MMB	2021/22 MMB/ MMB_{MSY}	2021/22 OFL	2021/22 Total Catch	Rebuilding Status
1	EBS snow crab	3							
2	BB red king crab	3							
3	EBS Tanner crab	3							
4	Pribilof Islands red king crab	4							
5	Pribilof Islands blue king crab	4							
6	St. Matthew Island blue king crab	4							
7	Norton Sound red king crab	4	1.03	2.05	2.27	1.10	0.29	0.003	
8	AI golden king crab	3							
9	Pribilof Islands golden king crab[3]	5							
10	Western AI red king crab	5							

[1] As estimated in the 2022 assessment.
[2] For Norton Sound red king crab, MMB on 2/1/2022 is estimated using the current assessment in January 2022.
[3] PIGKC specifications are set on a calendar year basis

Table 2. SSC recommendations from the final 2022 Norton Sound red king crab SAFE in February 2022. Biomass values are in thousand metric tons (kt). Tier designations in this table are based on the projected stock status in 2022/2023. Stocks for which the SSC recommended different harvest specifications from the CPT are bolded. Harvest specifications for SAFE Chapters 1 – 4 and 6 are set in October and Chapters 5 and 8 – 10 are set in June, in the year according to the assessment frequency cycle (see current SAFE Introduction for assessment cycle). Chapter 7 (Norton Sound Red King Crab) is set in February. OFLs and ABCs for 2021/2022 are available in the October 2021 SSC report.

SAFE Ch.	Stock	Tier	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	B_{MSY} basis years[1]	2022/23[2] MMB	2022/23 MMB / MMB_{MSY}	γ	Natural Mortality (M)	2022/23 OFL	2022/23 ABC	ABC Buffer
1	E. Bering Sea snow crab	3										
2	Bristol Bay red king crab	3										
3	E. Bering Sea Tanner crab	3										
4	Pribilof Is. red king crab	4										
5	Pribilof Is. blue king crab	4										
6	St. Matthew blue king crab	4										
7	Norton Sound red king crab	4a	0.18	1.90	1980 – 2022 [MMB]	2.42	1.27	1	0.18 (0.58 >124mm)	0.30	0.18	40%
8	Aleutian Is. golden king crab[3]	3										
9	Pribilof Is. golden king crab[4]	5										
10	W. Aleutian Is. red king crab	5										

[1] For Tiers 3, 4 where B_{MSY} proxy is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years from which the catch average for OFL is estimated. MMB on 2/1/22 is estimated using the current assessment for Norton Sound red king crab.
[2] MMB is estimated on 2/1/2022 for Norton Sound red king crab and on 2/15/2022 for all other stocks, using the current assessments.
[3] AIGKC OFL and ABC are calculated by combining two separate assessment models for the EAG and WAG, as presented in the current assessment
[4] PIGKC specifications are set on a calendar year basis

Table 3. Maximum permissible ABCs for 2022/23 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. Stocks for which specifications are rolled over between assessments or were set in February or June 2021 are included. Values are in thousand metric tons (kt). Harvest specifications for SAFE Chapters 1 – 4 and 6 are set in October, and Chapters 5 and 8 – 10 are set in June, in the year according to the assessment frequency cycle (see current SAFE Introduction for assessment cycle). Chapter 7 (Norton Sound Red King Crab) is set in February. PIGKC specifications are set on a calendar year basis.

SAFE Ch.	Stock	Tier	2022/23 Max. ABC	2022/23 ABC
1	EBS Snow Crab[1]	3		
2	Bristol Bay RKC[2]	3		
3	Tanner Crab[3]	3		
4	Pribilof Islands RKC[4]	4		
5	Pribilof Islands BKC[5]	4		
6	Saint Matthew BKC[2]	4		
7	Norton Sound RKC[2]	4	0.30	0.18
8	Aleutian Islands GKC[2]	3		
9	Pribilof Islands GKC[5]	5		
10	Western Aleutian Islands RKC[5]	5		

Basis for P* calculation of Max ABC,
[1] P* was not used to calculate the Max ABC for this stock therefore Max ABC = OFL
[2] CV on OFL
[3] MCMC
[4] CV on terminal year biomass
[5] Tier 5 (90% OFL)

Norton Sound Red King Crab

The SSC received a presentation on the 2022 NSRKC assessment. There was no public testimony. The SSC appreciates the detailed presentation and the effort put into addressing SSC and CPT questions raised during earlier reviews. This included progress on multiple aspects of NSRKC biology, assessment data and model explorations of natural mortality. The SSC found the assessment document to be much improved, with a basic description of the model and its key assumptions, and a more detailed discussion of model results with bridging models from model 19.0e to the author-recommended model. Many technical details are contained in appendices that are helpful for reference. The SSC also thanks the CPT for their careful review of this assessment. Their table outlining CPT and SSC concerns related to the selection of an ABC buffer was helpful as well.

The NSRKC assessment is a length-based model of male crab abundance. In 2021, the retained catch represented only the winter commercial and subsistence fisheries. The summer commercial fishery was not conducted. Changes from the base model to the author-recommended model included the author-preferred proportional method for estimation of discards, as well as the separation of the summer commercial CPUE time series into three time periods, including an estimate of catchability (q) for each time period and two summer retention probabilities. These changes were implemented to better reflect known changes in the fishing practices over time.

The author presented seven models in this assessment

- 19.0e, with updated data and the proportional method used for discard estimation
- Model 21.0, based on 19.0e with changes to the CPUE catchabilities and summer retention probabilities
- Models 21.2 and 21.3 are bridging models from 19.0e to 21.0
- Models 21.1, 21.4 and 21.5 explore different approaches to natural mortality

The CPT noted that the base model, 19.0b, with updated data was not brought forward. **The SSC strongly requests that the suite of models presented for harvest specifications always include the base model with updated data**, in agreement with the CPT. The SSC notes that this was specifically requested in their October 2021 minutes related to NSRKC model runs.

The author recommended using Model 21.0 or 21.5 in harvest specifications. The CPT found little difference between the two and recommended using 21.0 for the sake of parsimony. Model 21.0 represents an improvement over Model 19.0e, as it incorporates changes in retention practices in the fishery and treats the CPUE data more appropriately. **The SSC agrees with the CPT and author-recommended Model 21.0 for harvest specifications**. **Results from this model indicate that the NSRKC stock is not overfished and catch during 2021/2022 did not exceed the OFL so the stock is not subject to overfishing.**

The author brought forward Tier 4 harvest specifications calculated using the size-dependent natural mortality values from Model 21.0. However, the CPT recommended continuing to use the single natural mortality value (0.18) used in previous years. In terms of the use of multiple natural mortality rates to calculate the Tier 4 harvest control rules, the SSC commends the author for bringing this to their attention and believes this approach makes general sense. **However, the SSC agrees with the CPT and recommends using the status quo Tier 4 approach for establishing the 2022/2023 OFL and ABC, which would mean the use of the single natural mortality rate (0.18).**

The SSC appreciates the CPT's careful approach to selecting the ABC buffer. **The SSC continues to recommend a buffer of 40% and references the table in the CPT report as justification.** Further, the SSC notes Model 21.0 exhibits a positive retrospective pattern, with a Mohn's rho value that is increased slightly from last year's base model. While there are more survey data available from 2021 and the new model is fitting the 2021 data well, the 2020 survey data are still not fit well. The summer commercial fishery did not operate for the second consecutive year, which decreases the data available to the assessment model. Finally, the SSC continues to be concerned with the lack of resolution for an appropriate treatment of natural mortality for this assessment.

The SSC acknowledges and supports the list of recommendations that the CPT developed for the assessment authors. The SSC wishes to emphasize the following:

- With the base model missing from the set of models this year, the method to estimate discards has not been fully resolved. This continues to be a priority.

- As mentioned earlier, an evaluation of the alternative Tier 4 harvest specifications related to the use of length-dependent or length-independent natural mortality when determining OFL and ABC and alternatives and their consequences should be brought forward for consideration in the fall.

- It was not evident how the length-based mortality visually improved the fit to the larger length-classes in the data. It would be helpful if a rationale was given for how the length-based mortality employed in the model itself is addressing an issue in the residuals and the fits to the compositional data.

- Addressing the problem of having parameter estimates hitting the bounds will be critical moving forward, given that these are survey selectivity parameters.

- The biological context for natural mortality used in the model is still not well understood. The authors' explorations this year demonstrate some benefit in having a size-dependent natural mortality rate, but this approach did not resolve the lack of model fit to larger crab. Consequently, the SSC believes some progress was made, but the authors still have not fully resolved this issue. Allowing for the estimation of M across all size classes in the model is one possibility to partially alleviate this misfit, but the SSC recognizes that this is often difficult to do in data poor situations. Nevertheless, it would be instructive to continue to see models where this is attempted. In addition, the authors should consult with regional managers to identify the potential for additional large crab mortality sources.

- Further, the authors also state that the transition size matrix is informed by tagging data, not by actual molt data. The SSC recommends that the authors work directly with the scientists conducting the laboratory growth studies so that those data are collected in a way that informs the molting probability function in the stock assessment.

- The SSC supports continued work towards using GMACS and exploring the value of using VAST for assessing survey data.

Aleutian Islands Golden King Crab Proposed Model Runs and GMACS

The SSC was presented with a list of the proposed models to be brought forward for the annual assessment of the Aleutian Islands golden king crab stock (AIGKC) at the May 2022 CPT meeting. The models recommended by the CPT are:

- Model 21.1a: Prior accepted model with updated input data.
- Model 21.1e: As for model 21.1a, except that separate catchability coefficients and additional CV parameters are estimated for the fish ticket (1985-1998), early (1995-2004) observer, and late (2005+) observer CPUE indices.
- Model 21.1f: As for model 21.1e, except that the CPUE standardization is based on year*area interactions.
- Model 21.1e2: As for model 21.1e, but with the size-at-maturity increased from 111mm to 116mm.
- Model 21.1f2: As for model 21.1f, but with the size-at-maturity increased from 111mm to 116mm.

The CPT indicated that Model 21.1a will not be considered because it assumes that catchability was the same for the fish ticket and early observer CPUE series and that this is not an ideal approach. Instead, results from this model will serve to provide a link with the previous assessment. **The SSC endorses the assessment model alternatives as recommended by the CPT to be brought forward in May 2022.**

An update on implementing the AIGKC assessment in the GMACS framework was provided and the progress being made is very encouraging. **The SSC looks forward to further updates and seeing GMACS versions of these models for both EAG and WAG in June for possible consideration for setting specifications.**

The SSC appreciates the author's efforts to address past CPT and SSC comments and concurs with CPT recommendations for additional work on CPUE standardization and exploration of the year: area interaction effect, evaluation of the utility of Aleutian Islands trawl survey data, and revision of the size-at-maturity value.

Recognizing that the lack of size and sex information in the trawl survey data would make it difficult to find an appropriate selectivity function to use with this index, the survey data could still be used to examine if the observer index is a good index of abundance. The SSC recommends the authors provide a side-by-side comparison of the area-wide indices to see if trends in the time series are similar and that the authors include the survey index in the SAFE in the future for context, even if it is not used in the model.

With respect to estimating a new size-at-maturity value based on chela height/chela length relationships, the SSC recommends that the authors provide a rationale for only using the most recent data to determine size at maturity instead of the entire dataset. The SSC also recommends that, in addition to comparing the analytical approaches, the authors provide a biological rationale for their findings.

The SSC expressed concern over the continued retrospective pattern in the EAG model, which might be indicative of a source/sink dynamic between the EAG and WAG that is unaccounted for in the model. It was noted that increasing M did not appear to mitigate this issue. The SSC recommends that the authors examine the catchability parameters, which are about half as large in the EAG as in the WAG and explore whether this is possibly an issue with scaling of the index. The SSC found it surprising that the catchability parameters were in the range of one, which indicates that indices are on the scale of absolute abundance. It was noted that the difference in catchability estimates is about the size of the retrospective bias in the EAG.

The SSC also requests the authors provide a rationale for the use of the years 1987-2016 for average recruitment rather than including more recent years given changes in environmental conditions. While it is common to not include the most recent recruitment estimates, it is expected that the recruitments from 2017-2018 should be sufficiently well established at this point. Finally, the SSC has previously recommended exploring a single-area model but agrees with the CPT's prioritization of transitioning to GMACS and exploring the year: area interaction effect on the CPUE standardization. **The SSC, however, requests that exploration of a single model for AIGKC with two areas and shared parameters remain an item to explore in the near future.**

Survey Updates

Bristol Bay Red King Crab resampling

The SSC received a summary of an evaluation of the 10% threshold for resampling female Bristol Bay red king crab. During the discussion, it was noted that one of the initial purposes of the resampling was to assess reproductive status, due to the supposed delay in the molt-mate cycle timing in years with cold bottom conditions, but that has turned out not to be variable among years. However, the resampling is important to capture the change in size and to have an accurate estimate of abundance by size. The resampling results have shown that female abundance changes between the original and resampling time period, suggesting that crab movement relative to temperature should be considered when a threshold is determined. The SSC concurs with the CPT's recommendations, specifically clarifying the goals of resampling with the stock assessment author and consideration of standardization of the selection of stations for resampling. The SSC reiterates the requests from October 2021 that, in addition to examining temperature effects on the timing of the molt-mate cycle, the authors explore other potential drivers (e.g., prey quality or quantity) that could underlie the incomplete molt-mate cycle observed in 2021. Another suggestion was to examine the temperatures prior to Leg-1 of the survey as a predictor of the state of embryos at the time of the survey. The SSC looks forward to future updates and the opportunity to weigh in on any recommended changes to the resampling protocol.

St. Matthew and Pribilof Islands Corner Stations

The SSC received a summary of an examination of the impact of dropping St. Matthew and Pribilof Islands corner stations for survey abundance estimates for crab stocks. The SSC wishes to acknowledge the efforts of the authors to develop an operating model and for conducting the retrospective analysis, and thanks them for their work. While the SSC appreciates the need to look for cost-saving efficiencies so limited resources can be used where most needed, it shares the CPT's concerns about survey reduction and comparability over time. The SSC supports the CPT's recommendation to extend analysis to include size compositions and other stock assessments, such as investigating the potential effect on the Tanner crab assessment, given the high catches in these stations.

Updates to TOR for crab SAFEs

The SSC supports the CPT's proposed changes to the terms of reference for SAFE chapters for BSAI crab stocks, including efforts to clarify and standardize summary tables that include management performance, status, and catch specifications. Specifically, summary tables in the main body of a SAFE chapter for a given stock will provide information for each model run. In addition, the SSC recommends that the executive summary of the SAFE chapter will provide information for the author recommended model only and the BSAI Crab SAFE Introduction Chapter will provide information for the CPT recommended model, specifying if that differs from the author-recommended model. **The SSC references its recommendation from December 2021 that assessment authors do not change recommendations in documents between the Plan Team and the SSC meetings and that deliberations and disagreements over assessment and other recommendations be documented in the Plan Team minutes.** This ensures that changes between author recommendations and Plan Team recommendations are clearly documented

and easily tracked. The SSC also appreciates the CPT's discussion regarding efforts to develop a standardized table and figure output for all SAFE chapters and encourages coordination with Groundfish Plan Teams to, as much as reasonably possible, strive for consistency, standardization, and reproducible documentation across all stocks.

Modeling Workshop/GMACS Progress

The SSC received a summary of the modeling workshop held at the conclusion of the CPT meeting. The SSC appreciates the update, and the continued effort of the workshop leads, CPT, and assessment authors to improve GMACS, such as merging the base code – currently used for king crab – with the terminally molting branch proposed for use with snow crab, improvements to the projection module, and updating/improving documentation and visualizations. In addition, the SSC is encouraged by the progress being made in transitioning stock assessments to this framework, such as the methodical work done on the AIGKC assessment model at this workshop (and earlier in December). These workshops provide an excellent opportunity to make significant progress in a short time and the SSC supports similar workshops in the future.

Snow Crab Rebuilding Plan Update

The SSC received a report from Diana Stram (NPFMC) and Katie Palof (ADF&G) on the status of snow crab modeling and the development of a rebuilding plan. Cody Szuwalski (AFSC) answered questions and provided additional information. The SSC appreciates this update and the continuing work by the author. Public testimony was provided by Scott Goodman (Bering Sea Fisheries Research Foundation) and John Gauvin (Alaska Seafood Cooperative).

Snow crab model development has focused on investigation of the apparent mortality event in 2018-2019, time-varying catchability, treatment of maturity, and transition to the GMACS platform. These efforts are important to the development of the 2022 assessment and the pending rebuilding plan.

CPT report on modeling

The SSC strongly supports the efforts to move the snow crab assessment (and others) to the GMACS platform. The SSC recognizes the challenges in creating a bridging model between the status quo snow crab assessment and GMACS. Previous efforts have shown that there are differences in both the population dynamics equations and the likelihood functions, such that results have been similar but key differences have remained even in closely aligned models. At this time, it does not appear worthwhile to continue to program new features into the status quo model in order to more closely match GMACS, nor to program features into GMACS solely to foster a cleaner bridging analysis. However, the SSC supports plans to provide additional bridging information before discontinuing the status quo model. Previously highlighted concerns included the difference in the recruitment penalty (related to the lack of constraint on the sex-ratio in GMACS), as well as implausibly high estimates of fishing mortality. **The SSC requests that the model comparisons provided to the CPT in May and SSC in June include a consideration of these and any other remaining differences between the models. As requested in October 2021, the SSC reiterates that the Tier 4 calculations of OFL and ABC be brought forward in October as a backup to all other modeling approaches.**

Snow crab have shown a straddling distribution between the eastern and northern Bering Sea survey areas, more than any other crab species. However, analyses to date have not included the NBS in the index, nor formally considered NBS information in a spatial context to potentially inform catchability and to help evaluate the relative roles of mortality vs. movement in the recent dynamics. **The SSC recommends that the survey team make the development of a VAST model-based index for snow crab a high priority, even if the index does not include the most recent year's survey data due to survey data availability and fall-assessment timing.** A VAST model would ideally provide both an index that includes the entire

surveyed range (EBS and NBS) as well as a tool for investigating temporal variation in the spatial distribution with potential covariates. In addition to the NBS, the SSC would be interested in any data describing snow crab movement to deeper waters west and off the shelf as highlighted by members of the industry in October 2021. **The SSC looks forward to "what happened" analyses and notes that it will be important to have a sufficient range of GMACs models to consider in June that represent different hypotheses, such as crab movement out of the area or a mixture of movement and mortality.** The SSC also looks forward to updated mapping of the time series of observed data as well as model predictions.

The 2021 snow crab assessment identified the high degree of sensitivity of management outputs to the estimated fishery selectivity relative to the maturity schedule. **The SSC recommends that further exploration focus on best representing the biology of the species and the selectivity of the fishery in the modeled population dynamics.** If the best model turns out to be inconsistent with the current approach in the Tier system (e.g., impacts of maturity preceding selectivity on F35%), this should be addressed separately.

Noting that the snow crab fishery is in progress now, it could be very helpful to characterize how the fishing season is going based on local knowledge. **The SSC recommends working with BSFRF and ABSC to summarize observations from harvesters participating in the 2021/2022 season.**

Snow crab rebuilding
The example calculations provided for the CPT and SSC were very helpful.

The SSC supports the approach to provide projections based on several recruitment periods, treatments of M, as well as multiple levels of fishing mortality. **Specifically, the SSC supports alternatives including recruitment periods of status quo (1982-2020), 1989-2020, each with and without continued high M. For each of these alternatives, a comparison should be provided of trajectories with no fishing mortality, bycatch only (including other crab fisheries), and an approximation of the state harvest control rule.**

The estimate of higher natural mortality in 2018-2019 is related to the extremely high 2014 recruitment. The authors should consider whether it is sensible to use this value in equilibrium average recruitment for the reference points and projections or whether it should be lowered or excluded. These and any additional alternatives (such as excluding recruitment after 2013) should include specific hypotheses/rationale for why they may be appropriate to consider in the rebuilding plan. **The SSC recommends that each alternative use consistent assumptions (i.e., M and recruitment) for the population trajectory and the reference points.**

The SSC notes that adequate characterization of uncertainty in the rebuilding analyses is critical, as criteria are probabilistic in nature. **The SSC recommends inclusion of the uncertainty in the time series estimates of MMB, as well as in the B_{MSY} calculation, based on estimation of model parameters, noting that the covariance in these quantities will need to be accounted for as well.** It may be helpful to plot the ratio of these quantities with associated uncertainty.

The SSC also requests that Tmin and Tmax are labeled directly on rebuilding trajectory figures.

The SSC notes that the 2022 trawl survey data may be very informative in evaluating mortality and movement hypotheses explaining the recent decline. Therefore, the SSC recognizes that the preliminary work done on the rebuilding analysis may need to be updated in the fall.

C-3 Snow Crab Rebuilding Plan Update

Please refer to the "Snow crab rebuilding" section under the C-2 BSAI Crab for SSC comments related to the snow crab rebuilding plan update.

D-1 Halibut Catch Share Plan for Areas 2C/3A Allocation Review

The SSC received a presentation from Sarah Marrinan (NPFMC). Linda Behnken (Alaska Longline Fishermen's Association) provided oral public testimony. Richard Yamada (RQE Alaska), Linda Behnken (Alaska Longline Fishermen's Association), Kathy Hansen (Southeast Alaska Fishermen's Alliance), Tom Gemmell (Halibut Coalition), and Randy Kraxberger (self) provided written testimony.

The SSC congratulates the analysts on developing a document that clearly shows how the commercial and charter sectors managed under the catch share plan (CSP) respond to having an allocation structure and generate benefits from their allocated share. It is clear the analysts drew on SSC feedback provided during the development of the Pacific Cod allocation review and analysts have made the CSP exceptionally accessible to the public. **The SSC finds that the analysis of the CSP is sufficient to inform the Council as to whether the current objectives of the allocations under the CSP are being met**, following some minor revisions as practicable.

The SSC has the following suggestions for minor modifications of this report:

- The dashboard metrics retain the same titles between the commercial and charter sectors, although not all metrics use similar or comparable data. It would increase the transparency of the document to alter the names of the metrics, or expand upon them (e.g., "Value: Ex-vessel revenue") to precisely describe what is measured.

- The dashboard lacks a sufficient metric of sustained participation by fishing communities, in both sectors. A regional quotient stacked area graph, or a Gini coefficient by community, would be a useful addition.

- More specificity on the purpose of measuring diversification – such as understanding alternative fishing revenue sources beyond the target fishery – could be used to inform the selection of one or more specific metrics. For example, the current charter sector diversification metric measures changes in products (trips) *within* the charter halibut fishery, but it may be useful to track engagement *beyond* chartered halibut such as revenue from non-halibut species in the charter sector, other non-fishing charter opportunities (e.g., hunting, wildlife viewing and glacier viewing), or participation in commercial fisheries. As noted in the current analysis, systematically collected quantitative data on these types of diversification activities are relatively scarce; however, it seems likely that the opportunities for diversification would vary considerably by subarea and community. For this or future allocative analyses, it would be useful to develop a more detailed qualitative description in the text regarding the differential distribution of diversification opportunities and responses, with appropriate caveats regarding data limitations.

The SSC further reflected on this analysis as an evolution of the process by which the Council responds to the allocation review requirement. The SSC notes that this analysis did not incorporate all significant users of halibut, including subsistence users and PSC users, whose benefits derived from halibut are not considered alongside the fleets included here. The SSC also notes that this analysis includes discussion and evaluation of management within the charter and commercial sectors as well as an overview of the IPHC process that accounts for removals. In some cases, these go beyond addressing the effects of the allocation itself, or the benefits derived from the allocated share by each sector, and thus bleeds into a program review.

The SSC appreciates reflective program evaluation, but notes that such information can be omitted from future, more focused allocation reviews. **The SSC recognizes the time limitations that occurred for this CSP workplan due to COVID and requests the opportunity to review workplans for future allocation reviews.**

This is the first allocation review with a significant recreational component, raising the issue of whether and how to develop metrics that are directly comparable across very different sectors. While a suite of directly comparable metrics is clearly useful, the **SSC recommends that in general, where the differences between sectors make it reasonable to do so, dashboard metrics be selected that demonstrate how each sector creates benefits, but without pushing to make them directly comparable in allocation reviews**. Properly constructed dashboard metrics can daylight distributional effects of the allocation and catalyze discussion among the public, even if they are not directly comparable across sectors**. If the Council decides a specific proposed amendment or reallocation should be further analyzed, the SSC could provide advice for calculating comparable metrics** for additional components of value such as reflecting those derived from value added processing for commercial harvests, or components of value attributable to secondary species caught on charter trips or joint lodge and meal purchases for charter harvests.

D-4 Trawl Electronic Monitoring

The SSC received a presentation from Anna Henry (NPFMC), Melanie Rickett (AKRO), and Josh Keaton (AKRO). The SSC appreciated the detailed and well-organized presentation and the opportunity to provide preliminary input into this trawl electronic monitoring (EM) program before initial review. Public and written testimony was provided by Julie Bonney (Alaska Groundfish Data Bank, oral and written) and Ruth Christiansen (United Catcher Boats, written), attesting to the value and success of the program and collaborative experience thus far.

The presentation and document laid out a solid foundation for the initial analysis and the EM work represents a great collaborative effort with industry. The level of collaboration expressed in the presentation and document is greatly appreciated. The SSC noted that it could be beneficial to document this collaboration particularly with regard to industry input, the input and collaboration from state agencies, as well as broader participation by NMFS (specifically the stock assessment group). This could involve listing who generally has been involved, what input is being provided, and where that input is adding value. This would be helpful to use as a model for future collaborative work. The program would benefit from documenting the degree of acceptance and positive participation in the program. This should be set up to identify initial buy-in, while some continued monitoring of acceptance and willingness to participate should help the program avoid issues, surprises and data degradation.

This program represents a novel step for the NPFMC to use EM as a tool to verify logbooks and compliance, rather than as a means for gathering catch and species composition data. The SSC was impressed with the initial success of the pilot program and EFP. **The SSC has several suggestions for the initial review of the proposed program**:

- Explore roughly how monitoring resources made available through savings in this program will be reallocated within and outside of the pollock trawl sector. Specifically, if the program implementation could improve collections in other sectors, this could be highlighted as a benefit of the program.
- With the relaxation of MRAs, an overview of what the sector could potentially target without those restrictions would be useful.
- The pollock stock assessment team should be closely consulted concerning whether loss of haul-level spatial information will impact any ongoing or future analyses and how the data changes will

be treated in the assessment (e.g., effective sample sizes for biological collections, weighting of samples from tenders vs. individual vessels). It will be essential that authors are prepared to incorporate these new data streams before they become permanent rather than being done in a post-hoc manner.

- Provide details on how catches and biological data could be assigned to trip or haul-level information when catches from multiple CVs are mixed on tenders, or how pooled data can be tracked and analyzed appropriately.

- Confirmation that this program will not result in a loss of overall specimen and biological samples, particularly in the GOA where this can be most challenging.

- Evaluate the potential for large shifts in discard estimates during the year within CAS as compliance monitoring is completed on video review.

- Provide more detailed numbers in the next iteration, including examples of biological samples before and after the EFP.

- An illustrative example of how salmon PSC calculations would differ under this program than with current methods that are not based on EM would be helpful (e.g., how weighted and combined for the tenders), including a GOA and BSAI example.

- There should be a formal direct mechanism for continuing to gather feedback directly from the captains and fleet and processors more generally. It is recognized that conversations seem to be taking place now, but this user group might also have ongoing suggestions for providing improvements for the process as well as identifying issues.

D-5 Essential Fish Habitat

The SSC received reports on Essential Fish Habitat (EFH) component 1, EFH descriptions, and EFH component 2, fishing effects analysis. Public testimony was provided by Jon Warrenchuk (Oceana), John Gauvin (Alaska Seafood Cooperative) and Cory Lescher (Alaska Bering Sea Crabbers). Additional written comments were received from Marissa Wilson (Alaska Marine Conservation Council), Jamie Goen (Alaska Bering Sea Crabbers), and Jon Warrenchuk and Ben Enticknap (Oceana).

Component 1 - Species Distribution Models

The SSC received reports from Jodi Pirtle (AKRO) and Ned Laman (AFSC) on advancing Essential Fish Habitat (EFH) descriptions and maps for the 2022 5-yr review. Additional information was provided by Jim Thorson (HPR, AFSC) and Gretchen Harrington (AKRO). The SSC thanks the analysts for their excellent work to improve EFH descriptions, for their efforts to solicit reviews and input from the stock assessment authors, Plan Teams and the SSC, and for their responsiveness to comments and suggestions. In particular, the SSC appreciates the concise background, summary of methods, clear examples and detailed summary tables for evaluating the new EFH descriptions. The SSC also appreciates agency staff who were available to answer questions about EFH processes and complex technical details.

Overall, the information provided in the discussion paper and attachments represents a substantial improvement and refinement of EFH descriptions over the previous review cycle. Some of the key improvements and refinements are:

- EFH descriptions were expanded to include more species and stages with up to three life stages by species for 32, 25 and 42 groundfish species in the EBS, AI and GOA, respectively, as well as for five crab species in the EBS, two in the AIs and octopus in all regions.

- EFH maps for all species were based on an expanded suite of five Species Distribution Models (SDMs) and EFH was quantified based on an ensemble model approach, wherein individual members of the ensemble are weighted based on out-of-sample predictive performance (root mean squared error or RMSE) from cross-validation. Updated SDMs and the model ensemble, which generally performed considerably better than the 2017 SDMs, were based on a carefully selected set of criteria for model comparisons.

- Uncertainty in the mapped abundances was quantified based on a cross-validation approach and the coefficient of variation (CV) was mapped along with the abundances.

- The analyses advance almost all species and life stages to EFH Level 2 descriptions based on habitat-related abundances and, for a subset of juvenile life stages, to EFH Level 3 descriptions based on habitat-related vital rates. This advancement to level 2 information for the first time provides a common numerical abundance metric for comparisons across models and not only made the ensemble approach possible but also sets the stage for greatly expanded uses of the SDMs that better reflect habitat quality, to the extent that high abundances are indicative of higher quality habitat. The transition to the use of SDMs that predict numerical abundance as the response variable also provides an improved basis for future incorporation of other fishery-independent and potentially fishery-dependent data sources to inform EFH definitions.

Given these clear advances, the SSC believes that a large majority of the EFH maps reflect the best available science for characterizing EFH. The SSC recognizes that the EFH distributions represent summer distributions at the time of the trawl surveys in most cases, whereas fish distributions may change seasonally and fishing activities occur throughout the year. For some of the species, stock assessment author expert reviews noted that the model fits to the survey data result in a poor representation of EFH due to data inadequacies; for example, where the spatial footprint of the species extends well beyond the survey area, where the survey gear sampling performance is limited for a particular species, or the species occupies habitats that are inaccessible to survey gears. In these cases, the NMFS bottom trawl surveys in particular do not adequately represent the full spatial distribution and abundance of a species / life stage. **Therefore, the SSC notes that, by themselves, the EFH maps for these species and life stages do not provide a sufficient basis for assessing adverse fishing effects or for EFH consultations. The SSC supports the ensemble SDM approach for EFH descriptions, but requests that the limitations of the data for these species and life stages are clearly highlighted and communicated to other analysts and to the public**. Concerns about the representativeness of survey information relative to species distribution are not new and have been a long-standing EFH research priority. This 5-yr review focused on model improvements that will facilitate the broad inclusion of additional data sources in the future.

To determine fishing impacts (EFH component 2), additional information will need to be considered for some species and life stage combinations that are poorly represented by the survey data. If the Core EFH areas in these cases are used with the FE model to determine whether fishing impacts are more than minimal and not temporary, results may provide some insights relevant to a portion of the stock but will not be reliable indicators of overall fishing impacts. Additional data sources that could be considered are summarized in the documents provided and include observer data and longline surveys. **The SSC clearly heard from analysts that changing SDMs was not possible under the proposed timeline due to resource limitations. However, to the extent possible, the SSC recommends that the EFH maps be updated with additional information before running the FE models for species/life stages where the stock authors had substantial concerns about bottom trawl or other survey data accurately representing species distributions.** In some cases, this may require the SDM team to employ single SDM models (e.g., MaxEnt) rather than ensembles to accommodate disparate data types and as such the interpretation of EFH as 95% of the species population may differ (probability of occurrence versus

numerical abundance). Where the incorporation of additional data is not feasible, the SSC suggests that the determination of adverse fishing effects for species without a reliable estimate for the Core EFH area could be based on estimated fishing effects determined over the smallest area that encompasses an exploited stock (i.e., where catches have historically occurred based on the catch-in-areas database), while determinations for juvenile and subadult stages may not be possible. Absent additional quantitative analyses, the determination would need to be based on expert assessments for the species in question.

Data limitations are of concern primarily for those species that inhabit the slope and untrawlable areas, but concerns differ among the species where stock assessment authors had low confidence in the EFH maps. **Therefore, to better understand the nature of the concerns and the data limitations across stocks, the SSC requests that the SDM team work directly with stock assessment authors to provide a summary table that evaluates the species for which elevated concerns were identified against the following minimal criteria and possibly additional criteria as identified by the SDM team:**

- Survey reliability: Does the trawl survey reliably sample the species abundance and distribution in the area surveyed?
- Seasonal representativeness: Does the summer distribution reflect the habitat of the species or are there indications that the distribution varies substantially among seasons?
- Spatial representativeness: Does the estimated EFH represent the distribution of the species within the FMP area or does the species extend substantially beyond the estimated EFH?

If any of these criteria are not met, the corresponding EFH map and text description should be clearly flagged as being potentially unreliable or only reliable as indicators of limited summer distributions. This will help users and analysts better understand and take into account the additional uncertainty that is not captured in the maps of model uncertainty (CV) provided in the documents. **To better communicate uncertainties about the overall reliability of the EFH descriptions to the public, the SSC suggests that the summary tables of model performance include a plain language reliability score (qualitative) based on both model performance criteria and any identified concerns.** This table and brief description could consist of a predictive performance summary of the model using a good, medium, or poor rating (currently described in the document for individual quantitative metrics); an assessment of reliability (e.g., adequate/not adequate for FE determinations) based on underlying data concerns described in the bullets above; and any other limitations the authors believe are important to communicate at a high level. The SSC also requests the authors consider, for the next review cycle, methods to better communicate uncertainty associated with the final maps of EFH and fishing impacts and intermediate products that may be available (e.g., SDM or FE outputs). During staff presentations, AKRO staff indicated a NMFS-led EFH SDM working group will be formed, and perhaps this would be a good topic for this working group to consider, noting that FE is a complementary product derived from SDM and may require a joint effort to provide a comprehensive discussion. Despite the limitations as noted above, the SDM results represent an impressive and substantial improvement over the 2017 review.

In addition to making SDM results widely available through the FMP and websites, the analysts plan to share code via a GitHub site for other analysts and researchers to use. The SSC strongly supports this approach to increase transparency and reproducibility. The SSC highlights that the authors used state-of-the-art models and defined EFH using an approach that was developed in an open and transparent way. While some of the decisions, such as the 5% encounter rate threshold for defining area occupied are *ad hoc* and can be influential, the SSC commends the team for striving for consistency and for rigorous and objective analyses based on those and other choices.

The SSC notes that there is tremendous value to these products that goes well beyond meeting MSA mandates. Primary uses are to inform the Fishing Effects analysis and EFH consultations. The document provides a brief summary of uses in research (e.g., on climate change impacts) and in a stock assessment context. In the latter context, ESP indices that are based on EFH information provide an on-ramp for using this information in the assessments. The utility of EFH products undoubtedly goes well beyond these examples, but information on their use by researchers, by the general public, and by agencies and other organizations for planning purposes, is not readily available. **The SSC recommends that this information be collected where possible to help inform both the next 5-yr review and how to better share the results more effectively and broadly to enhance their impact.**

The SSC notes that, as another benefit to researchers, the EFH descriptions and the effects of different variables on abundance provide a wealth of information on ecologically relevant relationships and patterns. For example, the SSC notes that bottom depth, variables relating to current speed or tidal flows (a possible proxy for prey aggregations), bottom temperature, and substrate-related variables were frequently important. Differences between juveniles and adults were noted in their relative importance, with living substrates more often associated with juvenile life stages, while other substrate variables such as grain size or rockiness were often associated with juvenile or subadult life stages (as well as adults of some rockfish), and currents or temperatures appeared to be most often associated with adult stages. These patterns suggest the importance of physical and living structures for early life stages, possibly to reduce predation, and the role of currents and water masses for adult distributions, possibly reflecting prey availability.

The improved EFH definitions in many cases resulted in substantial differences in the size of the EFH area between the current analyses and those published previously. These appeared to be largely due to SDM model methodological differences and to the use of a single model in 2017 (relative to the current ensemble approach) and are to be expected given the substantial updates to the modeling approach, incorporation of updated or different habitat covariates and differences in the threshold used for defining area occupied. The EFH area often varied substantially among individual models, particularly for species with a small spatial footprint and highly variable catches. The SSC notes that the main reason for using an ensemble modeling approach was to address this variability across individual models. A particularly influential change between the approaches used in this and the previous review could be the definition of 'area occupied', which was fixed at including any area with an estimated encounter probability over 5%, whereas this threshold was previously determined on a species-specific basis. The SSC notes that defining EFH based on the area that contains a certain fraction of the total abundance (see below) would eliminate the need for this somewhat arbitrary and likely influential choice.

An important decision for the next review will be whether to modify the definition of EFH to better reflect the higher level of information (level 2 EFH) that is now available for almost all species and life stages. The definition of EFH used in the document follows the EFH definition set forward in the Final EIS on EFH in Alaska (NMFS 2005), but that definition is subject to interpretation. To more fully use the abundance-based level 2 information, **the SSC recommends that, for the next 5-yr review, the SDM team considers a measure that narrows EFH to encompass higher-density areas that cumulatively are home to 95% of the proportion of a species/stage based on either numerical abundance or biomass, rather than 95% of the total area occupied**. However, such a change could have substantial impacts on the resulting EFH area and on any analyses that use EFH (e.g., FE analysis) and would have to be carefully evaluated before implementation. The approach also has drawbacks for species that may consist of multiple stocks within an FMP area. For example, red king crab in the Bering Sea consists of three managed stocks (Bristol Bay, Pribilof Islands, Norton Sound) that are clearly distinguished under the current EFH definition. Re-defining EFH based on the area containing 95% of the abundance of the species would likely exclude the Pribilof Island region and Norton Sound from EFH because all of the highest abundances and over 95% of the total abundance likely occur in Bristol Bay. Similar issues would apply to stock groups that combine species with low and high abundance. This could be addressed by defining EFH

separately by stock as suggested by the CPT. **Any revisions to the EFH definition should be carefully explored by the proposed NMFS-led EFH working group and during the development of the next EFH Research Plan to identify the advantages and disadvantages of different EFH definitions**. This could be included in the proposed publication that was recommended in the discussion paper to provide guidance to analysts ahead of the next review, which "*... may encompass an evaluation of thresholds and percentile areas applied to the SDMs and EFH maps, including the selection of the EFH area or subarea used to support the EFH component 2 fishing effects analysis*". Such a review may also benefit from discussions across Fishery Management Councils to learn from EFH approaches in other regions.

With regard to EFH definitions, the SSC requests that the discussion paper and the Tech Memos, to the extent possible, clarify that EFH for this 5-yr review was defined based on a proportion of the area occupied (i.e., the footprint), rather than the area corresponding to a proportion of the population's total abundance. While this is clearly evident in the results presented, the description in the document is often ambiguous. For example, the documents refer to "the area circumscribing the top 95% of the SDM-predicted abundance" (Attachment 3, p. 6, lines 165-168), which is at odds with the definition that was used.

The SSC provides these additional, specific recommendations for the development of a new EFH Research Plan to guide the next 5-yr review:

- SDM modeling is a rapidly evolving field, including the development of joint species distribution models. There have been several high-level reviews of these types of models and model performance (*e.g., Norberg, A., Abrego, N., Blanchet, F.G., Adler, F.R., Anderson, B.J., Anttila, J., et al. (2019). A comprehensive evaluation of predictive performance of 33 species distribution models at species and community levels. Ecol. Monogr., 89, e01370.*). Although the analysts applied state-of-the-art approaches, the SSC suggests that the EFH Research Plan should consider an in-depth review of available approaches, including considerations of Joint SDMs. Such joint SDMs do not have to include all species in an area but could be limited to a carefully selected subset of species that have known associations.

- The SSC encourages further efforts to identify ways in which the EFH information can contribute to the stock assessment process through ESPs and other 'on-ramps'.

- The current EFH definitions focus on summer survey data only and provide a much-improved snapshot of summer distributions. **The SSC supports recommendations to extend the analyses in the future to use fishery-dependent data, longline surveys, acoustic surveys, etc.**, to both enhance maps of summer distributions and to define EFH at other times of the year where possible, building on the approach developed during the 2017 5-yr review. However, the SSC notes that this type of intercalibration exercise will require careful consideration of the relative catchability among different gear types, the spatial distribution of effort, and targeting behavior in the case of fishery-dependent data.

- **The SSC previously encouraged, and the discussion paper recommends, the move toward a more dynamic definition of EFH,** for example in time blocks, which would require careful consideration of the time frames used for defining EFH. The current EFH definitions use all available data but don't account for long-term changes in the underlying habitat or shorter-term variability in dynamic habitat components. The bridging analyses illustrate that the addition of new data alone can impact results, especially in previously under-sampled areas, possibly suggesting habitat changes in recent years. In cases where long-term trends are a concern, it would be sensible to select a recent period during which conditions have been relatively stable, for example after observed discontinuities in large-scale climate variability in 1988/89 or after 1999, when conditions were generally warmer. Defining an appropriate period could be supported by an analysis of the dynamic variables (e.g., Dynamic Factor Analysis, change-point analysis) to use a time period that

best reflects more recent conditions. To the extent that the intent of EFH descriptions is to estimate the "potential habitat" available to a species and life stage, characterizing EFH under contrasting environmental conditions would be most useful. This approach could be used to explore changes in EFH in a changing climate and to capture trends and changes in habitat suitability. For example, for species whose distribution is strongly associated with water temperatures, EFH could be defined separately for warm and cool periods. Similarly, EFH could be defined for periods with contrasting ocean circulation patterns as captured by bottom currents or other dynamic variables. **The SSC recommends that both longer-term average EFH and EFH under contrasting conditions for those species whose distribution is known to be linked to changing ocean conditions be considered in the next 5-yr review**. The SSC looks forward to seeing an example of such an approach as part of the EFH determinations for the Arctic FMP, currently scheduled for June.

- The SSC appreciates the move to life stage specific models for almost all groundfish stocks and encourages the team to prioritize life stage specific models for crab species based on available maturity data.

- **The SSC supports a recommendation brought forward by the CPT and in public testimony to consider mapping EFH by management area for separate stocks within an FMP area**. One example is red king crab in the Bering Sea, which consists of three distinct stocks.

- The SSC encourages the analysts to consider objective approaches to eliminate isolated areas where the model suggests elevated abundances that are not supported by any occurrences in the data and are spatially separated from the main distributional areas.

- The SSC appreciates the inclusion of the PR-AUC as an additional criterion for evaluating the SDM models as it provides useful information on model performance with respect to the presence of a species, particularly for relatively uncommon species. The SSC suggests including the PR-AUC and species prevalence as routine criteria in future model updates.

- The SSC encourages the analysts to explore options that account for both abundance and uncertainty in the definition of EFH.

- The SSC encourages the analysts to provide general comparisons of the abundances estimated in the EFH SDMs and those estimated in the stock assessments.

- The SSC supports the additional recommendations in Table 18 of the discussion paper and highlights the following priorities:

    - Further development of methods to combine multiple surveys to make full use of available data and to expand coverage beyond any one survey region.

    - Development of process studies to advance EFH description to level 3 and possibly 4, if appropriate. The SSC suggests that the EFH research plan consider a case study for the development of level 4 EFH description for at least one species / life stage to better understand the information and methods needed to advance to level 4.

    - With regard to considering additional covariates in the future, the SSC agrees with exploring the proposed variables in Table 79 of Attachment 3 but notes that some of these variables reflect surface features (e.g., Chl a) that may or may not be relevant to demersal fish and crab and might be considered a lower priority. The SSC suggests adding variables that are indicative of frontal structures, which often aggregate prey and their predators. These could be defined by gradients in bottom temperature and salinity. The SSC further

suggests exploring the use of variables that reflect the vertical structure of the water column.

- Inclusion of alternative data sources such as longline survey data, fishery-dependent data, acoustic data and other sources.

The SSC looks forward to the development of the EFH research plan and to future opportunities to provide input on the directions of this valuable effort. **The SSC was encouraged to learn about the proposed working group and agrees that this provides an excellent avenue to further explore ideas about how to improve EFH descriptions in the future to better inform the public and support decision making.**

Component 2 - Fishing Effect Model

The SSC received a report from John Olson (AKRO) and Scott Smeltz (Alaska Pacific University) on the structure, development and data inputs informing the FE model as part of the EFH evaluation process. The SSC thanks the authors for providing a clear and concise document. The SSC also appreciates agency staff who were available to answer questions about EFH processes and complex technical details. This presentation and the associated discussion paper provide a complete description of the underlying model structure and assumptions, including calculations describing how habitat features are averaged for a given sediment type to determine aggregate recovery time (Section 3.6, pg. 20), which had previously been requested by both the SSC and the public.

The SSC thanks the EFH authors for their efforts in model development and for providing the SSC with sufficient detail in the review materials to evaluate whether the FE model provides a reasonable basis for moving forward with using the FE model in this EFH review cycle and, ultimately, its use for evaluating whether fishing activities are having a 'more than minimal and not temporary' adverse effect on EFH for BSAI and GOA FMP species. Modeling methodology is largely unchanged from that used for the 2017 EFH review cycle. However, the authors highlighted changes made to the input data, the transition from a continuous to a discrete model, and described an error in the 2017 modeling code where longline and trawl inputs were transposed. **The SSC supports the current version of the FE model for analysis to evaluate fishing impacts for the 2022 5-year Essential Fish Habitat review cycle, after addressing SSC suggestions below as practicable.**

Analysis of the effects of fishing on habitat requires a synthesis of gear-specific impacts on different habitats, quantifiable metrics for the frequency and distribution of fishing effort that contacts benthic habitats, and physical and biological characteristics of seafloor habitats themselves. The FE model operates on a 5-kilometer by 5-kilometer grid across the Bering Sea, Aleutian Islands, and Gulf of Alaska, representing the proportion of undisturbed and disturbed habitat within each grid cell through a discrete time framework, where the cumulative impact of fishing events and subsequent recovery of habitat features are tracked at monthly time increments. Within the FE model the impact of a fishing event is calculated as the product of the nominal area swept, the proportion of gear that is in contact with the seafloor (contact adjustment), and the susceptibility of habitat features to a given gear type within a region. The recovery rate for disturbed habitat, within a given grid cell, is calculated for each sediment type as the average of all habitat features associated with that sediment and a recovery time that is randomly selected from a uniform distribution of recovery times (in years) assumed for each habitat feature. Public comment raised the question of whether it was reasonable to assume the average recovery time across all habitat features for a given sediment type. The SSC discussed this issue and **supports the current method of averaging recovery time across habitat features given the absence of a specific method and empirical information from which to make a priori assignment of the relative value (e.g., weighting) for different habitat features**.

The FE model assumes a nominal width impacted by a fishing event, a bottom contact adjustment, and a susceptibility of different habitat features to each gear type. While the specific values assumed for these variables describing fishing impact are listed in the discussion paper (Appendix 2, pg. 44; Appendix 3, pg. 49), **the SSC requests, prior to finalizing the document, an expanded description of the origin of these assumed values from either the literature or local knowledge of the fishing industry. The SSC further recommends, prior to finalizing the 2022 FE model, that the authors work with Alaska Regional Office in-season management personnel to determine if fishery definitions are complete** (e.g., Appendix 2). The SSC notes that future iterations of FE may need to consider additional gear categories such as slinky or longline pots and encourages further research on these gear configurations.

FE model definitions for habitat feature susceptibility to specific fishing gears and the recovery time for different habitat features are drawn from a global analysis of fishing impacts by Grabowski et al. (2014). **With respect to the question of whether it is appropriate to use values derived from such a synthesis for parameterizing the FE model for the North Pacific, the SSC supports the decision to base the parameters on such a synthesis** and highlights that meta-analytical approaches for deriving reasonable values for unknown parameters is common practice within stock assessments for parameters such as natural mortality. **However, the SSC feels it is important to include data specific to the North Pacific to the extent practicable, given potential differences in the growth and recovery of habitat features at northern latitudes, and encourages the authors to incorporate results from the 2020-2024 Alaska Deep-Sea Coral and Sponge Initiative, when available, as well as any additional information on the distribution of habitat features across sediment types from NMFS survey products.** The SSC believes this may help inform the current assumption that long-lived habitat features with assumed recovery times of 10-50 years only occur in deep and rocky sediments below 300 meters. **Prior to finalizing the document, the SSC requests expanded descriptions of, and justifications for, the assumed recovery times detailed in the document.** In addition, the SSC recommends that the authors be explicit in indicating whether recovery times for a feature and substrate type are unknown versus not present (e.g., filling in blank cells in Appendix 3 of the document).

Unobserved fishing events are not currently included in the FE model assessment of fishing impacts, which may account for 7-12% of total unobserved fishing events where vessel monitoring system (VMS) data was available. The presenters noted that unobserved information has, for the most part, not been included in past EFH cycles, and that estimates of effort from unobserved events with VMS, derived from the Catch in Areas database (used to derive the 7-12% range), were substantially different than observed events. This is likely related to error/bias associated with algorithms that determine where fishing occurred and calculating an associated haul/set footprint. The SSC also notes that a large portion of unobserved events is due to vessels that do not have VMS (e.g., IFQ fishery) and thus considerable development work is likely required to include this information. **The SSC recommends that inclusion of unobserved fishing events, or the development of a multiplier for observed fishing events to expand the cumulative impact to account for unobserved fishing events including non-VMS fleets, is a top priority for future model development**. The SSC notes that impacts of BSAI crab fisheries are not included in the current FE model and suggests the authors work to include potential impacts from these fisheries, as feasible. **Prior to the June SSC review, the SSC recommends adding a map and/or table showing the extent of unobserved groundfish and halibut fishing relative to observed fishing for recent years and, to the extent possible, the authors should provide a qualitative discussion about how gaps in coverage may influence FE outputs. In addition, given that unobserved fishing events are not currently included in the FE model and that the proportion of observed fishing events varies across regions, the SSC recommends that impact metrics not be aggregated to the North Pacific scale**.

To guide further FE model development and to address any lingering concerns about model structure, assumptions, or data inputs, **the SSC recommends review of the FE model by the Center for Independent Experts (CIE).** The SSC notes that the last CIE review of methods used for this purpose

occurred in 2002 and was focused at the time on the predecessor to the current FE model, the Long-term Effects Index (LEI) model. The SSC suggests CIE review should be a top priority and should be conducted prior to FE model use in the next 5-year EFH cycle; however, the SSC does not feel that use of the FE model in the current EFH cycle should be contingent on CIE review. Terms of reference for the CIE review could include model structure, parameter assumptions, and data inputs including fishing effort, sediment data and EFH definitions.

With respect to the hierarchical process for identifying whether to elevate a species for possible mitigation due to fishing impacts, **the SSC notes that for groundfish species in Tier 4 and below there is no available definition for MSST and suggests that for these species analysis of disturbance to core habitat areas with the FE model should not depend on biomass relative to reference points.** The CPT highlighted issues related to stock author review processes for rebuilding stocks. The SSC notes that modeling efforts to define EFH may be informative to rebuilding plans and progress towards rebuilding (noting that a stock may be above MSST but not yet rebuilt). Therefore, the SSC encourages the use of habitat modeling outputs and methods, data inputs, and stock author input to help inform specific rebuilding plans and monitor progress towards rebuilding, as appropriate. However, the SSC does not recommend changes to the current hierarchical review process at this time given the detailed rebuilding analysis (including potential regulatory actions) and monitoring of rebuilding progress that is associated with the development and amendment of rebuilding plans, noting that these activities may occur outside of the 5-year EFH review interval.

Given the dependency of FE model predictions on Core Habitat Area as defined by EFH, the SSC suggests that consideration of stock author comments on the reliability of SDM-derived EFH designations based on the criteria outlined above (survey reliability, seasonal representativeness, spatial representativeness) should be used to determine whether the current EFH definition of Core Habitat Area is sufficient for use within the FE model. In cases where SDM-derived EFH definitions are deemed inadequate, the question of whether to elevate a species for possible mitigation should be based on other sources of information.

Finally, the SSC notes a discrepancy in the document that should be corrected: Page 17 indicates unobserved data is not incorporated into the model; whereas on page 8, the second paragraph indicates both observed and unobserved effort tracks are being included.

D-6 Marine Mammal Conservation Status

The SSC received presentations from Robyn Angliss, Paul Wade, Tom Gelatt, and Jeremy Sterling (AFSC - Marine Mammal Lab, MML), Lorrie Rea (University of Alaska Fairbanks, UAF), Joel Garlich-Miller (United States Fish and Wildlife Service, USFWS), and Suzie Teerlink (AKRO - Protected Resources Division, PRD). Public testimony was provided by Jon Warrenchuk (Oceana).

The SSC thanks all the presenters for their time and efforts, including the new presenters from USFWS, UAF, and AKRO-PRD. Recognizing it is challenging to condense information from over 20 species and multiple regions, the SSC is appreciative and commends the speakers for distilling the requested information into the time allocated. The SSC has received marine mammal updates since 2017 and this year, efforts were made to request information that is complementary to but not duplicative of the ESRs. **The SSC supports continuing to receive these reports as they provide opportunity for new, fisheries-relevant information and broad perspectives for the Council's strategic and ecosystem-based management efforts.** As the Council meetings and timing are evaluated, the SSC is supportive of evaluating the frequency and timing of the report.

Direct/Indirect Interactions

Presentations from the AKRO-PRD highlighted outreach efforts targeting the fishing sector to minimize interactions with marine mammals. Initiatives included "Do not feed sea lions" and "Do not shoot seals and sea lions," which consisted of signs, videos, and flyers. Additional outreach focused on minimizing entanglement for pinnipeds and for large whales. In light of recent sightings of the North Pacific Right Whales in the Gulf of Alaska (included in the GOA ESR 2021), a species that in the North Atlantic has experienced significant threats from entanglement in fishing gear, the SSC is supportive of these continued efforts to communicate threats, mitigation, and the process to follow if an entangled whale is sighted.

There are currently three negligible impact determination permits for the incidental take of Endangered Species Act (ESA)-listed marine mammals in federal fisheries, with a fourth permit application expecting to clear in February 2022. For many species, there are presently minimal direct interactions with fisheries; for some species it was noted that interactions may increase in the future as fisheries move north in concert with changes in water temperatures. Walrus were highlighted as a species that has indirect interactions with fishing fleets, in the form of disturbances at coastal haulouts in the Bering Sea as vessels and aircraft transit the area. As seasonal sea-ice cover and duration continue to decrease, concerns of disturbance will increase as more walrus haul-out on shore. The SSC appreciated learning about innovative efforts from the USFWS that utilize AIS to develop a "geofence" around walrus haulouts, and the associated outreach to commercial fleets.

The MML is identifying killer whale stocks involved in depredation of catch from fishing gear and the temporal/spatial scope of those interactions. Presenters noted that AFSC is also currently re-estimating depredation rates from sperm whales using existing data. **The SSC looks forward to hearing the results of those analyses (tentatively, in 2023), and discussed that it would be informative to know how depredation is changing over time, including spatial changes in occurrence. The SSC is also supportive of the upcoming virtual workshop AKRO-PRD is hosting regionally (Alaska) and nationally on effective methods of deterring marine mammal interactions with fishing operations**. Workshops will be held with industry and communities in spring 2022.

Ecosystem Links

The SSC was encouraged to see continued efforts to resolve and discern mechanistic links between marine mammal indicators and changes in the physical environment or food webs. These studies provide context for indicators in ESRs and risk assessments, can improve predictability of ecosystem models, and can inform the Council's strategic planning efforts.

At the request of the SSC, the MML presented information on a recent publication, Merrill et al. 2021, that explored demographic changes in northern fur seal populations on St. Paul Island by assessing patterns in maternal foraging trip duration. This analysis found spatial and interannual variation in trip durations, that pup mass was correlated with trip durations, but no relationship between maternal foraging trip duration and indicators of prey quality or quantity. The results showed that trip duration shared a slight positive relationship with bottom temperatures. The SSC discussed these findings and noted that while promising as a metric for broad environmental changes, further research is needed to identify the mechanistic link between the physical environment and observed behaviors (e.g., driven by competitors or food distribution). Another paper on fur seals, Short et al. 2020, was noted through public comment. The study explored the correlative relationship between catches of pollock and first year survival of northern fur seals. Results showed reduced survival in years of high pollock catches, but no relationship with biomass of pollock. The SSC discussed that this pattern may be related to spatial dispersal of fur seals to lesser extent than the amount of fish, and whether the correlation may be driven by the pollock catches in the 1960s and 1970s, with less relevance to contemporary fishing practices.

A presentation from Dr. Rea (UAF) provided an in-depth look into the study of mercury in the Aleutian Island food webs, which was designated as "Noteworthy" in the 2021 AI ESR[1]. The SSC commends this uniquely integrated, long-term, and collaborative approach. In brief, relatively high total mercury concentrations have been found in Steller sea lion (SSL) pups in the central and western Aleutian Islands, with higher concentrations observed in the western Aleutian Islands in both SSL and in sampled fish. It was noted that of 1611 fish sampled, only 13 had concentrations above thresholds of concern (1ppm) for human consumption and almost all were yellow Irish lord. The proportion of SSL pups at Agattu island that are in the high-risk category (with mercury concentrations above published thresholds for health impacts) has doubled over 10 years.

The research team, which includes UAF, ADF&G, AFSC, Ocean Peace Inc., and Texas A&M, has several on-going, and planned projects that are building off of these efforts to explore the questions related to the source(s) of the mercury: "Is higher mercury in the western Aleutian Islands due to diet difference in adult female SSLs?" and "Has the diet of adult females changed over time, potentially leading to an increase in mercury transferred *in utero* to their pups?". The SSC looks forward to hearing the results of the on-going diet modeling that pairs samples from fish and SSL pups from 2011-2021. In partnership with USFWS, the UAF team is currently looking at mercury in invertebrates, as these relatively immobile species may be good indicators of 'point sources' of mercury in the Aleutian Islands. Graduate students are also exploring temporal changes in mercury in fish, and spatial patterns of mercury in fish using delineations based on passes between the islands (instead of SSL management units). In the SSC's December 2021 minutes, the SSC noted the lack of ecosystem-level studies in the Aleutian Islands region, which presents challenges for interpreting the impacts of various indicators and for fisheries management in the region. **The SSC continues to strongly support efforts that take integrative approaches to studying this ecosystem,** and specific to this study, discussed opportunities to include sampling of seawater and air to aid in discerning potential sources of mercury inputs into the marine environment. As many of these species explored may be important for coastal communities, the **SSC is encouraged to see the involvement of one local community in the study of mercury, and encourages further efforts toward co-production of information, outreach, and the dissemination of research results to local communities, especially for research such as this with potential human health implications related to the contamination of subsistence resources.**

More broadly, the SSC discussed the importance of upper-trophic level predators as sentinels of food webs and encouraged expanding efforts to improve our understanding of linkages between marine mammals, the physical environment, and prey species. For example, population monitoring of SSLs in the Gulf of Alaska suggests impacts of the recent marine heatwaves (see below) and the SSC suggested that sea lion diet information that spans these changes would be informative for understanding what may have driven the observed patterns in non-pup and pup counts. Similarly, the SSC encouraged studies of diets and telemetry-based foraging behaviors of walrus in the Eastern and Northern Bering Sea as sea ice continues to shift. These regions are seeing dramatic shifts in the benthic communities and crab stocks; as benthic foragers, walrus may be a good indicator of overall benthic production, carrying capacity, or expansion of harmful algal blooms.

Population Trends/Distributions

Updates were provided for a number of species on the current population trends. In brief:

Steller sea lions
Population surveys were flown in 2021 in the GOA. Non-pups and pup numbers were all trending positive across the 15yr window (2006-2021) with increases of 1.8-2.8% annually. Context was provided of trends

[1] Topics designated as "Noteworthy" in the 2021 ESRs were formerly designated as "Hot Topics."

relative to the prior marine heatwaves. In 2017, approximately 1000 non-pups moved from the eastern gulf to the central gulf and there was a decline in pups. In 2019, there was a decline in non-pup counts in the eastern and central gulf, but an increase in pup numbers. New data from 2021 showed a 10% increase in the eastern and central GOA of non-pup numbers (decline of 5% in western GOA), while pups remained constant in eastern and central GOA (decline of 9% in western GOA). Surveys were also flown in Southeast Alaska in 2021, but the data were not discussed. Surveys are planned for 2022 in the Aleutian Islands.

Northern fur seals
Surveys were conducted in 2021, though limited in scope, and showed a 3.84% decline over 3 years on St. Paul Island (2018-2021). Presenters noted a large confidence interval in 2021 due to incomplete sampling. Trends at St. George and Bogoslof Island were reported to the SSC in 2020.

Whales
Abundance estimates for sperm whales (for a small part of their range) are expected to be updated in 2023. Currently there are outdated estimates for populations of transient (mammal-eating) killer whales. Abundance estimates of the Alaska resident stock of killer whales will be updated and available for public comment this spring, 2022. In 2021, an aerial survey was conducted for Cook Inlet belugas. No belugas were observed in lower Cook Inlet. The next survey is planned for 2022.

Walrus
Walrus populations are currently considered robust, and population stressors low. Stressors are expected to increase into the future, and a population decline is expected over time.

The SSC was supportive of efforts, across species, to incorporate new technology to improve population monitoring. Advances that were mentioned included unoccupied aerial system (UAS) techniques for northern fur seal surveys, satellite imagery for Cook Inlet beluga monitoring, and acoustic monitoring of beluga foraging behavior relative to salmon runs. The SSC discussed how these approaches may supplement or support abundance estimates, assist in improving conventional survey methods (e.g., timing and distribution), or how other sources of information could be incorporated (e.g., observations of animals from oil and gas platforms to corroborate/validate remote sensing techniques).

D-7 Economic SAFEs

The SSC received presentations on the Groundfish Economic SAFE and Crab Economic SAFE from Ben Fissel (AFSC) and Brian Garber-Yonts (AFSC), respectively. There was no public testimony.

The SSC recognizes the high quality of the ongoing work that is being done to provide clear and consistent data summaries and analyses needed to address economic condition-focused aspects of SAFE reports as described under National Standard 2 guidelines, as illustrated in both presentations.

The SSC identified the need to continue discussions around the appropriate vehicle for, and publication timing of, summaries of the social conditions-focused aspects of SAFE reports, as also described under National Standard 2 guidelines, including those of fishing interests, fishing communities, and fish processing industries. This same information is needed to address the issue of the sustained participation of fishing communities as required under National Standard 8**.** As reported by the SAFE presenters, the social and community information that has recently been removed from the groundfish and crab SAFE documents will be updated and made available later this year in the Annual Community Engagement and Participation Overview (ACEPO), although it should still be considered, with the Economic SAFE, a part of a set of SAFE-related documents. As noted in the October 2021 SSC report, the SSC acknowledges the innovative and outstanding work that has been done to date in relation to the collection and use of social and economic data and indicators to address specific analytic needs and to broadly address needs related to National Standards 2 and 8 (among others) in ACEPO, Ecosystem and

Socioeconomic Profiles (ESPs), Ecosystem Status Reports (ESRs), risk tables, and new products being developed under the Climate and Fisheries Initiative (CFI).

In that same report and in its December 2021 report, the SSC suggested that it may be prudent to undertake a comprehensive, inclusive, and transparent review of how socioeconomic information is incorporated across the range of evolving Council decision-informing products to facilitate efficient reporting, future indicator development, and reduce staff burden. Specifically, regarding the relationship between the Economic SAFE and ACEPO, the SSC expressed the potential concern that decoupling these documents and releasing them at different points in the year and having them reviewed during different Council meetings may result in a less comprehensive stock assessment and fishery evaluation process than would be the case if reviews were concurrent. The SSC recommends that consideration be given to the timing of the release of the documents as a part of a holistic review of how socioeconomic information is incorporated in Council decision-informing documents in the annual management decision making cycle. In the interim, **the SSC endorses the analysts' suggestion to include a few paragraphs in the Executive Summary or some other part of the groundfish and crab SAFE cross-referencing ACEPO and summarizing the most recent social and community information available.** Adding a slide or slides to the annual SSC presentation beginning next year will improve the connection between the economic and social/community information covered in the National Standard 2 guidance for SAFE documents. The SSC is particularly excited about one potential pathway to providing a more holistic view of human dimensions data -- the development of a new Human Dimensions Data Explorer Tool -- and looks forward to learning more about it during the next ACEPO presentation and to more data being integrated into the tool over time.

Additionally, both Economic SAFEs and the respective presentations contained a first look at the impacts of COVID. **The SSC appreciates the work that went into the careful analysis of COVID impacts in each of the SAFEs and the presentations.** The presentations included results of original analyses and links to other information on COVID impacts, including a recent survey. The SSC recommends developing an approach for documenting contemporaneous impressions of COVID impacts in the SAFE reports that can be carried forward with the data as an explanation for relatively large deviations in some of the economic data time series. For example, it may be helpful to include a separate COVID impacts section in each SAFE with a holistic summary and synthesis of impacts that may span multiple years. Capturing explanations of data anomalies now while the experience is fresh may be helpful.

Groundfish Economic SAFE

The Groundfish Economic SAFE presentation provided a broad overview of the economic performance of the groundfish fisheries in the 2020 data year, with particular attention to changes coinciding with COVID and some new additions to the report. **The SSC appreciates the organized and accessible format the Groundfish Economic SAFE uses to depict the current economic status of the fisheries, changes in the economic status of fisheries over time, as well as to provide a detailed economic history of the fisheries.**

The SSC appreciated the new and recently added detail in the Groundfish Economic SAFE and presentation. This includes the report card indices. The SSC found the indices to be helpful in providing a brief overview of the fishery and in increasing the accessibility of the SAFE. Other items the SSC found particularly useful included the recently added summary of in-season harvest revenue through September and the COVID impact analysis including the detailed decomposition of the price and quantity effects to explain changes in first-wholesale revenue.

The SSC looks forward to the market profile being updated with more specific information on COVID impacts next year.

Finally, the SSC expressed concerns over dropping the Amendment 91 EDR data from the report. Although the data collected have limitations, it is important for process transparency to summarize for the public what has been collected. The SSC suggests other paths forward be considered, such as presenting the data but highlighting deficiencies with, or limitations of, the data and what it does (or does not) show.

Crab Economic SAFE

The Crab Economic SAFE presentation provided an overview of the economic performance of the fishery in 2020, as well as a list of "things-to-do" for future iterations of the document, some of which are responses to previous SSC requests with the goal of increasing the consistency with the Groundfish Economic SAFE**.** The SSC particularly appreciated the analysis related to potential COVID impacts, including the information on labor use and compensation, as well as the vessel income and expense summaries. The SSC also appreciated the evolving lease market analysis, which is helpful to continue to monitor the economic status of the fisheries. Another major area of new work is related to understanding the structure of QS holding entities, which the SSC appreciates and looks forward to its continuing evolution. It is clear to the SSC that substantial work went into cleaning and analyzing administrative data to develop the new QS decomposition in the report. The SSC looks forward to further development of this line of work including integration and continuing refinement of community-scale results and additional work on areas including composition of active versus absentee owners, advancing the work on decomposing QS ownership by tenure, and concentration indices. The SSC also recommends an analysis looking more specifically at the flow of QS between entities (such as between communities) to provide a better picture of who is capturing the ownership benefits of the crab fishery and how this may be changing over time. Relatedly, the SSC looks forward to new and ongoing work related to vessel ownership decomposition.

The SSC appreciated the preliminary report card index results included in the Crab Economic SAFE presentation and looks forward to formal integration into the report. In response to the challenge related to depicting indices that have very different data magnitudes pre- and post-rationalization, the SSC has two suggestions that could be explored: (1) include a static section that includes pre- and post-rationalization data and summarizes the relatively drastic changes that became apparent upon, or soon after, the implementation of the rationalization program; or (2) use the post-rationalization period magnitudes and standard deviations to set the scale, and then include the pre-rationalization data as well. Another suggestion from the SSC is that one of the four metrics related to crew could likely be eliminated, as it could be derived knowing the other three. A final suggestion is to include a metric related to the continuing work on QS decomposition and community participation within the report card.

Finally, the SSC supports other next-step priorities including adding a section to parallel the In-Season section of the Groundfish Economic SAFE and – pending considerations such as those noted above related to which analysis belongs in which report – price forecasts.

SSC Member Associations

At the beginning of each meeting, members of the SSC publicly acknowledge any direct associations with SSC agenda items. If an SSC member has a financial conflict of interest (defined in the 2003 Policy of the National Academies and discussed in Section 3) with an SSC agenda item, the member should recuse themselves from participating in SSC discussions on that subject, and such recusal should be documented in the SSC report. In cases where an SSC member is an author or coauthor of a report considered by the SSC, that individual should recuse themselves from discussion about SSC recommendations on that agenda item. However, that SSC member may provide clarifications about the report to the SSC as necessary.

If, on the other hand, a report is prepared by individuals under the immediate line of supervision by an SSC member, then that member should recuse themselves from leading the SSC recommendations for that agenda item, though they may otherwise participate fully in the SSC discussion after disclosing their affiliations with the authors. The SSC notes that there are no financial conflicts of interest between any SSC members and items on this meeting's agenda.

At this February 2022 meeting, a number of SSC members acknowledged associations with specific agenda items under SSC review. Amy Bishop acknowledged that her supervisor, Lorrie Rea, is a presenter for Agenda Item D6 Marine Mammals update, though Dr. Bishop was not involved with the work being presented. Brad Harris is a contributor, and supervises John Olson and Scott Smeltz who are also contributors, to the Fishing Effects model under Agenda Item D5 EFH. Robert Foy is the second level supervisor for Jim Thorson (Agenda Item D5 EFH) and Jennifer Ferdinand, who is a contributing author for the Agenda Item D4 Trawl EM discussion paper. Dr. Foy is also a third level supervisor or greater for: Martin Dorn (CPT co-chair), Mike Litzow (CPT co-chair), Cody Szuwalski (C2 BSAI Crab); Steve Barbeaux, Wes Larson, Cindy Tribuzio (contributing authors on D4 Trawl EM preliminary analysis); Ned Laman, and other co-authors of the discussion paper on Advancing EFH Descriptions and Maps (Margaret Siple, Tom Hurst, Christina Conrath) and numerous contributors to the stock assessment author map reviews (Agenda Item D5 EFH); Jeremy Sterling, Tom Gelatt, Paul Wade, Robyn Angliss (Agenda Item D6 Marine Mammal update); and finally, the authors of the Groundfish SAFE Economic Data report (Ben Fissel, Michael Dalton, Brian Garber-Yonts, Alan Haynie, Stephen Kasperski, Dan Lew, Chang Seung, Kim Sparks, Marysia Szymkowiak, Sarah Wise) and the Crab Economic Data report (Brian Garber-Yonts), all under Agenda Item D7 Economic SAFE reports. Dana Hanselman directly supervises Wes Larson and a second-level supervisor for Cindy Tribuzio, who reviewed the D4 Trawl EM discussion paper but were not co-authors. Jason Gasper is also married to Dr. Tribuzio. Dr. Gasper recently became the direct supervisor of Steve Lewis, who contributed data to the fishing effects evaluation, but was not an author for, Agenda Item D5 EFH. Andrew Munro is a second level supervisor for Toshihide Hamazaki, co-author of the NSRKC assessment, under the C2 BSAI Crab agenda item. Chris Siddon is a co-author on the AIGKC assessment, a direct supervisor of Jie Zheng (co-author of the NSRKC and AIGKC assessments), Katie Palof (CPT co-chair), and Lee Hulbert (co-author for AIGKC assessment), and is a second-level supervisor for Shareef Siddeek (lead author of AIGKC assessment). Ian Stewart provided information for Agenda Item D1 CSP review but was not a co-author.