North Pacific Fishery Management Council

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SCIENTIFIC AND STATISTICAL COMMITTEE
FINAL REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
June 6th – 8th, 2022

The SSC met from June 6 – 8th, 2022 in Sitka, AK, with some members participating remotely. Members present in Sitka were:

Sherri Dressel, Co-Chair *Alaska Dept. of Fish and Game*	Franz Mueter, Co-Chair *University of Alaska Fairbanks*	Amy Bishop *University of Alaska Fairbanks*
Mike Downs *Wislow Research*	George Hunt *University of Washington*	Robert Foy *NOAA Fisheries—AFSC*
Dana Hanselman *NOAA Fisheries—AFSC*	Brad Harris *Alaska Pacific University*	Kailin Kroetz *Arizona State University*
Andrew Munro *Alaska Dept. of Fish and Game*	Ian Stewart *Intl. Pacific Halibut Commission*	Patrick Sullivan *Cornell University*

Members present remotely were:

Alison Whitman, Vice Chair *Oregon Dept. of Fish and Wildlife*	Chris Anderson *University of Washington*	Curry Cunningham *University of Alaska Fairbanks*
Jason Gasper *NOAA Fisheries–Alaska Regional Office*	Kathryn Meyer *Washington Dept. of Fish and Wildlife*	Chris Siddon *Alaska Dept. of Fish and Game*

SSC Administrative Discussion

The SSC received a report from Diana Evans (NPFMC) on the B1 May 2022 progress report on "Council process ideas for change". Ms. Evans shared that the Council may choose at this June 2022 meeting to shift the nomination process for SSC and AP members earlier in the year, and may direct staff to issue the call for nominations at the June meeting rather than at the October meeting and open the nominations period immediately after the June meeting. The Council may also request SSC input on expertise needed in new membership, and/or identify specific expertise in the SSC call for nominations. **To provide timely input, should the Council choose to make these changes, the SSC developed recommendations for expertise of additional members that the SSC believes would be valuable to supplement their current knowledge base. These would include: (1) a scientist with broad expertise in ecosystem science and/or ecology, (2) a social scientist with a background in anthropology, sociology, human geography, or a related field, and (3) a scientist with fish population dynamics and stock assessment background.**

The SSC called for volunteers for an SSC subgroup that will work on Research Priorities in preparation for that agenda item in 2024. Members that will comprise the subgroup include Amy Bishop, Curry Cunningham, Mike Downs, Robert Foy, Kailin Kroetz, Chris Siddon, Pat Sullivan, and Alison Whitman.

Robert Foy (SSC member, NOAA-AFSC) provided an update from the SSC subgroup planning the February 2023 SSC workshop. The workshop is intended to focus on rapid ecosystem changes in the northern Bering Sea and southern Chukchi Sea. The focus was chosen given recent extreme environmental events in the region and the need to understand the use of these areas by species that are currently managed in the Eastern Bering Sea Fishery Management Plans. The general workshop goal is to identify the science and monitoring requirements for supporting future Council decision-making under increased uncertainty. The workshop may include an exploration of proactive approaches for achieving management goals in a non-stationary environment and an assessment of the applicability of existing frameworks to address ecosystem changes. The SSC discussed whether a one- or two-day workshop would be possible given uncertainty about the agenda for the February meeting and the desire to maximize participation in the workshop. The next steps for the subgroup will be developing a one-day agenda and identifying potential participants.

B1 Plan Team Nominations

The SSC reviewed the nominations of Ms. Caitlin Allen Akselrud, Ms. Beth Matta, Dr. Andrew Seitz, Dr. Michael Smith, and Ms. Jane Sullivan to the BSAI GPT, and Ms. Kristan Blackhart to the GOA GPT. The SSC finds these nominees to be well-qualified and recommends the Council approve their nominations.

C1 Central Gulf of Alaska Rockfish Program Adjustments

The SSC received a presentation on the Draft for Final Review of the Environmental Assessment (EA) from Sarah Rheinsmith (NPFMC) and Jon McCracken (NPFMC). Public testimony was received by Julie Bonney (Alaska Groundfish Data Bank; written and oral), Jon Warrenchuck (Oceana; oral), and Marissa Wilson (Alaska Marine Conservation Council; written). The purpose of this proposed action is to respond to changes in the fishery with measures that increase flexibility and efficiency for rockfish program participants and better enable participants to fully harvest the TACs for the primary rockfish species and land them in Kodiak, as intended. The alternatives considered included an option for an earlier season start as well as several options related to relaxing use and processing caps.

SSC review of the RIR in April 2022 recommended that analysts consider whether additional environmental analysis beyond a Categorical Exclusion was needed. In response, analysts concluded an EA was necessary and **the SSC's review at this meeting only encompasses the EA because the SSC in April found the RIR sufficient for Council decision making at final action, subject to minor modifications. As discussed in detail below, the SSC also finds the EA to be sufficient for Council decision making.**

During the SSC review in April 2022, most SSC recommendations were specific to the RIR and thus are not considered in this review. However, the analysts addressed two SSC recommendations from the RIR review that are pertinent to the EA:

1. *The SSC requested the analysts draw more extensively from monthly PSC data, in particular for the April 2021 fishery, to demonstrate the effect of the earlier start date on Chinook salmon and halibut.* The SSC appreciates the additional information provided in the analysis on monthly PSC (Tables 3-4 and 3-5) and notes the EA discussion on PSC relative to historical monthly patterns of catch, PSC limits, and monitoring requirements.

2. *The SSC recommended that the analysts consult with stock assessment authors of dusky and northern rockfish and Pacific ocean perch, and/or other relevant experts to consider the timing of parturition and exploitation relative to Alternative 2 in making a final determination about the appropriate analytic document.* The SSC appreciates the analysts reaching out to stock assessment authors and incorporating their expertise in the presentation.

Related to point 2, above, Alternative 2, Option 1, would amend the Rockfish Program (RP) start date to April 1st, which is the same date used for the emergency rule in 2021. The EA indicates that during the 2021 season, CVs utilized the flexibility of an April 1 start date: two vessels participated in the first and second week of April followed by nine and ten vessels during the third and fourth weeks of April, respectively. No CPs participated in April 2021. The key question that the EA and staff presentation addressed was whether additional effort in April is anticipated to sufficiently increase the harvest of primary rockfish species such that it significantly interacts with the stock dynamics and biology for these species. Principally, fishing during the months of April and May likely overlaps with the parturition period for the primary rockfish species.

Council staff presented information not in the EA on monthly removals of POP and noted that exploitation has historically been distributed over the fishing season. Staff also noted that, based on industry input, the flexibility afforded by the emergency rule allowed some harvest that would have otherwise occurred in May to be shifted to April. For POP, the fishery mortality projections assume roughly a third of the mortality has occurred prior to May 1, which is likely conservative relative to observed removals during the first part of the year and the timing of parturition (larval release). The utilization of TAC for northern and dusky rockfish has been low in recent years, anecdotally due to the species being difficult to catch and tradeoffs with more valuable species. The SSC also notes that total catch for primary rockfish species remains constrained by harvest limits set through the annual harvest specification process and RP regulations governing quota allocations, and these have been evaluated in previous NEPA analyses.

Therefore, the SSC concurs with the conclusion of the EA that the Alternatives being considered are likely to have minimal effects on the groundfish species caught. **However, the SSC recommends that the Secretarial review version of the EA clearly indicate that market conditions and/or fishing behavior could change from those observed in 2021 given the unusual events of COVID-19 and the loss of flatfish markets. Changes in fishing patterns are naturally expected to occur over time as well and the SSC recommends harvest patterns for primary rockfish species continue to be monitored and, if important changes occur, that they be considered in future assessments and/or the five-year RP review, as appropriate.** The SSC also encourages cooperative research on the reproductive biology of primary rockfish species, including the collection of biological information that may inform the assessment of maturity and the timing of parturition.

T**he SSC also recommends that the information provided in the staff presentation on historical monthly harvest of POP, primary rockfish species biology, and stock author input be incorporated into the Secretarial review version of the EA.**

The EA also identified that PSC, habitat, and social and economic resources could potentially be impacted by the action. **The SSC concurs with the EA conclusion that these resources would likely not be significantly affected by the action**. Based on the information provided in the EA, the additional month and changes to use caps under Alternative 2 are not anticipated to change the amount or seasonal distribution of PSC by large amounts. The analysis also notes that full observer coverage is required on RP trips and that PSC amounts are closely monitored given the regulatory limits in place. The EA notes that moving the fishery start date to April is not anticipated to result in significant changes to habitat impacts. Public testimony indicated that the additional month is unlikely to result in large changes in the spatial footprint of the fishery and fishing intensity would likely remain distributed across the fishing season.

The SSC recommends that these impacts continue to be monitored, and that important changes be included in the 5-year RP Review and/or next EFH review cycle.

C2 Bering Sea Aleutian Islands Pacific Cod Small Boat Access Initial Review

The SSC received a presentation from Kate Haapala (NPFMC) of an Initial Review draft RIR document that analyzes a proposed amendment to allow smaller hook-and-line (H&L) or pot catcher vessels (CVs) operating in the federal BSAI Pacific cod less than 60' hook and line (H&L) or pot CV sector to harvest Pacific cod from the jig sector's federal BSAI Pacific cod allocation. The proposed amendment would redefine the current federal BSAI Pacific cod jig sector to include jig CVs and catcher processors (CPs) as well as H&L or pot CVs that are less than or equal to either 55' or 56' length overall (LOA). Public testimony was provided by Dustan Dickerson (Unalaska Native Fishermen's Association) and Rachel Donkersloot (Coastal Cultures Research) and a written comment was received from Nikita Kuzmin.

The SSC commends the analysts on a clear, thorough, and thoughtful presentation and analysis. The analysis assembles the available and relevant information on the BSAI Pacific cod pot jig and less than 60' H&L or pot CV sector including the license limitation program, process for Pacific cod reallocations, fishery harvest and value trends by vessel group, and vessel linkages to communities. An overriding challenge for the analysts in evaluating this proposed action is the limited number of less than 60' LOA H&L or pot CVs in total (31 on average per year), and in particular those that are less than or equal to either 55' (a low of two vessels participating in the most recent year and an average of nine per year) or 56' (a low of five vessels in the most recent year and an average of 12 per year) and the accompanying data confidentiality constraints. The analysts, however, through a combination of quantitative data and qualitative narrative, presented an analysis that is comprehensive and sufficient for understanding the various costs and benefits of the proposed action, using the best available data.

Analysis of trends within vessel groups indicates that all groups have been negatively impacted in terms of catch and revenue due to Pacific cod TAC declines, but that the less than or equal to 56' LOA H&L or pot CVs have not been disproportionately impacted. Specifically, within the analysis of alternatives, catch statistics from 2008-2021 are provided by vessel group (jig, less than or equal to 56' LOA H&L or pot CV, and greater than 56' and less than 60' H&L or pot CV) allowing for analysis of historical trends by group. The percentage of the allocation landed by the less than or equal to 56' LOA vessels, including a typical annual reallocation from the jig sector, has not been decreasing over time.

The SSC finds the analysis adequate to allow the Council to understand the impacts of the alternatives. **The SSC finds the analysis sufficient to advance to final action after the analysts address the following minor recommendations:**

- **The purpose and need statement describes the motivation for this change as about entry, competition, and attenuating an ensuing race-to-fish, and these concerns were brought forward in public testimony. Figure 4.1 shows that the race has not reduced the share of catch going to smaller vessels. However, the SSC encourages the analysts to, if possible, explore whether shortening seasons are occurring** and if so, whether this is a result of the decrease in TAC or something else. For example, showing the number of fishing days per season, or the opening and closing dates for the A season, could help understand the extent to which seasons are shortening. A catch-per-day metric could provide a measure of whether fishing is occurring more quickly, potentially because of a race-to-fish.

A finding of reduced season length, in combination with the Figure 4.1 results, would give a more complete picture of whether the data substantiates the purpose and need statement. It would also be useful to include data on safety incidents that could be associated with a race-to-fish in this fishery.

- Although an excellent analysis considering the timeframe and data available, it is important to note that the numbers presented in Section 4.3 are all based on behavior under the current regulations that serve to constrain fisher choices. However, if regulations change, fishers will likely change their behavior. **The SSC suggests adding some clarifying language that emphasizes the difficulty of predicting responses post-management change and the inherent behavioral assumptions associated with the numbers presented.** For example, substantial entry to the new less than or equal to 55' or 56' LOA H&L or pot and jig sector could negatively impact jig participants over the long run (especially if the suboption of retaining the B-season as a jig-only fishery is not selected); on the other hand, if the new less than or equal to 55' or 56' LOA H&L or pot and jig vessels harvest a large portion of the allocation, this may jeopardize reallocation and full utilization of the stock.

    - In addition to general caveats, the analysts may want to consider caveating text like the following: "there would have been enough TAC in the BSAI Pacific cod jig sector's 1.4 percent allocation to support the new BSAI Pacific cod small vessel sector in every year from 2008 through 2021 under option 1 and 2". This would only be true under the assumption that the less than or equal to 56' LOA H&L or pot vessels would not increase their harvest, despite having a much longer period during the A season.

    - Another plausible assumption is that participants in the new less than or equal to 55' or 56' LOA H&L or pot or jig sector would increase their harvest with access to the jig quota in the A season and when they no longer have to compete with the larger H&L or pot vessels. In fact, the less than 60' LOA H&L or pot season closed by the end of January in recent years. Instead, under Alternative 2, Option 1 or 2, the vessels entering the jig sector would have until the end of April to harvest the A season jig quota.

- **The SSC also recommends the analysts explore additional information related to the community of those likely to be impacted.** Specifically:

    - In Table 4-1, it could be helpful to split the "*Small vessel sector (jig + ≤ 55' H&L/pot CV)*" row into two sub-rows (with one being a jig vessel count and the other being the ≤55' H&L/pot vessel count). Similarly, splitting the "*Small vessel sector (jig + ≤ 56' H&L/pot CV)*" row into two sub-rows (with one being a jig vessel count and the other being the ≤56' H&L/pot vessel count) would make it easier to assess potential differences between the two options.

    - In Section 4.5 Community Impacts, it could be helpful to note in the text (or in a new table) the community of ownership of those few vessels enumerated in the revised Table 4-1 that would have been eligible to be a part of the redefined less than 60' sector under one of the options but would be a part of the newly defined small boat sector under the other (i.e., the "swing" vessels).

- No exhaustive discussion of subsistence is needed, but instead of concluding there would be no direct or indirect impacts on subsistence, a more nuanced statement in Section 4.5 that does not exclude the potential for some indirect increase in subsistence activity or decrease in cost of subsistence by small vessels could be appropriate.

- The SSC also requests that, to the extent possible, the analysts explore the average historical vessel/participant dependence on the current less than 60' LOA H&L/pot sector. This could be done by calculating the average percent of total vessel revenue of the different groups (less than or equal to 55' LOA; less than or equal to 56' LOA; greater than 56 to less than 60' LOA) that is derived from this fishery.

- The SSC suggests that analysts might consider addressing data confidentiality challenges arising from the above suggestions by aggregating across years.

- Additionally, the SSC recommends the analysts include a brief description, if possible, of any expected changes in the timing or location of fishing effort, which could have localized stock effects.

- The SSC further suggests small changes to the text, figures and tables for clarity and readability of the document:

    - Distributional impacts are likely, as identified in the full analysis, but are not included in the abstract. Adding some detail would help readers understand that there will be losers under this change. In the abstract, the SSC suggests identifying some of the groups potentially negatively impacted:

        - In practice, this is a reallocation from the larger to the smaller vessels. The group of greater than 56' LOA and less than 60' LOA H&L or pot vessels (the proposed new less than 60' H&L or pot CV sector) is estimated to lose 22% of their historical average revenue ($1.26/5.63 mil); while the less than or equal to 56' LOA H&L or pot is estimated to have an opportunity to almost double (a 98% increase based on $1.08/1.10 million) their historical average annual revenue.

        - A set of Alaska communities identified in the main analysis.

        - The jig sector, if the suboption is not implemented.

        - There is substantial uncertainty over State fishery impacts.

    - The text related to the revenue gains and losses between the two groups of H&L or pot CVs is confusing and should be clarified.

    - An additional figure or a revised Figure 4.1, with the percentage of revenue each group has historically obtained, could help show the pattern of landings between the two H&L or pot groups.

    - The analysts might also consider:

        - Using stacked bar charts for Figures 4.1 and 4.2.

        - Clarify the average number of participating vessels <60' LOA (e.g., 27 at the start of 3.6.1; or 31 based on Table 4-1).

        - Providing a new table that separately enumerates, by gear type, the historical participation of H&L and pot vessels that would be included in the newly defined small vessel sector under options 1 and 2 as discussed during public testimony.

        - Suggestions for additional minor changes were provided directly to the analyst.

Finally, the SSC highlights several long-term potential outcomes of the proposed alternatives that qualitatively impact the fishing opportunities associated with LLP licenses and vessel capital and are not explored in the current analysis. The SSC suggests that these potential outcomes be acknowledged in the document. These potential outcomes may depend on additional factors such as whether Pacific cod TACs increase to previous levels. First, substantial changes to opportunities associated with LLP licenses change the value of the licenses directly affected, but also could influence other sectors. Specifically, Alternative 2 could signal to all LLP license holders that additional regulations could change their fishing opportunities and therefore permit value either directly (as in this case) or by introducing uncertainty regarding the future opportunities a permit will provide. In this case, increasing the catch available to smaller, less efficient vessels by decreasing available catch to larger, more efficient vessels could reduce the permit value. Another potential long-term impact could be experienced by the jig sector if Pacific cod stocks recover to a level where jig fishers would fish more or all of their allocation, but instead must compete with smaller H&L or pot CVs. Finally, changing length-based access opportunities can have substantial longer-term implications for fishers both within the target fisheries as well as others not explored within the RIR. As pointed out in the analysis, vessels in either group may have incentives to try to adjust their current length if they are close to the cutoff. More broadly, as described in the analysis, many of these vessels fish in multiple fisheries, and a vessel purchase is a substantial investment with the length chosen with consideration of available fishing opportunities. Frequent regulatory changes related to length could deter more specialized capital investments, such as deterring new vessel purchases and decreasing economic efficiency or undermining safety.

C3 Bering Sea Aleutian Islands Crab

The SSC received a detailed report on the May 2022 Crab Plan Team (CPT) meeting from Sarah Rheinsmith (NPFMC) and the CPT co-chairs, Mike Litzow (NOAA-AFSC) and Katie Palof (ADF&G). The SSC appreciates the CPT's efforts to streamline their presentation to the SSC. Not all CPT agenda items were presented to the SSC, though they are detailed in the CPT report. Items on which the SSC provided comments are below. Table 1 includes the stock status determination criteria, Table 2 includes the June 2022 SSC recommendations, and Table 3 details the maximum permissible ABCs and SSC-recommended ABCs.

Table 1. Stock status in relation to status determination criteria for 2021/22 as estimated in June 2022. Specifications for Pribilof Island Blue King Crab are rolled over from June 2021. 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	2.05	4.10	0.18	0.04	0.00116	0.00[3]	**Overfished**
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	5.85	11.72	12.59	1.07	4.81	2.72[3]	
9	Pribilof Islands golden king crab[4]	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] Catch and overfishing determination will be finalized in October after fishery is completed.
[4] PIGKC specifications are set on a calendar year basis

Table 2. SSC recommendations for Eastern Bering Sea crab stocks. Specifications for Aleutian Islands Golden King Crab are set in June 2022. Specifications for Pribilof Island Blue King Crab are rolled over from June 2021. 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	4c	0	4.10	1980/81-1984/85 & 1990/91-1997/98 [MMB]	0.18	0.04	1	0.18	0.00116	0.00087	25%
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]	3a	0.52 (EAG) 0.43 (WAG)	11.72	1987 - 2017	11.94	1.02		0.21	3.76	2.82	25%
9	Pribilof Is. golden king crab[4]	5	-	-	See intro chapter	-	-		-	0.093	0.070	25%
10	W. Aleutian Is. red king crab	5	-	-	1995/96-2007/08	-	-		-	0.056	0.014	75%

[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 Tier 1-4 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	0.00104	0.00087
6	Saint Matthew BKC[2]	4		
7	Norton Sound RKC[2]	4	0.30	0.18
8	Aleutian Islands GKC[2]	3	3.74	2.82
9	Pribilof Islands GKC[5]	5	0.092	0.07
10	Western Aleutian Islands RKC[5]	5	0.056	0.014

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)

General Comments to Crab Assessment Authors

The SSC had a number of comments applicable to multiple crab assessments.

The SSC noted that a stock structure template exists as part of the NPFMC spatial management policy but has not been completed for any crab stocks. The entire red king crab (RKC) population in the EBS would benefit from a thorough examination of stock structure via this stock structure template. Given the very specific spatial assessment of RKC stocks and the potential for climate-induced spatial distribution shifts, a better understanding of their stock structure would be useful. **The SSC recommends that the RKC authors work together to complete a stock structure template for June 2023.**

The SSC noted that there are two 250+ page documents produced for BBRKC per year. Particularly during preliminary model runs for May, a full document need not be produced, and a focused summary of model features and runs would be sufficient.

The SSC suggests that the CPT develop guidelines for when to change model start dates. Both BBRKC and Tanner crab assessment authors proposed changes to model start dates with similar, but not identical rationales. While changing start dates may lead to improved model fits to available data and allow for reduced model complexity in terms of removing time blocks for natural mortality or other parameters, there is a potential to lose historical context or the ability to better understand what might have caused model difficulties or demographic changes (e.g., increased mortality events). Thus, the overall goal of these guidelines would be to ensure a full discussion and consistent criteria be applied for proposed changes across stocks into the future. The SSC recommends that these guidelines for start date changes should consider data availability, model complexity, impacts to estimates of the average level and variation in recruitment, loss of historical context and perspective on natural mortality changes and how this would impact short and long-term projections for stock dynamics.

Aleutian Islands Golden King Crab

The SSC received the summary of the AIGKC stock assessment from the CPT co-chairs. Public testimony provided by John Hilsinger (F/V Alaska Trojan) focused on concern over using chela - carapace width relationships without biological confirmation of functional mating and concern about potential increasing trawl effort. Public testimony provided by Scott Goodman (Aleutian King Crab Research Foundation) reiterated the need to understand spatial variability in maturity, support for the 25% ABC buffer, and the need for a GMACS model to be able to better incorporate CPUE and maturity data.

The SSC thanks the stock assessment authors for the consideration of, and responses to, previous CPT and SSC comments. In particular, the SSC appreciates the substantial improvement in the GMACS AIGKC stock assessment model, considerations for minimum maturity, and updating the time series used for average recruitment. The AIGKC stock is managed by ADF&G on a two-area basis (east and west of 174°W longitude; EAG and WAG, respectively) with a harvest strategy based on model-estimated mature male abundance that specifies a 15% maximum harvest rate for EAG and 20% maximum harvest rate for WAG. The AIGKC stock assessment is based on two separate models (the EAG and WAG) that are configured similarly and model results summed to provide stock-wide management advice.

The SSC appreciates the authors addressing catchability and retrospective concerns by exploring time-varying catchability for the post-rationalization period in EAG. The SSC noted that there was an increasing trend in catchability with fairly clear steps in 2011 and 2014. By the end of the time series of estimates, the catchability is closer to that of WAG. **The SSC requests a future iteration of time-varying catchability constrained with appropriate penalties and/or exploring the use of time blocks within the post-rationalization period.**

While the fishery in the EAG was complete in time to inform this stock assessment, only 73% of the TAC for the WAG had been harvested at the time of the assessment. The authors assumed that the WAG final catch would equal the TAC and this year's CPUE would be based on the data available. While this assumption is consistent with recent practices, the **SSC agrees with the CPT recommendation that the authors provide a retrospective analysis to compare the actual CPUE at the end of the season to that projected and used in the model.** The retained catch and bycatch mortality was similar to, or lower than, other recent years. Fishery CPUE decreased in 2021-22 in the EAG and the WAG for the third year in a row (close to the average CPUE since 2003 and the lowest point since 2004, respectively).

The authors reconsidered the maturity estimates by comparing older and newer data sets using a broken stick model, resulting in a range of minimum size at maturity depending on which data set is used. **The SSC agrees with the CPT recommendation that the results of the new data (116 mm CL) be used this year because of the higher sample size and consistency in the data collection.** The SSC noted that the total mean maturity value for all samples combined in Appendix C presented by the authors did not appear to be accurate and asked that the table be checked. It was also noted during SSC discussion and public testimony that the minimum size at maturity was different in each region. **The SSC requests that a future analysis consider the spatial footprint of the historical and new data sets to determine if the data exist to show a temporal trend in the spatial variability in size at maturity.** This analysis should also consider temperature data that may be informative as to the cause of temporal or spatial variability.

The authors provided the 2022 assessment with five models that included Model 21.1e with three catchability parameters and associated additional CVs, Model 21.1f that substituted observer CPUE data standardized using year-area interactions, and similar models with a new minimum size at maturity of 116 mm CL. The authors also provided GMACS versions of each of the five models, for a total of ten models. **The SSC supports the CPT's recommendation to use Model 21.1e2 for both the EAG and the WAG as the basis for status determination and the OFL.** The SSC continues to be concerned about the strong positive EAG retrospective bias and fit to CPUE index trends. In addition, the retrospective bias for the WAG, while still small, has increased since 2021 and should be monitored for any potential serial over- or underfitting of the abundance index.

A 25% buffer to the maximum permissible ABC for AIGKC was applied from 2017 to 2020 but was increased to 30% in 2021 due to model convergence concerns. The authors conducted jitter analyses and concluded that there are no convergence concerns in the current model. Therefore, **the SSC agrees with the CPT recommendation to return to the 25% buffer,** noting the following remaining uncertainties: no fishery-independent index of abundance, uncertainty in natural mortality, limited spatial distribution of catch data relative to stock distribution, the small number of data points to derive CPUE estimates, retrospective patterns in the EAG, and recent changes in length frequencies in catch data. The SSC thanks the CPT for continuing to provide a clear table identifying additional uncertainties that should be considered in an ABC buffer.

The SSC supports the specific CPT recommendations for additional research and development of upcoming assessments. In addition, the SSC has the following requests:

- In the next assessment cycle, provide a model that includes year:area interaction in the CPUE index that includes all diagnostic tools, in particular, a retrospective analysis.

- Investigate the potential source of conflict between the CPUE indices and size composition data that may be causing the retrospective trend in EAG as suggested by the model with time-varying catchability.

- As the GMACS analysts develop and combine code, consider the ability of the model to accommodate 1) a unified (east and west) single-area AIGKC stock assessment model; 2) a two-area spatial model with some shared parameters and connectivity; and 3) the time series of cooperative survey data now available in both regions.

- Consider a focused AIGKC GMACS item on the January modeling workshop for comparison with the non-GMACS model.

- Based on public testimony regarding increasing trawl overlap with the AIGKC distribution, provide a map of historical trawl fishery distribution relative to the AIGKC fishery.

Bristol Bay Red King Crab Model Runs

The SSC received a report on model alternatives for setting harvest specifications for Bristol Bay red king crab (BBRKC) in October as part of the CPT report. The SSC congratulates CPT co-chair Katie Palof (ADF&G) on assuming the lead author role for this assessment and thanks Jie Zheng for his many prior years of assessments and responsiveness to requests from the SSC. Eleven models were considered related to how catchability and natural mortality were modeled, the inclusion of BSFRF data, and the start year of the model. The rationale for removing the BSFRF data were unrealistically high catchability coefficients when estimated, improved retrospective patterns without the time series, and general lack of influence in the model given the existing prior on survey catchability. The justification for starting the model in 1985 rather than 1975 is that the time-block of elevated M in the early 1980s would no longer be required.

The author recommended Model 22.0d in which M was fixed to 0.18 for males, the model started in 1985 to avoid modeling the dramatic decline in abundance in the early 1980s, and the BSFRF data were dropped. The CPT and SSC disagreed with removing the BSFRF data at this time. Significant time and thought have gone into the BSFRF survey, and it would be unfortunate to remove it rather than continue to determine how to best use it. Given the very high confidence intervals around the BSFRF estimates, they are unlikely to exert a strong influence on the model. Model 22.0b estimates a catchability over one, which was used as a rationale to not use the BSSRF data. The SSC notes that there are several factors that could result in a catchability over unity: 1) confounding with misspecified selectivities and M, 2) demographic leakage from other red king crab stocks outside of the BBRKC stock boundaries, and 3) as mentioned in the assessment, the BSFRF nets may be herding crab. **The SSC recommends exploring how to estimate both catchabilities (NMFS trawl survey and BSFRF survey), but with a linked prior to influence them to scale together (i.e., assume some approximate value of how much higher q is for that survey).**

The CPT did not recommend Model 22.0d, but recommended Model 21.1b (base GMACS model with updated bycatch data) and 22.0a which estimates M, retains the BSFRF data and starts in 1985. The SSC concurs with the CPT that starting in 1985 is an improvement. The catch history of BBRKC can still be documented, but the elevated M period has been a distraction from other model improvements and has little effect on harvest recommendations. The SSC suggested that it would be helpful if the CPT developed a set of criteria for choosing the start year of models (see General Comments for Crab Assessment Authors section of this report). The model (through likelihood profiles) and data (better fits) point toward a higher estimate of M. The SSC continues to encourage aging studies on this stock and notes that the current understanding of maximum age supports a higher M. **The SSC concurs with the CPT recommended models.**

The SSC recommended in the General Comments to Crab Assessment authors that the RKC authors work together to complete a stock structure template for June 2023. Further, the SSC also commented that a full document may not need to be produced for documentation of preliminary model runs, noting the BBRKC document at this June 2022 meeting was greater than 250 pages (see General Comments to Crab Assessment Authors section above).

Tanner Crab Model Runs

The SSC received a presentation describing analyses related to the Tanner crab stock assessment and proposed models for setting harvest specifications in October 2022. There was no public testimony. The work conducted since September 2021 addressed 1) revisions to the historical bycatch estimates in groundfish fisheries, 2) fitting to aggregate fishery biomass rather than sex-specific biomass, 3) revising survey input sample sizes using bootstrap variance estimates, 4) modeling discrete fisheries in the ADF&G management areas for Tanner crab, and 5) starting the model in 1982. Model results clearly showed concerns with the revision to survey input sample sizes and modeling discrete fisheries, and they were appropriately dropped from the final proposed models. The SSC supports incorporation of updated groundfish fishery bycatch information in all proposed models for review at the September CPT meeting, acknowledging that impacts to estimated demographic and management quantities of interest were minimal.

The SSC supports the CPT recommended models to bring forward for harvest specifications:

- Model 22.01: Base model from last year updated with new data (which includes the updated groundfish bycatch estimates).
- Model 22.03: 22.01 plus fitting to fishery aggregate biomass (instead of sex-specific catches and size composition data).
- Modified model 22.06a: 22.03 plus initial size composition starting in 1982 with a relatively small smoothing penalty (e.g., 0.1) applied. The SSC supports author discretion in selecting the most appropriate smoothing penalty.
- Modified model 22.06a as described above plus bootstrap estimates of annual input sample sizes.

Even though the estimation of input sample sizes did not perform as expected (it produced even higher sample sizes than default values in the base model), the SSC supports the CPT recommendation to revisit this approach with the revised start date (1982). In addition, the SSC commends the authors for proposing two models (22.01 and 22.03) with no parameters hitting bounds and the remaining models having only two or three parameters at bounds (depending on smoothing). The SSC recommends continued efforts to examine and address the remaining parameters that are still estimated at their bounds.

The SSC supports CPT recommendations to continue exploring alternative approaches to incorporating the BSFRF survey data in the assessment, attempting to model the ADF&G management areas as separate fisheries, and to continue making progress on a GMACS implementation for Tanner crab. However, the SSC recognizes that there may be benefits of waiting until additional improvements in GMACS occur, specifically the adoption of a GMACS model for snow crab.

The SSC also suggests that the CPT develop guidelines for changing model start dates. Both BBRKC and Tanner crab assessments proposed changes to their starting dates with similar rationales. Please refer to the General Comments for Crab Assessment Authors section above for a more detailed SSC recommendation.

St. Matthew Blue King Crab Model Runs

The SSC appreciates the CPT's presentation of the highlights from their May meeting on SMBKC. The SSC is tasked with recommending model runs for SMBKC and general options for assessments given the available data. There was no public testimony.

The last full assessment, which was in September 2020 (upon the move to a biennial cycle), concluded that the population was still below MSST and remains under a rebuilding plan to be updated this fall (2022). No changes to fishing regulations or further bycatch restrictions are expected. The CPT focused on recruitment expectations, core model issues, discrepancies in trends between pot survey and trawl survey, spatial hot spots in surveys and poor fit of models to survey data after 2010. SMBKC is currently a Tier 4 stock. The next full assessment for SMBKC will be completed in October 2022.

The assessment author responded to three specific concerns raised by the CPT and SSC in earlier meetings; namely, ideas as to why a discrepancy exists between the pot and trawl surveys, the usefulness of time varying catchability relative to model performance, and a validation of the parameters in the model relative to biological characteristics of the stock.

The difference between the pot and trawl surveys' spatial footprint could result in the differences seen in the trends. The CPT presented analyses from the author that support this idea and point the way to further approaches for resolving the observed differences in time trends between surveys. To help with the diagnostics, a comparison of trends between surveys in the areas where they overlap would be informative.

Allowing for time varying catchability did not seem to resolve any of the issues raised in earlier assessment reviews and would not be relevant to resolving issues potentially related to differences in survey coverage.

Regarding relevant biological characteristics gathered from the population that would be useful to compare and validate model parameters, the SSC recognizes that blue king crab life history parameters are not available, as no focused studies on those characteristics exist for that stock, and therefore these are borrowed from other species. At this time, only sensitivities of the model to increased natural mortality (M) were evaluated (Models 22.0a and 22.0b). Sensitivities to the model assumptions on growth and maturity will be explored at a later date.

The model was found to be not very sensitive to increases in natural mortality. The removal of the 1998 spike in M led to changes in MMB and recruitment, but did not improve the fit to size composition data, and these models were not recommended for consideration in October by the CPT. **The CPT recommended bringing forward the accepted 2020 assessment model (Model 16.0 – 2020 version) with updated data for 2021/2022. The SSC agrees with this proposed model.**

An update will be provided in October on rebuilding status.

Size bins in the model are being considered for modification. It is unclear how these modifications compare to biological expectations relative to absorbing other correlated processes in the model. Further exploration of this issue would be helpful. As increases in size bins are considered to improve model fit, authors should consider the empirical measures of molting probability that inform the model fit (growth matrix).

Pribilof Island Red King Crab Model Runs

The SSC received a presentation on the PIRKC proposed model runs. There was no public testimony.

PIRKC is assessed on a triennial cycle. The last full assessment was in 2019 and employed a GMACS assessment model. There has been no directed fishery for this stock since the 1998/99 season. Stock status is assessed using a B_{msy} proxy of 35% of the unfished (2000-present) biomass and catch is bycatch only.

The assessment author proposed:

- Model 22.1, which is the base 2019 GMACS model with updated survey and bycatch data,
- Model 22.1a which is Model 22.1 with size composition weights set to 50 and
- Model 22.1b, which is also Model 22.1 but with size composition weights divided by two.

The CPT supported bringing Model 22.1 forward for SSC review in October but did not support models 22.1a or 22.1b. Instead, the CPT recommended three new models for consideration:

- Model 22.1c which is Model 22.1 with ADF&G pot data,
- Model 22.1d – Model 21.1 with trawl survey size composition, and
- Model 22.1e – Model 21.1 with both ADF&G pot data and trawl survey size composition.

Models 22.1c, 22.1d and 22.1e were not reviewed by the CPT in May.

It is unusual to have CPT-recommended models presented to the SSC in June that were not reviewed by the CPT in May. **In general, the SSC prefers to avoid this situation and requests that authors address SSC requests for model runs in time for review. In this case, the SSC notes that the recommended models are responsive to previous SSC requests and supports the CPT's recommended models moving forward.** The SSC notes that any model brought forward in October, but not reviewed in June, will be held to a greater level of scrutiny.

The SSC also appreciates the exploration of EBS-wide PIRKC stock connectivity and concurs with the CPT recommendation to continue this investigation. **The SSC recommended in the General Comments to Crab Assessment authors that the RKC authors work together to complete a stock structure template for June 2023**. Further, the SSC encourages the continued development of PIRKC-specific life history characteristics (currently, information is borrowed from BBRKC).

Snow Crab Proposed Model Runs (GMACS)

The SSC received presentations on transitioning the EBS snow crab model to GMACS, recommendations on proposed October assessment model alternatives, and an overview of factors that may have contributed to the apparent collapse of the snow crab stock.

The SSC received written comments from Scott Goodman (Bering Sea Fisheries Research Foundation) and Jamie Goen (Alaska Bering Sea Crabbers), as well as testimony and discussion from Scott Goodman, Cory Lescher (ABSC), Edward Poulsen (F/V Patricia Lee), John Gauvin (Alaska Seafood Cooperative), and Mateo Paz-Soldan (City of St. Paul).

The SSC appreciates the comprehensive comparison of the current ('status quo') model and the proposed GMACS model that clarified differences between the two models for the CPT and SSC. The SSC did not recommend adopting the GMACS model in October 2020 and further explorations of GMACS were paused in 2021 as the platform at the time was not able to incorporate variations in non-fishing mortality that proved essential to capture recent snow crab dynamics. The document clearly lays out the advantages of GMACS over the status quo model and **the SSC agrees with the author and CPT recommendation to use the GMACS modeling platform for the 2022 assessment and for the snow crab rebuilding analyses.** The main reasons for moving to GMACS are summarized in the CPT report and include:

- Better convergence characteristics than the status quo model, which result in more robust parameter estimates
- Improved transparency and reproducibility, which will facilitate future review and benefit crab modeling efforts across stocks
- The ability to do projections, which are essential for the rebuilding analyses
- Improved fits to survey biomass data
- Improved fits to the BSFRF size compositions and recent size compositions for the NMFS surveys (in particular for immature crab)

In addition to the previously accepted base model ('status quo' model 21.sq) and the similar but not identical GMACS model (21.g), the author presented two versions of 21.g that fix either natural mortality (21.g.m) or both natural mortality and growth parameters (21.g.mg) at the values estimated in the status quo model. While model fits were similar overall, the GMACS configuration resulted in better fits to most data components but estimated substantially higher natural mortalities than the status quo model (0.36, 0.34, 0.35, and 0.38 in GMACS (21.g) versus 0.27, 0.28, 0.27, and 0.27 in the status quo model (21.sq) for mature males, mature females, immature males, and immature females, respectively), which resulted in a lower estimate of $B_{35\%}$.

The SSC shares CPT concerns over the high natural mortality estimates, which are a substantial departure from earlier assumptions about the likely range of M values. These high estimates resulted from a much broader prior on natural mortality assumed in the GMACS model. An additional minor concern was the overestimation of catches and abundances of large crab in 1982-1984 that apparently arose from the fixed numbers-at-age vector assumed in the status quo model. **Therefore, the SSC agrees with the CPT proposal to bring forward the following models for the September CPT meeting**:

1. Model 21.g (GMACS version from this meeting)
2. Model 21.g with priors on M that match those used in 21.sq
3. Model 21.g with an alternative specification of the initial numbers-at-age vector
4. Model 21.g with both of the above changes
5. In addition, the SSC requests to see Tier 4 calculations with the value for M from the last accepted model (not including the elevated values in 2018-2019) as a fall-back option for specifications

The SSC notes that models 2-4 are considered bridging analyses for evaluating the separate and combined impacts of changes in the initial numbers-at-age vector and in the prior on M on model results.

As noted by the authors, there are still many structural issues with these GMACS models, but the SSC agrees that the move to GMACS should facilitate resolution of these issues and provide a much improved basis for future model development. Considering the required rebuilding analyses, the SSC agrees that moving to a stable GMACS version is the highest priority at this point and recognizes that other issues such as those noted in the October 2021 SSC report may not be resolved in the near term. However, the SSC highlights in particular the following priorities:

- **The SSC strongly recommends that the urgency of accounting for snow crab in the northern Bering Sea requires that analysts prioritize working towards a model-based survey index that incorporates the NBS data and estimates the combined EBS and NBS snow crab abundance**, as well as considering the possibility that smaller, mature males are present in this area. The SSC recognizes that current year data are not available in time to be included in the assessment under the current schedule for assessment and review but suggests that even an index without the most recent year of NBS data is likely to be superior to only including survey biomass in the standard EBS survey area. In this context, the SSC also highlighted the need to improve understanding of changes in distribution, abundance and catches of snow crab in Russian waters.

- **The SSC strongly recommends including uncertainty intervals on estimates of biomass and abundances** when presenting assessment results.

- **The SSC continues to request an explanation for why the GMACS model estimates such a skewed sex-ratio for recruitment** (much higher females than males or the status quo) and whether it is reasonable or necessary to estimate sex-specific recruitment.

- **The SSC recommends that the author work with BSFRF to summarize observations from harvesters,** including fishery CPUE across space and depth among years, that may help inform stock dynamics.

- The SSC highlights the importance of assessing the current definition of male snow crab maturity given the possibility of snow crab maturing at smaller sizes and the sensitivity of reference points to assumptions about growth and maturity, as previously illustrated by the author. However, while the SSC welcomes further explorations on this issue, the SSC supports the current maturity assumptions for this year's model and rebuilding analyses considering other priorities.

- Finally, to more fully account for the effects of changing temperatures in the Bering Sea, the SSC encourages future explorations of temperature-dependent variations in growth and maturity.

With regards to the Ecological and Socio-economic Profile (ESP) for snow crab, the **SSC highlights previous requests to ESP analysts and Plan Teams to carefully consider the addition of social and community indicators in appropriate documents to meet requirements of National Standard 2**. **This is especially important for this stock in the context of upcoming rebuilding analyses** and will be critical to track changes during rebuilding to account for the needs of affected communities and to ensure a fair and equitable distribution of rebuilding benefits and costs. The SSC highlights in particular the cascading effects of the snow crab collapse on communities that strongly depend on the resource, such as St. Paul.

With respect to causes for the apparent collapse of the snow crab stock in the EBS, the SSC appreciates the author's expanded exploration of the potential mechanisms that may have led to the observed decline. These included potential effects of discarding, bycatch, cannibalism, disease, predation and temperature on non-fishing mortality and effects of temperature and spatial distribution on catchability. Key results from these analyses suggest that neither increasing predation from Pacific cod nor the increased frequency of bitter crab disease were plausible mechanisms for the decline. The author and CPT also considered bycatch and unobserved mortality to be unlikely culprits for the declines. However, the SSC notes that declines in

observed bycatch associated with trawl gear modifications does not account for unobserved mortality, and while these sources of mortality are an unlikely cause of the decline, their effects on the stock's ability to rebuild should be considered. The SSC suggests the authors continue to include the possibility of movement out of the area in addition to mortality hypotheses in future explorations.

The author's analyses suggest that bottom temperatures were a good predictor of mortality for immature snow crab. Potentially detrimental effects of high temperatures on immature survival and recruitment are consistent with previous research. The SSC suggests that the potential impacts of increased temperatures on immature snow crab could be explored through a bioenergetics model. **Critically, this observed link between temperature and mortality provides support for the use of high mortality scenarios or events for projections in rebuilding analyses that better represent recent conditions.**

Updates to Snow Crab Rebuilding Plan

The SSC received a presentation on the snow crab rebuilding analysis and CPT recommendations. The SSC recognizes the efforts that the author, the authors of the many supporting analyses, and the CPT have made on this stock's rebuilding analysis and in providing essential biological and fishery context.

The SSC received written comments and public testimony on snow crab as described above under the Snow Crab Proposed Model Runs section.

The SSC recognizes the additional challenge for the snow crab rebuilding analysis due to it coinciding with the technical transition from the status quo model to GMACS. It is generally not ideal to have three different models used for rebuilding, for last year's assessment and for the fall 2022 assessment. Some of the SSC's recommendations are intended to create as much consistency between these models as is possible. The SSC also recognizes the compressed timing of the analysis, acknowledging the need to press forward on the regulatory timeline, specifically noting that the CPT attempted to select the best alternative from only the information that was available in May.

The SSC highlights that snow crab are literally on the leading edge of climate change in the Bering Sea: the new and changing dynamics observed in the last few years appear to have rapidly transformed a healthy stock into one in need of rebuilding. Current climate projections suggest that the frequency of 'borealization', intermittent extreme temperature events, is already elevated relative to the historical period and is likely to continue to increase in the future. In light of these projections, the SSC recognizes that the range of rebuilding options should be structured accordingly, not simply assuming that the historical period is a good predictor of the future. **The SSC supports the CPT recommendation to use GMACS as the basis for rebuilding analyses but was not able to select appropriate rebuilding parameters given the information currently available. Therefore, the SSC provided guidance on rebuilding projections and fishing mortality alternatives that should be included in the next iteration of the analysis.**

The top priority for the rebuilding analysis is to use the tighter prior on M that is consistent with both last year's model and the preferred model recommended for the 2022 harvest specifications cycle by the CPT. This change will affect both the rebuilding trajectories as well as the B_{MSY} on which the rebuilding parameters will be determined.

The SSC supports the basic approach of selecting time-periods from which to resample recruitment strengths for structuring alternative rebuilding trajectories and notes that this is consistent with methods used for other crab rebuilding analyses. The SSC had considerable discussion regarding the treatment of M, noting that although a simple approach of creating rebuilding trajectories that use an average from a year (or years) as was done in the analysis thus far is technically appealing, this method is unlikely to adequately represent the effects of episodic mortality events on rebuilding.

The SSC notes that these episodic elevated crab mortality events are not isolated to snow crab but have been identified in several other BSAI crab stock assessments. **The SSC recommends a stochastic treatment of M, resampling of annual M values from the same period of years used for recruitment resampling.** To bracket a range of plausible trajectories, four time periods were recommended:

- 1982-2017: This period was recommended by the CPT, and will be similar to the results already provided, except for the use of the tighter prior on M during estimation. The SSC notes that this will likely be the most optimistic case, as it does not include the high estimated M associated with the apparent mortality event in 2018-2019.

- 1982-2019: This period matches the fully observed time series, including the elevated mortality in 2018-2019, but does not reflect the anticipated increased frequency of mortality events due to climate change.

- 1994-2019: This period follows the author's rationale for a break in the recruitment time series, reflecting more recent conditions while still allowing for the possibility of some high recruitment events.

- 2005-2019: This period corresponds to the most recent period of alternating warm and cool conditions in the Bering Sea and approximates a one in seven chance of an elevated mortality event, consistent with estimates of near-term future temperature variability in the Bering Sea.

Consistent with the treatment of mortality events for other crab stocks and for GOA Pacific cod, the SSC recommends using only the 'base' mortality rate (not including the 2018-2019 event), for each projection period, along with the resampled recruitments to calculate the B_{MSY} for determining rebuilding parameters. The SSC notes that longer term climate projections suggest even shorter periods for elevated temperature events that could generate a one in three chance of elevated mortality. The SSC highlights that, under this scenario, it is unlikely that the snow crab stock could rebuild to current reference points. The SSC discussed when and how B_{MSY} might be adjusted to reflect a higher mortality rate, i.e., specifically making the decision to adjust to the new 'prevailing conditions' and a different and lower level of productivity, allowing fishing at stock levels that would previously have been considered too low to provide for a fishery.

The SSC recognizes that these recommendations require technical changes to the analysis, possibly requiring modification to the GMACS projection methods. If it is not possible to add a stochastic resampling of annual M values to the rebuilding projections, the SSC notes that an average M over the range of years might still provide a reasonable basis for the rebuilding analysis. **Noting the compressed timeline for this rebuilding analysis, the SSC suggests if all of the four projection time periods cannot be evaluated that the first and fourth would be the highest priority.**

The SSC notes that the range of recommended projections may result in a T_{min} that exceeds 10 years. Therefore, the SSC supports the CPT recommendation to also calculate an updated mean generation time for snow crab, and if necessary, the three methods for determining T_{max} when $T_{max} > 10$ years.

The SSC supports the CPT recommendations of fishing mortality alternatives to include in each projection, with two additions for a total of five alternatives: No fishing mortality ($F = 0$), the average bycatch over a recent period (including both groundfish and other crab fisheries), an approximation of the State of Alaska's Harvest Control Rule (HCR) with recent bycatch (including groundfish and crab fisheries), an approximation of the State of Alaska's HCR without recent bycatch, and $F = F_{ABC}$ as the upper bound.

The SSC noted that the results presented at this meeting showed no rebuilding sensitivity (within one projection) to recent bycatch levels. However, the SSC recommends including one sensitivity projection using the State HCR and a larger value for bycatch that might represent an upper bound reflecting the inclusion of unobserved mortality. The SSC understands that the author may need to qualitatively consider research on unobserved mortality to develop this scenario, and only intends this sensitivity for comparative purposes. The SSC notes that unobserved mortality represents an unmodelled source of mortality that is already embedded in the observed time-series and that an appropriate treatment would need to first re-estimate population parameters while explicitly including this mortality. If the $F = 0$ or approximated State HCR alternatives result in population trajectories that are approaching T_{max}, the SSC recommends determining how large the bycatch would have to be for the median trajectory to reach T_{max}.

The SSC requests that future rebuilding analyses provide a summary of the technical specifications of how the projections are being run (e.g., how many forward simulations, which sources of uncertainty are included, whether Monte-Carlo error has been evaluated and is negligible for the quantities of interest). To aid in specific evaluation and comparison of rebuilding parameters, the SSC also requests that they be provided in tabular format including: T_{min}, T_{max}, mean generation time, and specific rebuilding times for fishing alternatives (potential T_{target} values).

The CPT identified several management actions that could be taken as part of a snow crab rebuilding plan. These included expanding the COBLZ area, revising the approach to the PSC limit via either changing the 'floor' at 4.5 billion crabs or specifying PSC for specific size-classes. The SSC also received public testimony identifying other potential tools including spatial and/or habitat specific management. The SSC notes that consideration of the efficacy of such actions will be possible when T_{max} has been selected and potential T_{target} values can be compared.

Finally, the SSC wishes to emphasize that the missing EBS/NBS survey in 2020 created a lag in the ability to recognize the declining stock trend and resulted in current analyses relying heavily on the 2021 survey data point; both the rebuilding analysis and the assessment may be strongly informed by the information gathered in 2022. The SSC also notes that the NBS may be increasingly important to the stock dynamics and fishery. To the extent possible, the SSC recommends including 2022 information in both the rebuilding and assessment analyses.

Survey Updates – Bristol Bay Red King Crab Resampling

The SSC received a presentation on changes proposed for the EBS trawl survey BBRKC resampling protocol. Public testimony was provided by Cory Lescher and Jamie Goen (Alaska Bering Sea Crabbers), Edward Poulson (F/V Patricia Lee), and Lenny Herzog (Bering Sea crab fishermen). Written comments were provided by Jamie Goen (Alaska Bering Sea Crabbers) and Scott Goodman (Bering Sea Fisheries Research Foundation). Under existing protocols, resampling occurs if ≥10% of the mature BBRKC females sampled during Leg 1 of the EBS survey have not completed their mate-molt cycle. Resampling occurs in 20–30 stations and involves 7–10 days at sea. The proposed change is to increase the resampling threshold to ≥25% and limit the number of resampled stations to 20.

In response to CPT and SSC requests, the analysts clarified that the primary goal of the BBRKC resampling program is to improve the accuracy of size composition data for post-molt females. Improving abundance estimates for mature females and estimates of reproductive status were secondary and tertiary goals, respectively. They reported a strong bottom water temperature effect on the proportion of pre- mate-molt females but noted that the limited availability of spring bottom temperature information affects its use as a pre-survey resampling predictor. Further, efforts to investigate other predictors of molt-mate phenology (e.g., prey availability) were limited because of a lack of data.

Finally, the analysts reported that due to the unpredictable movement of crab from nearshore areas into the survey domain, it is not practicable to standardize the resampled stations.

Looking back to 1999, the analysts noted that resampling would have been triggered at 10% but not at 25% in one year (2021) only. Comparisons of the size composition and estimates of abundance with and without resampling in 2021 were provided to support their conclusion that the proposed change would have minimal impact on the BBRKC stock assessment. The CPT supported the proposed change and noted that resampling is likely to become less common as the Bering continues to warm.

The SSC appreciated the thoughtful examination of the proposed change to BBRKC resampling. The SSC noted that there were no analyses indicating that the proposed change would improve the accuracy of size composition data for post-molt females, mature female abundance estimates, or estimates of reproductive status. In response to SSC inquiries, the analysts indicated that the primary purpose of the proposed change was to create flexibility in survey sampling station allocation in the future. Further, while the SSC appreciated the examination of 2021 data with and without resampling, the results did not elucidate the broader impacts of the proposed change on the BBRKC stock assessment going forward. The SSC also noted that public testimony provided by the representatives and members of the Bering Sea crab industry was not supportive of the proposed change.

The SSC does not support the CPT recommendation to implement the proposed revision to the BBRKC resampling threshold and recommends that BBRKC resampling be included in future survey strategic planning analyses.

Survey Updates – Corner Station Analysis

The CPT co-chairs presented an analysis of the impacts of dropping corner stations around the Pribilof and St. Matthew islands from the EBS survey. Public testimony was provided by Cory Lescher and Jamie Goen (Alaska Bering Sea Crabbers) and Edward Poulson (Bering Sea crab fisher). Written comments were provided by Jamie Goen (Alaska Bering Sea Crabbers) and Scott Goodman (Bering Sea Fisheries Research Foundation). The 26 corner stations require six to seven survey vessel days at a cost of about $100k and serve to increase sampling in areas that historically supported blue king crab and red king crab fisheries. The consideration of dropping these stations is part of an effort to free up staff resources to allow NMFS survey sampling in other areas including the potential for 10 deep stations along the northwest edge of the EBS survey grid near the international border. The analysts highlighted the need to balance the benefits of a standardized sampling design vs. the costs of permanent commitments to low-information sampling, flexibility needed to support allocation of sampling effort to other areas (e.g., deeper stations) and increased workload due to NBS sampling leading to increased injury rates of survey staff.

The analysis explored the impacts to abundance, length composition, and general crab stock assessment results. Results suggest minimal effects on Tanner and snow crab. However, removal of corner stations would likely increase uncertainty within the PIRKC and SMBKC assessments and produce reduced biomass estimates for SMBKC The survey group concluded that the additional flexibility gained by dropping the corner stations would offset the impacts to abundance, length composition, and general crab stock assessment results.

The CPT expressed concern about how changing the design would impact the long-term sampling of ecological information, discussed the possibility of dropping a subset of corner stations or other stations chosen at random and noted their support for sampling of deeper stations. Ultimately, the CPT did not recommend dropping corner stations this year but encouraged further exploration. Testimony from representatives and members of the fishing industry also opposed dropping the corner stations.

The SSC appreciated the thorough work of the analysts and acknowledged that the current sampling demands are challenging for survey funding and staffing. **The SSC concurred with the CPT and does not recommend dropping corner stations.** The SSC expressed concern over the increased pressure on survey staff and reports of rising injury rates and noted that these issues should be addressed separately from the sampling needs to first ensure safe working conditions for survey staff and support high quality data collection for stock assessments. The SSC recommends that corner station sampling be included in future survey strategic planning analyses.

Draft Risk Table for Bristol Bay Red King Crab

The SSC received a brief presentation of a draft risk table for BBRKC. The author and CPT requested SSC input on developing the table and whether to bring a draft table forward for review in October. The CPT was generally supportive of the risk table approach and noted the importance of flagging new concerns and those that are no longer applicable for crab stocks, given the CPT is tasked with recommending whether to maintain an existing ABC buffer, or to change it each year.

The SSC confirmed that, if risk tables are implemented for crab, risk tables should be developed by the stock authors with input from the CPT and that the tables should be included in the crab SAFE documents. In agreement with the CPT, the SSC noted that crab risk tables are likely to be different from those developed for groundfish owing to the crab ABC buffer selection process. The SSC noted that the items listed, and levels of concern reported, are not relative to an "ideal" assessment. The SSC reiterated that the tables are intended to capture items that are not addressed in the assessment and/or by the harvest control rule, and that the level of concern for each should be based on the degree to which that item contributes to the risk of the true ABC exceeding the OFL. For example, the current draft cites recent decreased recruitment as a population dynamics concern, but this is a concern that should be contained in the OFL determination from the model and the harvest control rule. Further details are provided in the SSC's Risk Table Workshop Report.

The SSC commends the author for both taking on the BBRKC assessment and developing the draft risk table. The SSC requests that an updated draft version be brought forward in October.

C4 Trawl Electronic Monitoring

The SSC received a presentation from Anna Henry (NPFMC) and Darrell Brannan (Brannan & Associates) on the Initial Review draft of an EA/RIR for using electronic monitoring (EM) to verify logbook records of discard events to support shifting human observer sampling shoreside for pelagic trawl vessels. Oral public testimony was provided by Julie Bonney (Alaska Groundfish Data Bank) and Brent Paine (United Catcher Boats).

The SSC thanks the analysts for a clear exposition of the mechanics of the EM program, how the data this program might produce would differ from the data generated by human observers, and the costs to individual vessels (in the BSAI) and the observer fee fleet (in the GOA). The SSC appreciates the process that has generated the information in this analysis; namely, using a sequence of pilot studies and an EFP to collect data and test processes within an adaptive management approach that allowed rapid refinement toward the Council's objectives. This facilitated fishery participants' understanding of the costs and benefits of EM and provided high quality data and information that the Council can use to select among the alternatives. The analysts have been responsive to SSC comments throughout the process and have produced an informative and clear document.

The analysis covers a comparison of the program-level costs of the human observer program with the costs of the proposed EM program using ranges based on experience during the EFP, and evaluates the biological data collected under the EM protocol. While there is variability and uncertainty in costs, the analysis presents the overall program-level costs and shows savings on the order of 25%, reflecting savings in both the GOA and the BSAI that are likely to be robust to identifiable sources of variation. Due to the differing structures of the observer programs for pollock vessels in the two regions, savings in the BSAI are likely to accrue to individual vessels, while in the Gulf, savings will allow observer funds to be allocated to other activities. The statistical properties of data collected by shoreside plant observers, as opposed to onboard observers, for gathering information under the paradigm of full compliance as confirmed by EM monitoring appears more than adequate in terms of coverage and will result in estimates of PSC that are reasonable, reliable, and likely to be unbiased. While there is some loss in haul-by-haul information relative to human observers, the increase in resolution and coverage of other information suggests the EM protocol will not negatively affect the pollock stock assessment and enhances data on bycatch and non-target groundfish species. However, some data on marine mammals and seabirds will likely be lost.

The SSC finds the analysis sufficient to advance to final action, following some minor revisions.

The SSC suggests the following changes to improve the content and clarity of the analysis:

- There is considerable variation in how, or if, participants would be impacted by joining this program and it would be helpful to have a more comprehensive exploration of this decision, potentially in a separate section. **First, there is heterogeneity in how the program-level cost savings is experienced by different participants, and the SSC recommends these distributional effects be elucidated.** The mechanism for savings affects incentives for and barriers to participation, and thus it would be useful to discuss more explicitly how different regional subfleets will be impacted. In particular, BSAI vessels see savings directly, while vessels in the GOA do not. The SSC suggests characterizing vessels that have and have not chosen to participate in the EFP, building on the current discussion that includes community and regulation information, and also considering participation rates by the portfolio of fisheries in which they participate (composition of catch), vessel size by group (e.g., BS, WGOA, other GOA), and any other characteristics the analysts think would be relevant. **Second, there are other economic and non-economic benefits or costs that may influence the choice to join**, such as not needing to host an observer on a small vessel or waiting for an observer to go out and social pressure. **Identifying and describing these factors qualitatively could also help provide a fuller understanding of the choice to join and in the longer run provide a better understanding of how to increase EM participation.**

- Include tender vessels in the estimates of costs and attribution of vessels to communities.

- **Include a qualitative discussion of communities or regions where potential loss of employment or business income related to a decrease in demand for at-sea observer services would likely be experienced and the potential for the increase in demand for shoreside observers to be met from local community labor pools.**

- List the communities included in the "Other AK" category in Tables 5-3, 5-13, and 5-19.

- The analysis presents differences in data collected by human observers and through the EM protocol, discussing them with the presumption that EM data are adequate for management purposes. This is based on previous comparisons of human observer and EM data contained in the pilot program reports. **It would be useful to summarize these analyses in this document, to provide an empirical basis within this final analysis that EM data will continue to support stock assessment and management.**

- The analysis has a lengthy discussion of the loss of haul-by-haul information relative to human observers, likely in response to past SSC questions. It would be useful to review the tone of this discussion to clarify that this information loss is manageable within the stock assessment process.

As the EM program operates, the SSC suggests considering the following aspects for refinement:

- Being conscientious about the time it takes to process the video data and the information collected by shoreside plant observers so that the information arrives in a timely manner for analysts to use in their assessments and for management actions. The SSC recognizes that the number of samples collected will be larger and notes the difference in the potential time needed for the transfer of information to data users.

- Continue development of methods to provide spatially-explicit information on incidental harvest.

- Continue to work on processes to allow collection of biological information from bycatch that is not retained and forwarded to the plant. This may include noninvasive methods, such as genetic sampling or photographs, and do not necessarily require transporting an entire organism (e.g., shark) back to the plant.

C5 Observer Program Summary

The SSC did not receive an update on the Observer Program Annual Report at this meeting due to time limitations.

D1 Salmon Reports

In response to both SSC and Council requests, the SSC received a series of presentations on salmon research in the North Pacific, stock status updates, genetic stock composition reports, updates to impact assessments, and the final report of the salmon excluder EFP. The SSC appreciates the time and effort put into these presentations and reports. Specific SSC comments are detailed below. There was no public testimony.

Chinook/Chum Stock Status

In response to the Council's October request, Katie Howard (ADF&G) presented the SSC with a stock status summary report and presentation that provided high level overviews of both chum and Chinook salmon stock status in Western Alaska. Both the presentation and report provided abundance indices in the Western Alaska region, which showed record low abundance in 2021 for each of the two species. Chum salmon run size estimates were also provided for the Yukon (summer and fall runs) and the Kwiniuk Rivers, both of which demonstrated the marked decline observed in 2020 and record low in 2021. The authors also noted that in 2021, only two of 14 escapement goals were met for chum salmon and five of 12 goals were met for Chinook salmon.

The SSC expresses continued concern over these severely declining trends and appreciated the update on salmon stock status for Western Alaska. To the extent it may help clarify elements of the stock status report for the Council, the SSC suggested adding some additional background information on the abundance index development, a high-level management rationale for the decisions included in the tables, and measures of uncertainty in the figure estimates (if readily available).

AFSC and ADF&G Salmon Research

The SSC received a presentation from Robert Foy and Ed Farley (NOAA-AFSC) summarizing ongoing salmon related research efforts led by the Alaska Fisheries Science Center (AFSC) and conducted in partnership with ADF&G, other agencies, organizations, and nations. Highlights from this comprehensive presentation included an overview of the various integrated ecosystem surveys and key findings on the drivers of poor salmon survival in the marine environment, as well as the role of AFSC research in the development of stock status assessments, ocean observation and catch origin estimates, among other areas of research.

The SSC also received a presentation from Katie Howard from ADF&G's Salmon Ocean Ecology Program on current and future salmon marine research. The presentation included an overview of the integrated ecosystem research done in partnership with AFSC on salmon ocean survival, a summary and application of their species distribution model for Chinook in the Bering Sea, and an update on *Ichthyophonus* prevalence in the region.

The SSC appreciated the comprehensive overview from both agencies on the impressive body of ongoing research. In light of the Council's November letter to the Secretary of Commerce voicing support for additional and dedicated funding for salmon research by AFSC, the SSC also considered whether this update could serve as an appropriate vehicle for outlining specific research priorities and needs as they relate to the Council's consideration of PSC in the high seas fisheries.

The SSC supports and highlights the value of the collaborative efforts that have been undertaken to understand the environmental and ecosystem drivers of salmon population trends. The research presented demonstrates the strategic value of having collaborations and research platforms that provide ecosystem level information and illustrates the importance of the Council's actions to encourage funding of these programs. In addition to valuable data on salmon, these also contribute to broader ecosystem assessments and the ability to predict food-web shifts and other impacts of climate-change in the Bering Sea. **The SSC was also encouraged to learn about the efforts by ADF&G and others to generate species distribution models, particularly ones that aim to develop daily predictions of the oceanic distributions of Chinook salmon. These models, in addition to information from SeaState on in-season interactions, are promising tools for management of salmon PSC.** Similar programs have been implemented along the West coast to reduce interactions between fisheries and marine mammals, sharks and turtles (EcoCast), sea turtles in Hawaii (TurtleWatch), and whales along the West coast (WhaleWatch).

Bering Sea/Gulf of Alaska Chinook and Bering Sea Chum Salmon Genetics

Presentations on the genetic stock composition of GOA and BSAI Chinook and chum salmon prohibited species catch (PSC) were provided by Chuck Guthrie (NOAA-AFSC) and Patrick Barry (NOAA-AFSC). Wes Larson (NOAA-AFSC) also provided a presentation on technological and workflow improvements and future directions for salmon bycatch genetics analysis.

The SSC thanks the presenters and the authors for their comprehensive reports on the salmon bycatch stock composition. The SSC also appreciates the effort that has been made to significantly reduce the timeline for analyzing genetic samples and drafting reports. The chum salmon genetics reports are current through 2021 and the switch from a microsatellite baseline to a SNP baseline, as well as more efficient chemistries (GTseq) and data processing pipelines, have helped make this possible. The Chinook salmon reports are current through 2020 for both the BSAI and GOA. Dr. Larson commented that they intend to continue to produce the chum salmon reports on this timeline (i.e., the following year) and will attempt to do the same with the Chinook salmon reports.

One of the challenges with completing the Chinook salmon report by April (or June) the following year is the timing of the reception of all the samples (i.e., the last samples are typically collected in October but not received by the lab until April). **The SSC highlights that the more rapid timeline for analysis and reporting greatly improves the utility of this information.** The SSC suggests the authors consider providing a preliminary report (e.g., information on bycatch numbers and timing, and preliminary estimates of A season stock compositions) if a final report cannot be completed in time.

The reports provided information on recent PSC numbers for both chum and Chinook salmon in context with historical PSC as well as patterns in timing and location of bycatch. **The SSC greatly appreciates the inclusion of an examination of the relationship of PSC timing with environmental indicators (e.g., sea ice extent) and fishing effort in the 2020 chum salmon report. These types of analyses are an important step to gaining a better understanding of patterns in salmon bycatch and developing tools to reduce PSC and impact on specific stocks.** However, the SSC agrees with the authors that more detailed analyses along these lines is perhaps beyond the scope of these annual reports. The SSC finds how the data are presented, in particular the figures that illustrate sampling proportion across seasons, useful to evaluate whether sampling targets are being met and representative samples are being collected.

The SSC also discussed several other improvements for the authors to consider for future reports:

- Include the P = 0 statistic in the regional stock composition estimate tables in the appendices in both sets of reports and provide an explanation of its meaning. This statistic is helpful for evaluating presence/absence of reporting groups with a small estimated contribution to the mixture sample.

- Provide confidence intervals of reporting group-specific numbers of fish, not just point estimates, in the regional stock composition estimate tables in the appendices.

- To provide context, consider including a figure illustrating average spatial PSC patterns over time or current year anomalies from the average across years, in addition to what is presented in Figure 5 of the 2020 Bering Sea chum salmon report, Figure 3 in the 2021 chum report, and Figure 4 of the 2020 Chinook salmon Bering Sea report.

- To the extent possible, make chum and Chinook salmon reports parallel in structure, content, and presentation to make it easier for readers.

The SSC appreciates the detailed presentation of the temporal and spatial patterns and trends in stock composition of the salmon PSC and notes some changes in the PSC for both Chinook and chum salmon not only in total numbers, but also stock composition and where and when specific reporting groups are caught. This, of course, raises the question as to what factors are driving these patterns? Gaining a better understanding of what influences the amount and composition of reporting group-specific PSC is potentially important for developing strategies to reduce the PSC and avoid specific stocks and minimize impact on them. Some initial explorations were provided in the 2020 chum salmon report and Dr. Larson discussed some of their ongoing and future activities that are taking this next step. He described a collaboration with industry (SeaState) to refine spatial clusters based on fishing effort and develop ways to improve stock avoidance strategies. He also noted that they have submitted a proposal, in collaboration with university partners, to develop stock-specific distribution models for chum salmon PSC. The SSC is encouraged by these efforts and the collaboration with SeaState and university colleagues.

As these collaborations mature and tools are developed and applied to salmon avoidance measures, communication with the public continues to be important. A potential communication vehicle may be the Incentive Plan Agreements where description of the rolling hot spot and avoidance measures are provided. The SSC does not receive these reports but, should the genetics information be incorporated in industry

measures, the SSC would appreciate an overview about how the information is being used. Also, as new products are produced, the SSC recommends authors consider whether it is best to include these results in the standard genetics reports or as separate reports. The SSC reiterates its suggestion from April 2021 to consider producing simplified "report card" reports, unless there are significant changes or specific issues or actions in front of the Council.

Overall, the SSC commends the Genetics Program at Auke Bay Laboratories on their successful efforts to improve efficiencies so that the genetics reports could be presented on a timelier basis, as well as their plans moving forward to improve understanding of long-term trends, to explore the influence of environmental variables on bycatch trends and composition, and to develop, through collaboration, strategies to facilitate the avoidance of specific stocks. The SSC supports these efforts and believes that they have the potential to help inform Council policy choices in the future about salmon PSC management.

Finally, during discussion of this item as well as the Trawl EM Initial Review (Agenda Item C4), concerns were raised about the lack of haul-level PSC information when multiple hauls are aggregated to the trip level. This is not a new issue given genetics information has been collected shoreside in the EBS pollock fishery for many years. **The SSC requests the authors explore post-stratifying the EBS shoreside collected genetics data by the fishing trip and fishery activity (e.g., grouped areas, times, vessels) rather than the current haul-level stratification, which requires dropping data from trips that occurred over multiple ADF&G statistical areas.** This may also allow for aggregation of genetics information at levels that correspond to fishery activity and salmon avoidance measures, which could be informed by industry input.

Chinook AEQ Update

The SSC received a presentation from Jim Ianelli (NOAA-AFSC) on updates to the Chinook salmon adult equivalency (AEQ) modeling efforts. The AEQ model converts Chinook salmon taken as PSC in EBS pollock trawl fisheries into the equivalent number of maturing adult Chinook salmon that would have returned to freshwater, either to spawn or be available for coastal or in-river fisheries. Genetic stock composition data from PSC samples are used to allocate adult equivalents among reporting groups permitting calculation of impact rates relative to observed run sizes. Recent updates to the AEQ exercise include (1) recent PSC genetic stock composition, (2) updated age composition information for returning adult salmon and re-weighting of reporting group specific age-at-return proportions based on relative abundance, and (3) updated age-length keys for estimating PSC age composition from reported length compositions. The SSC notes that estimated AEQ impact rates from 2011 to 2021 have averaged 1.9% for Coastal Western Alaska Chinook salmon and 0.6% for the Upper Yukon reporting group, with increased impact rates in 2020-2021. The SSC thanks Dr. Ianelli for his presentation on AEQ model developments and updates.

Given observed changes in the age composition of maturing Chinook salmon throughout the Arctic-Yukon-Kuskokwim region, the SSC highlights the value of these periodic updates to AEQ modeling efforts, as these changes influence the estimated probability of maturing at age, conditional on assumed age-specific marine mortality, and resulting estimates of adult equivalent mortality and impact rate. The SSC further highlights the utility of the "what if" analysis describing the likely impact rate for the Upper Yukon River and Coastal Western Alaska reporting groups had the full PSC cap of 45,000 Chinook salmon been realized.

With respect to the AEQ modeling, the SSC offers the following recommendations. Currently, a coefficient of variation of 10% is assumed for the abundance of mature salmon returning to freshwater for AEQ calculations; however, the SSC notes the increasing use of state-space Chinook salmon run reconstruction methods, which directly estimate uncertainty in mature salmon abundance.

The SSC encourages analysts to consider incorporation of these direct estimates of uncertainty where possible for reporting groups as an alternative to the assumed 10% CV. The AEQ analysis assumes age-specific marine mortality rates with the probability of maturing at age, conditional on these estimates. The SSC highlights the potential sensitivity of AEQ and impact rate estimates to assumptions about age-specific marine mortality. While the analyst highlighted that some level of uncertainty in these estimates is assumed and propagated through AEQ estimation, and that prior sensitivity analyses had indicated that total AEQ and impact rates were less sensitive to these values compared with genetic composition of bycatch and total bycatch numbers, **the SSC recommends that future AEQ reporting would benefit from either a description of these past sensitivity analyses or updated analysis of sensitivity to marine mortality assumptions.** With respect to description of the AEQ modeling, for transparency and clarity, the SSC recommends future documents incorporate a more detailed description of all sources of uncertainty and variability assumed in the analysis. Additionally, given the strong interest from coastal and subsistence-dependent communities in PSC impacts in the face of ongoing restrictions to subsistence harvest opportunity, **the SSC encourages NMFS and Council Staff to continue exploring options for making both AEQ methods and findings more understandable and approachable for non-technical audiences.**

The SSC had some discussion with the analyst about alternative methodologies for estimating AEQ mortality and impact rates including a stage or age-structured integrated population model approach, which would directly fit to abundance, age and length composition information, and bycatch numbers. **The SSC supports efforts to advance the AEQ methodology including the exploration of alternative model structures that may better account for process variation and observation error in input data.** With respect to the timing of informational updates on AEQ analyses, the SSC encourages the Council to consider whether it may be more appropriate to review these materials at meetings that do not coincide with the start of the salmon fishing season, as the SSC is concerned this may limit stakeholder participation. Finally, the SSC notes that research relative to the stocks that comprise the 3-river index is ongoing and looks forward to the opportunity to review, as practicable, should changes in methodology occur.

Chum Impact Recommendations

The SSC received an update from Diana Stram (NPFMC) on issues and staff recommendations for assessing PSC impacts to Western Alaska chum salmon. The SSC notes that, on average, Western Alaska chum salmon represent 15% of PSC while Upper/Middle Yukon River fall chum salmon represent 4% on average. The current state of knowledge regarding chum salmon PSC includes total PSC numbers and genetic composition estimates within time and area strata. In response to the Council request for recommendations on evaluation of impacts of pollock fishery chum salmon PSC, staff highlight that, relative to Chinook salmon, information on the age composition of chum salmon and absolute estimates of escapement are limited, which presents challenges for calculation of PSC impact rates. The SSC notes that it would be possible to calculate Western Alaska and Yukon River fall chum salmon AEQ mortality and these estimates might be useful for informing potential PSC impacts, if this were something the Council wished to pursue. However, these AEQ mortality estimates would be uncertain given necessary assumptions regarding marine mortality and age at maturity and of limited value without calculation of impact rates. Given the lack of total abundance estimates for many chum salmon genetic reporting groups, **the SSC does not support calculation of PSC impact rates at this time**. **The SSC supports the additional recommended analyses including expanded analysis of the spatial and temporal location of Western Alaska and Yukon River fall chum salmon PSC, and continued work to develop representative estimates of chum salmon ages in PSC.**

The SSC thanks Council and ADF&G staff for considering the potential for chum salmon AEQ and impact analyses and describing the current data limitations.

Salmon EFP Excluder Report

John Gauvin (Alaska Seafood Cooperative) presented the final report on experimental efforts to improve salmon excluders for trawl nets used in the Bering Sea pollock fishery. The SSC appreciates the effort that went into this research and, in particular, the work of Mr. Gauvin for guiding it.

The report provided an overview of research to modify pollock trawl gear to avoid salmon PSC in the EBS. The intent of the EFP was to inform the pollock industry about gear modification that could potentially improve salmon escapement from the net. Three boats with different levels of power were employed over three years, with sequential changes in the design of salmon excluders specific to each vessel. Salmon escape rates were between 31 and 39% with the initial design, however, the series of modifications done to improve these levels of escape during this EFP were unsuccessful at improving maximum escapement or consistency among tows.

Should there be continued effort to improve the efficacy of the excluders, the SSC has several suggestions. A re-examination of experimental design and the ability to obtain sufficient data may allow researchers to provide statistically significant results. For example, pairwise comparisons could be used, either through paired t-tests or more generally paired differences between treatment and control observations within an ANOVA to reduce the variation and take advantage of pooled observations. Research that focuses on separating the effects of gear-specific variability (e.g., horsepower, tow speed, artificial light and species-specific behavior) from environmental differences (e.g., location, water clarity, depth, amount of pollock) would be valuable. The gear-specific variability could be explored through experimental design (i.e., conducting different experiments), while the environmental factors could be reduced by conducting paired comparisons. Focusing on gear modification alone first would be beneficial. Once gear modification has evolved to the point of having confidence that it fishes effectively, exploring the sensitivity of the new gear to environmental factors would be a useful second step. Consideration of understanding bycatch avoidance versus percent escapement might be useful to see if one approach is better than another for addressing the larger goal. Also, a power analysis to determine sample sizes needed once the design is in place would help guide the necessary effort to achieve statistical significance and then assess biophysical importance (i.e., whether the difference is meaningful in terms of salmon saved versus pollock lost).

SSC Member Associations

At the beginning of each meeting, members of the SSC publicly acknowledge any direct associations with SSC agenda items. If an SSC member has a financial conflict of interest (defined in the 2003 Policy of the National Academies and discussed in Section 3) with an SSC agenda item, the member should recuse themselves from participating in SSC discussions on that subject, and such recusal should be documented in the SSC report. In cases where an SSC member is an author or coauthor of a report considered by the SSC, that individual should recuse themselves from discussion about SSC recommendations on that agenda item. However, that SSC member may provide clarifications about the report to the SSC as necessary. If, on the other hand, a report is prepared by individuals under the immediate line of supervision by an SSC member, then that member should recuse themselves from leading the SSC recommendations for that agenda item, though they may otherwise participate fully in the SSC discussion after disclosing their associations with the authors. The SSC notes that there are no financial conflicts of interest between any SSC members and items on this meeting's agenda.

At this June 2022 meeting, a number of SSC members acknowledged associations with specific agenda items under SSC review. Mike Downs clarified his connection to agenda item C1 GOA Rockfish Program Adjustments EA/RIR, in which he is listed as a contributor. Dr. Downs contributed to an analysis that is referenced in the document but did not contribute directly to the analysis for this C1 agenda item.

Jason Gasper contributed to the C4 Trawl EM initial review and the C5 Observer Annual Report. Dana Hanselman supervises Wes Larson and Ed Farley, and is the second-level supervisor for Chuck Guthrie, who are co-authors on salmon genetics reports under D1 Salmon report. Dr. Hanselman is also the spouse of Kalei Shotwell, a co-author of the Snow Crab ESP (C3 BSAI Crab). Brad Harris provided input on the salmon EFP, which is included under the D1 Salmon Report. Robert Foy is the second line supervisor for Jennifer Ferdinand (C5 Observer Annual Report) and the third or greater level supervisor for contributors to the following agenda items: all AFSC GPT nomination recommendations; Mike Litzow, Cody Szuwalski (Agenda item C3 BSAI Crab); Ed Farley, Wes Larson, Chuck Guthrie, Pat Barry, Jim Ianelli, and AFSC authors on the salmon bycatch genetics reports (D1 Salmon reports). Finally, Chris Siddon is a co-author of the AIGKC assessment (C3 BSAI Crab), supervises the lead AIGKC assessment author, Shareef Siddeek, and Katie Palof (BSAI Crab CPT co-chair and author of BBRKC and SMBKC assessments, C3 BSAI Crab).