NORTH PACIFIC FISHERY MANAGEMENT COUNCIL

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SCIENTIFIC AND STATISTICAL COMMITTEE
FINAL REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
June 3rd – 4th, 2024

The SSC met from June 3rd – 4th, 2024 in Kodiak, AK. Members present in Kodiak were:

Sherri Dressel, Co-Chair
Alaska Dept. of Fish and Game

Franz Mueter, Co-Chair
University of Alaska Fairbanks

Alison Whitman, Vice Chair
Oregon Dept. of Fish and Wildlife

Chris Anderson
University of Washington

Curry Cunningham
University of Alaska Fairbanks

Mike Downs
Wislow Research

Martin Dorn
University of Washington

Jason Gasper
NOAA Fisheries—AKRO

Robert Foy
NOAA Fisheries—AFSC

Michael Jepson
Independent Contractor

Kailin Kroetz
Arizona State University

Brad Harris
Alaska Pacific University

Dana Hanselman
NOAA Fisheries—AFSC

Kathryn Meyer
Washington Dept. of Fish and Wildlife

Andrew Munro
Alaska Dept. of Fish and Game

Patrick Sullivan
Cornell University

Robert Suryan
NOAA Fisheries—AFSC

Ian Stewart
Intl. Pacific Halibut Commission

SSC members that attended virtually include:

Chris Siddon
Alaska Dept. of Fish and Game

SSC members that were absent include:

Amy Bishop
University of Alaska Anchorage

SSC Administrative Discussion

The SSC received a report from Diana Evans (NPFMC), announcing that the SSC will have an in-person meeting in Anchorage February 3–5, 2025 to review Chum salmon EA/RIR Initial Review and other topics. Ms. Evans also announced the departure of Council staff member Nicole Watson prior to this June meeting, and the upcoming departure of Sam Cunningham, Sarah Rheinsmith-Gardiner, and Sarah LaBelle after this June meeting. The SSC extends best wishes to each of them in their future endeavors and expresses gratitude for their work and assistance at the NPFMC.

If the Council chooses to extend a call for SSC nominations for 2025, the nominations period would open after the June meeting. **If the Council extends a call for SSC nominations and chooses to identify specific expertise in the call, the SSC developed recommendations for expertise of additional members that the SSC believes would be valuable to supplement their current knowledge base due to members that are likely to step down at the end of 2024. These would include: (1) a social scientist with a background in anthropology, sociology, human geography, or a related field, and (2) a scientist with broad expertise in quantitative ecosystem science and/or ecology with a specific expertise in marine mammals. If, or when, filling these positions, the SSC highlights it would be beneficial to identify someone who also has experience in working with Alaska coastal communities and who has scientific expertise with LKTK.**

Franz Mueter (SSC co-chair and member of the SCS8 steering committee, UAF) provided an update from the SCS8 steering committee regarding the eighth national meeting to be held August 26–28, 2024, in Boston. The workshop's theme is "Applying acceptable biological catch (ABC) control rules in a changing environment". There will be four NPFMC SSC participants, including Dr. Mueter and Sherri Dressel (NPFMC SSC co-chairs, UAF and ADF&G, respectively) along with Mike Downs (SSC member, Wislow Research) and Chris Anderson (SSC member, UW) who will represent the social sciences, which was one of the requests from the organizers. Dr. Mueter reminded the SSC that there will be two case studies from the North Pacific region which will focus on sablefish, presented by Dan Goethel (NOAA-AFSC), and pollock, presented by Paul Spencer (NOAA-AFSC). Dr. Mueter conveyed that the SCS8 organizers have been responsive to the NPFMC SSC's desire for an opportunity to present specific case studies to help the North Pacific (and other regions) with particular challenges. In the NPFMC SSC's case, these are to examine how socio-economic information on sablefish and how temperature dependence of recruitment for pollock may be incorporated, respectively, into management advice. The SSC anticipates that the SSC and the Council will receive an update on outcomes from the SCS8 meeting at the October NPFMC meeting.

C1 NMFS Observer Annual Report

The SSC received a presentation from Sara Cleaver (NPFMC), Jennifer Ferdinand (NOAA-AKRO) and Geoff Mayhew (NOAA-AKRO) on the Observer Program 2023 Annual Report with an overview of substantial changes to the Annual Deployment Plan (ADP) and NMFS recommendations for the 2025 ADP. These changes were introduced and presented to the Council in October and December 2023 for the 2024 ADP; however, the SSC did not review the draft ADP at that time due to time constraints. This June agenda item is unusual in that the SSC is tasked with reviewing NMFS recommendations for the 2025 ADP without a full review of the 2024 ADP or a full year of data to assess its performance. **With that in mind, the SSC found the NMFS recommendations reasonable overall and considered them a reflection of continued improvements to a program that balances many objectives.** The SSC discussion focused on the NMFS recommendations contained in Chapter 6 of the Annual Report.

NMFS recommends continuing the proximity allocation method for the partial coverage strata, excluding trawl electronic monitoring (EM) sector, in 2025. This is a new method introduced in the 2024 ADP. Since a full year of data has not yet been collected, the effectiveness of the method cannot be evaluated at this time. **The SSC supports its continuation in 2025 to ensure consistency in deployment and allow for a more comprehensive review of its performance in future annual reports. The SSC continues to support the objective of lowering the variances of estimated catches and minimizing data gaps.** Based on retrospective analyses of fishery data, the method performed well statistically, as shown in the draft ADP. The SSC would be interested in a map or other information on how this sampling method works compared to previous methods or to the cost-weighted box analyzed in the draft ADP. An example or figure that shows how each method allocates observer effort in some snapshot in space and time would be helpful.

NMFS recommends continuing with the current sampling strategy in the trawl EM sector for PSC monitoring and biological samples. **In addition to understanding the costs of the program, the SSC would like to see an analysis of whether the increase in EM changes the spatial coverage or species composition of the biological samples available for stock assessments and genetic stock composition, and whether these samples adequately represent catches.**

To address previous delays and inefficiencies in data processing, NMFS recommends that the Observer Program work closely with the Pacific States Marine Fisheries Commission to find an optimal video review selection rate and strategy to enhance the utility of EM data. The SSC has voiced concerns about the time required for video review, as some of these data are critical for in-season management and accurate stock assessments. **The SSC supports the NMFS recommendation to assess how delayed, or missing, fixed-gear EM data impact the risk of exceeding OFLs, TACs, PSC limits or other thresholds.**

NMFS expects to implement the regulated trawl EM program in 2025, requiring vessels to opt-in and adhere to specific monitoring plans and hardware requirements. The recommendations lay out clear steps for integrating EM into trawl fisheries. **The SSC reiterates the need to ensure that stock assessments are able to track the continued increase in EM and that necessary data continue to be collected, including age- and length-composition samples.**

Beyond the NMFS recommendations, the SSC had other general comments as follows:

- **Given continued evidence of an observer effect** (characteristics of observed trips differ from unobserved trips indicating differences in vessel fishing behavior when an observer is aboard, e.g., differences in duration and species landed), **the SSC encourages continued statistical analysis to better understand the differences and the degree of resulting bias in estimates**.

- **The SSC requests that the Observer Program annual report include tracking statistics on the collection of length and aging structures for stock assessment.**

- **The SSC requests that efforts continue to try to resolve the current disconnect between the ODDS system and the eLandings system.**

- **The SSC reiterates its recommendation from June 2023 that the analysts work towards providing cost per day calculations for EM coverage similar to those provided for observer coverage, as a basis for evaluating operational tradeoffs between cost and data quantity and quality.**

- **The SSC recommends that an occasional CIE (Center for Independent Experts) review be convened to review the ADP, with emphasis on novel methods such as the proximity allocation method and other elements of the Observer Program as appropriate.**

- **The SSC would appreciate the opportunity for future review of the draft ADP, when substantial changes to the methods are proposed.**

C2 Bering Sea Aleutian Islands Crab

The SSC received a report on the May 2024 Crab Plan Team (CPT) meeting from Sarah Rheinsmith-Gardiner (NPFMC) and the CPT co-chairs, Katie Palof (ADF&G) and Mike Litzow (NOAA-AFSC). 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 and Table 2 includes the June 2024 SSC recommended harvest specifications.

Table 1. Stock status in relation to status determination criteria for 2023/24. Dark gray fill indicates parameters not applicable for that tier. Values are in thousands of metric tons (kt). Status determination recommendations made by the SSC are based on the best scientific information available and final status determination will be made by NMFS Headquarters following SAFE review.

Ch.	Stock	Tier	MSST	B_{MSY} or B_{MSY} proxy	2023/24[1] MMB	2023/24 MMB/ MMB_{MSY}	2023/24 OFL	2023/24 Total Catch	Rebuilding Status
1	E. Bering Sea snow crab	3					15.44		
2	Bristol Bay red king crab	3					4.42		
3	E. Bering Sea Tanner crab	3					36.20		
4	Pribilof Is. red king crab	4					0.685		
5	Pribilof Is. blue king crab	4					0.00116		
6	St. Matthew blue king crab	4					0.07		
7	Norton Sound red king crab	4	0.99[3]	1.98[3,4]	2.40	1.19	0.31	0.2	
8	Aleutian Is. golden king crab	3	5.77	11.54	12.72	1.10	4.18	2.61	
9	Pribilof Is. golden king crab[2]	5					0.114		
10	W. Aleutian Is. red king crab	5					0.056		

[1] MMB on 2/1/2023 for Norton Sound red king crab as estimated in the 2023 assessment and on 2/15/2024 for all other Tier 1-4 stocks using the 2024 assessments (this footnote is corrected from February 2024 and draft June 2024 SSC reports).
[2] PIGKC specifications are set on a calendar year basis.
[3] Values are corrected from February 2024 and draft June 2024 SSC reports.
[4] B_{MSY} proxy basis years for NSRKC are 1980 - 2023.

Table 2. SSC recommendations for Eastern Bering Sea crab stocks. Stocks for which specifications are rolled over between assessments (Pribilof Island red king crab, Pribilof Islands blue king crab, Pribilof Islands golden king crab and Western Aleutian Islands red king crab) or were set in February 2024 (Norton Sound red king crab) are also included. Biomass values are in thousands of metric tons (kt). 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, Chapters 5 and 8 – 10 are set in June, and Chapter 7 is set in February, in the year according to the assessment frequency cycle (see current SAFE Introduction for assessment cycle). For 2025/26 specifications, Chapter 7 will be set in December 2024.

Ch.	Stock	Tier	F_{OFL}	B_{MSY} or B_{MSY} proxy	B_{MSY} basis years[1]	2024/2025[2] MMB	2024/25 MMB / B_{MSY}	Natural Mortality (M)	2024/25 OFL	2024/25 ABC	ABC Buffer
1	E. Bering Sea snow crab	3b									
2	Bristol Bay red king crab	3b									
3	E. Bering Sea Tanner crab	3a									
4	Pribilof Is. red king crab	4a	0.21	1.71	2000-2021			0.21	0.685	0.51	25%
5	Pribilof Is. blue king crab	4c	0	4.20	1980/81-1984/85; 1990/91-1997/98			0.18	0.00116	0.00087	25%
6	St. Matthew blue king crab	4b									

[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.

[2] MMB is estimated on 2/1/2024 for Norton Sound red king crab and projected on 2/15/2024 for all other Tier 1-4 stocks, using the most recent 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. Sub-tiers are reported separately for each model and are detailed in the assessment document.

[4] PIGKC specifications are set on a calendar year basis.

Table 2. (CONT.) SSC recommendations for Eastern Bering Sea crab stocks. Stocks for which specifications are rolled over between assessments (Pribilof Island red king crab, Pribilof Islands blue king crab, Pribilof Islands golden king crab and Western Aleutian Islands red king crab) or were set in February 2024 (Norton Sound red king crab) are also included. Biomass values are in thousands of metric tons (kt). 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, Chapters 5 and 8 – 10 are set in June, and Chapter 7 is set in February, in the year according to the assessment frequency cycle (see current SAFE Introduction for assessment cycle). For 2025/26 specifications, Chapter 7 will be set in December 2024.

Ch.	Stock	Tier	F_{OFL}	B_{MSY} or B_{MSY} proxy	B_{MSY} basis years[1]	2024/2025[2] MMB	2024/25 MMB / B_{MSY}	Natural Mortality (M)	2024/25 OFL	2024/25 ABC	ABC Buffer
7	Norton Sound red king crab	4a	0.18	2.02	1980-2024	2.5	1.24	0.18	0.333	0.233	30%
8	Aleutian Is. golden king crab[3]	3	0.55 (EAG), 0.44 (WAG)	11.54	1987-2020	11.39	0.99	0.22	3.725	2.794	25%
9	Pribilof Is. golden king crab[4]	5	-	-	-	-	-	-	0.114	0.085	25%
10	W. Aleutian Is. red king crab	5	-	-	-	-	-	-	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.

[2] MMB is estimated on 2/1/2024 for Norton Sound red king crab and projected on 2/15/2024 for all other Tier 1-4 stocks, using the most recent 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. Sub-tiers are reported separately for each model and are detailed in the assessment document.

[4] PIGKC specifications are set on a calendar year basis.

General BSAI Crab Comments

The SSC requests the authors and CPT consider coordinating the approach to analyzing the Bering Sea Fisheries Research Foundation (BSFRF) data for the two Chionoecetes crab and Bristol Bay red king crab (BBRKC) stocks, and specifically consider developing the results as a prior on selectivity for use in the models.

Aleutian Islands Golden King Crab

The SSC received a summary of the Aleutian Islands golden king crab (AIGKC) stock assessment. The SSC thanks the stock assessment author for their work and responses to previous CPT and SSC comments. There was no public testimony for AIGKC harvest specifications.

AIGKC is managed with a single OFL and ABC. However, ADF&G manages the fishery in two areas (east and west of 174°W longitude; EAG and WAG, respectively), with a harvest strategy based on model-estimated mature male abundance that splits the TAC and specifies a 15% maximum harvest rate for EAG and 20% maximum harvest rate for WAG. The AIGKC assessment is based on two separate models (the EAG and WAG) that are configured similarly and model results are summed to provide stock-wide management advice.

The retained catch and bycatch mortality to date were similar to other recent years. Fishery CPUE in 2023/24 continues to diverge between the two regions, with the EAG CPUE near the time series high and the WAG CPUE near the post-rationalization low.

The author presented three models for each of the two areas (EAG and WAG). The models represent updates to GMACS version 2.01.M.10 and include an average recruitment reference period updated to 1987–2020 for calculation of $B_{35\%}$. **The SSC requests the rationale for using the terminal year minus four year approach to define the reference period for future assessments**. In addition, since the February 2024 SSC review, the following modifications were implemented: consideration of Tweedie distributions in place of the negative binomial distributions in the generalized additive model (GAM) CPUE standardization, removal of the interaction of latitude and longitude as a covariate in the GAM CPUE standardization and correction of fish ticket data for 1985–1998 standardization.

Three models are compared in the SAFE report:

- 23.0a: 2023 base model, with updated time series data;

- 23.1: Model 23.0a + truncated size composition;

- 23.1b: 23.1 + two selectivity periods in the pre-rationalized directed fishery.

All models estimated a decrease in mature male biomass (MMB) at mating in 2023 compared to 2022 in the EAG, and a slight increase in the WAG. The author-preferred model for the full stock was Model 23.1, though Model 23.1b performed better for the EAG on its own. Model 23.1 excluded size-composition data for sizes smaller than the lower limit of the first size-class in the model. The SSC requests that a future assessment consider whether revising size bins to include the smaller crab would be warranted based on consistency of historical presence of those smaller crab.

The SSC supports the author's and CPT's recommendation to use Model 23.1 for both the EAG and the WAG as the basis for harvest specifications and status determination. Results from these models indicate that AIGKC is not overfished. Although directed fishing for AIGKC was complete at the time of the assessment, total catch was not final as the groundfish fisheries were still ongoing, so overfishing determination for AIGKC will occur at the October 2024 NPFMC meeting.

Specifications for the AIGKC stock are based on the combined areas of EAG and WAG. The EAG stock was above MMB$_{35\%}$ (Tier 3a), while the WAG stock was below MMB$_{35\%}$ (Tier 3b) in 2023/24. As the SSC noted last year, the OFL calculation method in the current assessment does not appear to exactly follow the method approved by the SSC and CPT in 2017. However, current OFL calculations are likely conservative compared to the method approved by the SSC and CPT. **Therefore, the SSC supports the CPT-recommended OFL calculation approach as specified in the current assessment.** For future consideration, the SSC recommends returning to calculation of a single OFL and ABC for the combined model results (as in 2017). The SSC recommends continued exploration into single-area or a two-area spatially explicit model, noting that a two-area spatially explicit model may be a bridge between previous separate model approaches and a combined model approach. The SSC notes that, if the model changes to a single-area or a two-area spatially explicit model, the specific method for calculating the OFL may change.

The SSC notes that overfishing cannot be determined at the present meeting because total catch is not fully accounted for. **The SSC recommends that the CPT explore whether to conduct this final assessment on the same cycle as other crab assessments in September/October to better align the assessment with the annual cycle of catch mortality.**

The CPT and author continue to be concerned about the fit to the indices. **The SSC recommends prioritizing further consideration of data weighting, as the Francis re-weighting continues to be an issue in this assessment.** The SSC is concerned with the overly precise model biomass estimates given the data, particularly in the WAG. Exploring the Dirichlet data-weighting approach may be a viable option, but the weight on the indices, the size of the standard errors from the CPUE standardization, and the weight on the tagging data need to be considered in concert. This may alleviate the need for exploring the time-varying catchability recommendation from the CPT.

A 25% buffer between the OFL and ABC for AIGKC was applied from 2017 to 2020 but was increased to 30% in 2021 to reflect model convergence concerns. The buffer was subsequently reduced to 25% in 2022 after model convergence concerns were reduced. However, the EAG model continues to exhibit a poor fit to the index data and a poor retrospective pattern in MMB. **The SSC agrees with the CPT recommendation for continued use of the 25% buffer for this assessment and supports the resulting ABC.**

The SSC supports the specific CPT recommendations for additional research and development of upcoming assessments. In addition, the SSC notes the following from the previous list of recommendations:

- The SSC places a high priority on incorporating information from the cooperative survey into the assessment and supports the CPT recommendation to incorporate this survey as a separate fleet.

- Further examination of the retrospective pattern in terms of magnitude, direction and cause continues to be important.

- The CPT suggested that next year's model should be 25.0. The SSC reminds the CPT and authors that new model year numbers are only applicable if there is a major structural model change.

- The current method of projecting the remaining landings for the current incomplete season seems overly complicated and the SSC recommends a more straightforward method for determining total catch be considered, such as basing it on the average fraction harvested to date.

EBS Snow Crab Model Runs and Currency of Management

The EBS snow crab assessment author prepared an atypical report that did not focus on exploration and development of alternative models. Instead, efforts in this assessment cycle focused on 1) a narrative explanation of the assessment model, including recent changes and a rationale for those changes, and 2) exploring potential alternatives to the current metric for reproductive output (e.g., currency of management), MMB. Both items were flagged as high priority requests by the SSC in its October 2023 meeting report. The SSC appreciates the extensive work done by the assessment author to address these concerns.

The current MSY proxy for snow crab is $F_{35\%}$, which is the fishing mortality associated with a 35% reduction in the spawning biomass per recruit. The basis for this work is Clark (1991)[1], though there was some work testing the suitability of $F_{35\%}$ for crab when the tier system was adopted. Clark (1991) looked at relative yield for a plausible range of stock recruit relationships focused on groundfish, including both Beverton-Holt and Ricker curves, and determined the fishing mortality rate where the minimum yield was maximized across all stock recruit curves (called "maximin" yield). The assessment author repeated Clark's (1991) analysis for snow crab biology and stock recruit curves where alternative measures for reproductive output were used in place of MMB. Results indicated that the maximin yield occurred at 55% of unfished stock size for mature male biomass, and 28% of unfished stock size when the biomass above 95 mm was used to quantify reproductive output.

The assessment author recommended using biomass >95 mm as the currency for management, noting fieldwork by Canadian scientists where no male crabs less than 95 mm were observed in a successful mating embrace. The CPT did not agree with this approach, and wanted clear evidence that this was a better metric for reproductive capacity. Unfortunately, this information has not been easy to collect. **The SSC recommends that AFSC crab biologists evaluate whether lab studies of reproductive behavior could be designed to provide information on the appropriate measure of reproductive output, or whether observational studies would be needed.**

The CPT suggested that a potential way forward would be to repeat Clark's maximin analysis using both steepness and alternatives for the definition of reproductively active males (i.e., MMB, crab >95 mm in the maximin calculation). **The SSC supports the exploration of this approach with possible adoption in the fall for 2024/25 harvest specifications.** This approach would account for the possibility that larger males are reproductively important, and ideally would provide an F_{MSY} proxy that would perform reasonably well regardless which metric of reproductive output is correct or the true underlying form of the stock-recruitment relationship.

The SSC requests that the Clark maximin re-analysis more closely follow the original analysis, which was carefully crafted to encompass a reasonable range of discrete stock productivities. Clark (1991) used both Ricker and Beverton Holt curves, used three curves intended to span a plausible range of steepness (0.50, 0.67, and 0.80), and excluded alternatives of 0.33 and 0.89 steepness. The SSC notes that $F_{X\%}$ is the fishing mortality associated with an X percent reduction in spawning output per recruit (not percent reduction in stock size as shown in the draft document). It will be important to provide plots showing yield and the percent reduction in the different reproductive output measures as a function of fishing mortality. The SSC also requests that an exploitation rate be reported in addition to fishing mortality, which can be misleading because of the right-shifted selectivity curve for snow crab. This shift results in very few crab experiencing full-selection fishing mortality. Ideally, this analysis would use the parameters estimated in the GMACS operational model, rather than the snow crab research model.

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[1] W. G. Clark, 1991 Groundfish exploitation rates based on life history parameters, Canadian Journal of Fisheries and Aquatic Sciences, 48, Pages 734–750.

Concerning the GMACS assessment model, the SSC continues to recommend that the assessment author explore ways to incorporate the molt to maturity data in the model in a way that reflects the observation error associated with those estimates. An analysis in a GLMM modeling framework, which treats years as random effects, would provide smoother estimates, accommodate differing sample sizes by year and length, and deal appropriately with years in which data are missing. Another possibility that was suggested in the CPT report was to include the annual observed probabilities of terminal molt as data and then fit them, as in the Tanner crab assessment.

The SSC supports the CPT recommendation that the author bring forward Model 23.3a for specifications in October 2024.

The assessment author provided a proposed Tier 4 model that used the design-based survey biomass estimate decremented by natural mortality to the time of fishery. **The SSC recommends that this model be brought forward in the fall but requests that an additional Tier 4 model be provided for comparison,** as recommended in the Simpler Modeling Workshop report and requested in the SSC's June 2023 and October 2023 Reports**.** This additional model would use the random effects model (REMA) to smooth survey estimates and would not decrement with natural mortality. This is similar to the standard approach for Tier 5 groundfish. More generally, the SSC would like to see a simple and consistent approach be used for crab Tier 4 "fallback" calculations, as is currently done for BBRKC and EBS Tanner. However, the decision to use smoothed (REMA) or design-based survey indices for Tier 4 calculations could be potentially justified by comparing differences in survey biomass observation error, relative to REMA process error, across crab species. The SSC noted that when the observation error is low, the REMA model would be very similar to the non-smoothed design-based estimates, and when observation error was high it would follow the data less closely. Design-based survey biomass estimates could be used when observation error is low relative to process error, while REMA model estimates may be more appropriate when error is high. Depending on the treatment of the natural mortality decrement within the Tier 4 approach, it is important to make sure the reference points are internally consistent (i.e., if natural mortality is decremented for biomass, it should also be done for the reference point calculation).

The SSC appreciated the appendix describing research on the potential impacts of climate change and density-dependence on snow crab population dynamics. This analysis is useful for evaluating the prospects for stock rebuilding, as well as providing a glimpse of potential future conditions. The SSC emphasizes that projections of climate change impacts, while useful, are highly uncertain and conditional on the assumption of stationary climate relationships. Populations have various strategies for adapting to climate change that are not captured by linear extrapolations of current relationships and caution should be used when presenting these results. For example, the Northern Bering Sea (NBS) may become a more favorable habitat for snow crab and serve as a refuge from climate change. Incorporation of NBS bottom trawl survey data into the stock assessment using VAST or some other spatiotemporal modeling approach for intercalibration with EBS shelf survey data, as has been previously recommended by the SSC, may help us to better understand the role of the NBS on snow crab stock dynamics.

Bristol Bay Red King Crab Model Runs

The SSC reviewed model alternatives for setting harvest specifications for BBRKC in October 2024. The SSC thanks the author for thoroughly reviewing recent and past CPT and SSC comments.

There was a small, directed fishery in 2023, after two years of no directed fishery due to State of Alaska harvest control rules for female biomass.

This assessment has been run in GMACS since 2018. Eight models were considered (including the base model) that included updates to GMACS to correct the season for incorporating MMB relative to M,

estimating M with an informative prior rather than fixing it, estimating survey selectivity using the BSFRF selectivity experiments as a prior, and removing the 1975–1980 time block in molting probability.

Changing the season when MMB is incorporated in the GMACS model resulted in minimal effects on model likelihoods and MMB estimates. This change was necessary to properly account for natural mortality. Estimating M with a tight prior rather than fixing it led to an improvement in the retrospective patterns. Survey selectivity estimates based on BSFRF selectivity experiments as a prior resulted in selectivity curves similar to those in the base model, but the CPT had concerns about how this prior was implemented in GMACS and did not recommend going forward with this model this year. Model output was not changed by removing the 1975–1980 time blocks in molting probability.

The SSC concurs with the CPT and the author recommended models to bring forward in October, specifically Model 23.0a (.p7) and Model 24.0c. The SSC also recommends bringing forward a Tier 4 calculation similar to October 2023. Moving forward, the SSC recommends that the author bring forward a model that adds the BSFRF prior on selectivity for the 2025 assessment. The SSC agrees with the additional considerations listed by the CPT in their minutes prioritizing; 1) considerations of selectivity time periods based on gear types and 2) consideration of time-varying selectivity in the fishery data relative to the survey data.

Tanner Crab Model Runs

The SSC thanks the author for their extensive work in addressing previous SSC and CPT requests. The author presented a total of ten model runs; three of which were implemented in the currently accepted TCSAM framework and seven were exploratory implementations in GMACS. The TCSAM models presented were the most recently accepted model used for setting harvest specifications in October 2023 (23.03b), the same model with updates to the 2013–2017 BSFRF survey data (23.03c), and Model 23.03c with additional 2018 BSFRF data (23.03d).

There was little difference among these models in terms of fits to data sources and estimates of biomass, although updates to the BSFRF data in models 23.03c and 23.03d caused two parameters to hit bounds (overdispersion parameters of the Dirichlet multinomial error distribution for BSFRF survey size composition data). The SSC was concerned that minor changes to the BSFRF data in Model 23.03c resulted in parameters hitting bounds that did not occur in the base model (23.03b).

The SSC supports the author and CPT recommendation to bring forward Model 23.03d in September/October, updated with the 2023/24 NMFS survey data, provided that the issues related to parameters on bounds can be resolved. To that extent, the SSC recommends the author provide additional detail in the changes to the underlying BSFRF data from 2013–17 that caused parameters to hit bounds, including details on any possible changes to the data weighting. The SSC also requests a more detailed description of the paired-haul selectivity methods for Tanner crab using the BSFRF and NMFS side-by-side (SBS) studies (currently cited as Stockhausen in prep). **If the author is unable to resolve the parameter bounding issue, the SSC recommends that an alternative model that fixes these parameters at a value of 1.0 and that has no other parameters on bounds be brought forward in addition to Model 20.03d and the Tier 4 approach (using the SSC recommended 2023 method).**

The SSC also requests that the author address the following specific items prior to the October meeting:

- Consider a smoothed approach instead of the current empirical approach to the terminal molt curve, which assumes no observation error.

- Show confidence intervals on estimated time series when comparing model runs, in order to allow interpretation of whether differences among alternative models are statistically meaningful.

- Remove the connection between 2019 to 2021 when plotting survey time-series estimates and variances.

- As noted in General Crab Comments, consider coordinating the approach to analyzing the BSFRF data among the two Chionoecetes crab and BBRKC stocks, and specifically consider developing the results as a prior on selectivity for use in the model.

In response to previous SSC requests to consider developing a simplified Tanner model using the GMACS framework, the author also presented Model G24.02 with six additional runs building on this as a base GMACS model (G24.02a–G24.07). At a high level, the base model was simplified from the TCSAM models by removing the time blocks for natural mortality, initiating the model in 1982 (to avoid gear changes in the bottom trawl survey), and by fixing many of the biological processes and estimating them externally. The additional runs explored modifications to how the crab size composition data were fit, fixing the NFMS survey selectivity to either the overall mean or annual mean estimated selectivity from the BSFRF survey data, applying annual estimates of the size/sex-specific probability of having undergone terminal molt instead of a mean estimate from the same analysis, and replacing the design-based NMFS survey index with a model-based (VAST) survey index.

All of the GMACS models met the authors' convergence criteria but had relatively poor fits to biomass indices overall. In particular, the model fit to the VAST-based survey index (G24.07) was unable to fit the survey peaks. The models also exhibited mixed success in fitting to the size composition data, especially when selectivity or molt probability was unable to vary over time. **The SSC concurs with the CPT that these models require further development and with the author and CPT recommendation to conduct a detailed bridging analysis as a next step. The SSC supports the CPT recommendation to make GMACS development the focus of the January 2025 modeling workshop.** The SSC supports the CPT recommendation to resolve the issue with small mature males in the initial population structure and the large fishing mortality estimated in a few years for the BBRKC bycatch fleet during this development.

As GMACS implementation continues to develop, **the SSC supports the continued exploration of a geostatistical time-series for Tanner crab,** possibly with an estimated additional variance term or constrained process error on catchability to improve model fit. Additionally, the SSC looks forward to future discussions on the relative performance of sdmTMB and VAST from the CPT, including prioritization of specific crab stocks for this work given staff resource constraints. The SSC also recommends that a similar method of the treatment of the BSFRF data be considered for the Tanner GMACS model as in the EBS snow crab model where it is used to inform the prior on survey selectivity, or at minimum an evaluation of the relative merits of each approach.

The SSC is encouraged by the overall progress in implementing the Tanner model within the GMACS framework and would like to acknowledge the significant contributions made to GMACS by both the assessment author and the University of Washington (Andre Punt).

St. Matthew Blue King Crab Model Runs

The SSC reviewed the proposed models for the St. Matthew Island blue king crab (SMBKC) 2024 assessment. This assessment is conducted on a biennial basis and the last full assessment occurred in 2022. There has been no directed fishery for this stock since 2015/16. The stock was declared overfished in 2018 and has been under a rebuilding plan since 2020. The stock decline is attributed to adverse environmental conditions affecting recruitment to the population, rather than to any fishery-related effects and the rebuilding plan does not impose any fishery-related restrictions.

This is a Tier 4 stock and the assessment uses the GMACS modeling framework. Males measuring ≥ 105 mm CL are considered mature in this assessment. The B_{MSY} proxy is obtained by averaging estimated MMB using the full assessment time frame (1978 – 2022).

General challenges with the SMBKC assessment include 1) an inability to reconcile conflicting trends in abundance in the NMFS EBS bottom trawl and ADF&G pot surveys and 2) relatively poor fits to both survey datasets in recent (2010+) years. The proposed models do not address these two challenges directly and the authors note that work to develop a single survey index using a spatio-temporal approach (e.g., sdmTMB) is ongoing.

The authors examined seven models. An updated version of GMACS (version 2.01.M.10, 2024-02-27) was used for all models and model explorations all focus on natural mortality. First, the 2022 accepted model (16.0) was run in the updated GMACS software with updates including 2022/23 groundfish bycatch, 2023 NMFS trawl survey, 2022 ADF&G pot survey data. Next, Model 16.0a used a fully updated historical time series for the ADF&G pot survey relative abundance index and size compositions and corrected an erroneous relative abundance data point from the 2016 ADF&G pot survey. Then, for Model 16.0b, the SSB estimation time frame was shifted to later in the year (from modeled season 4 to season 5) to align with the reference date (15 February) for calculation of federal management biomass quantities. Finally, all the updates and adjustments applied in models 16.0, 16.0a, and 16.0b were incorporated into Model 16.1, the suggested new base model. These changes resulted in a small decrease in estimated 2023 MMB (Model 16.1 = 1,394 t) compared to Model 16.0 (1,498 t).

Three new models, built on Model 16.1, were used to explore the impacts of varying M. In Model 24.0a, M was estimated using a tight prior (mean = 0.18, CV = 0.04), following the BBRKC stock assessment. Model 24.0b estimated M using a less restrictive prior (mean = 0.18, CV = 0.1) and Model 24.0c fixed M = 0.20, the value resulting from Model 24.0a.

The authors recommended bringing forward models 16.1 (base model) and 24.0c for consideration in September.

The SSC agreed with the CPT that using the M estimate from Model 24.0a as the fixed value in Model 24.0c was improper. The CPT recommended that the authors construct a new model, 24.1, which builds on 16.1 as its base but uses a fixed value for M from the 2023 BBRKC assessment (i.e., 0.23 yr-1).

The SSC concurs with the CPT recommendation to bring forward Models 16.1 and 24.1 for setting harvest specifications in October 2024.

The SSC also supports the authors presenting a version of Model 16.1 in October 2024 with the corner stations dropped from all previous years. This research model would provide retrospective insights into the impacts of dropping these stations, as will occur in the 2024 EBS trawl survey, but this research model would not be used for management.

The SSC supports the CPT recommendations for future work and offers the following suggestions:

- Continue work to create a single index of abundance integrating data from both trawl and pot surveys using spatiotemporal approaches. The SSC suggests the authors explore the use of these methods for each survey separately before initiating work to combine them. An exploratory spatial analysis, including maps depicting the spatial structure of relevant survey observations, should be provided to support the selection of an appropriate geostatistical approach. In addition to standard diagnostic plots (i.e. Q-Q plot, residual histograms, and observed vs. predicted encounter probabilities), the distribution of spatial residuals should accompany model results (e.g., see the December 2020 SSC minutes on the use of the VAST Model for EBS Pollock).

- Explore increasing the number of size bins used in the assessment models.

- Examine the likelihood profile on selectivity.

- Correct the y-axes labels on pot survey CPUE plots.

ESP Updates

The SSC understands that limited staffing is preventing the establishment of full ESPs for all crab species and appreciates the efforts of the Importance Methods Project to evaluate statistical methods for scoring effects of individual indicators. **The SSC supports the proposal to produce generalized ESP report cards that are relevant to all stocks within a region as a near-term alternative to full species-specific ESPs.** An immediate example of where this approach would be informative is in evaluating differences observed in western and eastern AIGKC, with respect to differing conditions in the two regions and associated biological responses of groundfish that were identified in the 2023 Aleutian Islands Ecosystem Status Report.

The CPT acknowledges the importance of evaluating stationary (non-time varying) vs. non-stationary (time varying) relationships with ESP indicators. While this is a concern for indicators, there can be important information to be gained even before a new statistically relevant relationship develops. The SSC recommends exploring approaches to evaluate annual deviations from established relationships to provide early warning indicators of change. Annual deviations consistently in one direction can be an early indication of relevant change before a sufficient number of years of data are gathered to produce a new statistically significant relationship. As the CPT also indicated, the EBS snow crab stock provides an example of how abrupt changes in ecosystem indicators might have informed changes in the system before or during the decline.

Survey Update

The CPT report highlighted the efforts of the bottom trawl survey modernization efforts in the Bering Sea, with the primary focus on comparing 30 to 15 minute side-by-side tows that will continue in 2024 and also include side-by-side comparisons of the shelf gear (83-112) and slope gear (Poly Nor'Eastern). Changes to the bottom trawl survey are to be gradually implemented in the coming years with a change to 15-minute tows possibly occurring as early as 2026. **The SSC requests updates on the survey modernization process as it moves forward.**

The CPT report also noted the importance of length-weight (L-W) data that are used for abundance to biomass conversions. **The SSC supports the CPT recommendation that this topic be further explored at the January 2025 CPT modeling workshop, along with consideration of how L-W regression parameters will be used in projections for computing OFLs from the results of stock assessments.** Given changes in L-W relationships over time, the CPT discussed using the most recent ten years of data or a sliding window approach. **The SSC recommends evaluating various time steps and methods for identifying sliding windows for smoothing.** The primary concern is to avoid smoothing through abrupt step changes that might occur. The SSC also acknowledges and encourages evaluation of additional morphological measures that might provide information on crab maturity, as the CPT noted from a recent publication on Tanner crab.

Observer Program Changes

Observer program changes focused on hybrid data collection for Tanner and snow crab. It was noted that the way hybrids are recorded might be different for fishery-dependent versus fishery-independent sampling. The SSC supports the CPT request for an update at the September CPT meeting and the four recommendations outlined in their report. **The SSC supports continued monitoring of hybridization but recognizes the benefit of simplifying and streamlining data collection.** Given the rapid changes in climate and species distribution patterns in the Bering Sea, there is potential for stronger interactions between snow crab and Tanner crab populations than have occurred historically.

BSFRF Update

The SSC appreciates the efforts of BSFRF and all those involved in these research efforts. The SSC received one oral public comment from Scott Goodman (BSFRF) and is pleased to hear that one or two more years of research are planned, as capturing inter-annual variation in ocean conditions, particularly temperature, is critical to understand variability in size- and sex-specific habitat use.

Economic Impacts of Snow Crab Closure

The effort to evaluate economic impacts of the EBS snow crab fishery closures was postponed but is making progress, with the CPT report noting that a working group has been formed that includes economists from NOAA-AFSC, NOAA-AKRO, and the Council staff. The immediate goal of the working group will be to develop standard socioeconomic indicators to inform 2024/25 groundfish TAC setting, but the CPT was asked at this meeting for specific feedback regarding which socioeconomic indicators to include in 2024 crab ESP report cards to inform the OFL/ABC, and ADF&G TAC setting. The CPT requested that all fishery performance, economic and community indicators previously reported in the BBRKC and snow crab ESPs be retained. Because economic indicators are lagged, the CPT expressed interest in seeing price nowcasts in September as part of the ESP report cards, if possible. It was noted that the current socioeconomic indicators included in crab ESPs do not include the full scope of what the Council requested in their [December 2023 C4 Socio-economic indicators motion](#). The working group will focus on developing additional community-based indicators and differentiate between indicators intended to inform the OFL/ABC (fishery performance/health of the stock) and the TAC (economic and community indicators). The SSC supports evaluation of these and other metrics in addition to fishery performance indicators, but the SSC cautions that only socioeconomic indicators that inform stock status should be used to inform risk tables (i.e., ABC specifications).

C4 Small Sablefish Release – Initial Review

The SSC received a presentation from Sarah Cleaver (NPFMC), Jon McCracken (McCracken & Associates), Andrew Olson (NOAA-AKRO) and Dan Goethel (NOAA-AFSC) on the initial review draft analysis for the proposed management measure to allow the release of small sablefish in the fixed gear individual fishing quota/community development quota (IFQ/CDQ) fisheries. The SSC thanks the authors for their extensive work in the short time since the last review and for their inclusion of previous SSC recommendations in the analysis and in this draft.

Oral public testimony was provided by Linda Behnken (Alaska Longline Fishermen's Association). The SSC considered this public comment in making its recommendations.

The Council action includes two alternatives. Alternative 1, no action (*status quo*), would retain current regulations and continue to prohibit any release of sablefish. Alternative 2 included two options: Option 1 removing the regulations prohibiting release of sablefish and Option 2 allowing release of sablefish less than 22 inches in total body length. The Council also specified four elements for further analysis: 1) selection of an appropriate discard mortality rate (DMR), 2) a description of accounting for catch and release mortality in the stock assessment and management, 3) a description of monitoring and enforcement provisions to allow estimation of discards and 4) for Option 1, a timeline for further review if the action is adopted (either three, five or seven years) and Option 2 specifying that the action will sunset after five years. The Council further requested an evaluation of selectivity of sablefish pots and of escape rings as a tool to reduce the catch of small fish.

The draft EA/RIR includes a broad summary of the current sablefish fishery, an evaluation of how release mortality would be accounted for in the stock assessment, potential economic and social impacts, monitoring and enforcement changes that would be needed, and a simulation experiment to evaluate the effects of release and discard mortality on the long-term spawning biomass, landings, and approximate gross revenue. The simulations include four future recruitment scenarios, three discard mortality rates

(DMRs) (as previously recommended by the SSC), and sensitivity analyses of the shape of the retention function, the fraction of the future ABC actually harvested, and the price structure. The document focuses on comparing the *status quo* with Alternative 2 Option 2 – retention of all sablefish 22 inches in length or larger in order to meet the timeline for this initial review.

The simulation analysis found that only a small fraction of the current catch consists of fish less than 22 inches in length, and therefore the population and fishery results had only a small response to allowing release of these fish under all assumed DMRs. Simulation results show that with the application of the Tier 3 harvest control rule, none of the DMR scenarios evaluated had a large effect on the long-term spawning biomass, demonstrating that this potential action does not appear to have a substantive impact on conservation outcomes within the broader management approach. The SSC found this result to be an important extension to previous equilibrium analyses. Simulated dead discards were found to be minimal, and there was only a small potential increase in gross revenue as a result of this action. There was no increase in the probability of entering an overfished state. Sensitivity analyses showed that discards increased with increasing age at retention, and that landed catch and gross revenue also increased, again without strong feedback to spawning biomass. The SSC found that evaluation of the large set of results was enhanced by the interactive Shiny tool created to present the results of both the base simulations and the sensitivity analyses. The SSC encourages the further use of interactive tools for this and similar analyses.

A second analysis using both quantitative and qualitative methods explored the potential for social and economic benefits and costs. This analysis used more detailed fleet data and qualitative methods to augment the simulation model revenue results that used simplifying assumptions related to catches and prices. The analysis suggested that substantial aggregate revenue impacts are unlikely and that there is heterogeneity in participants' ability to leverage discarding to improve profitability. Specifically, potential benefits accruing to participants and costs borne by participants may vary across locations and vessel classes.

The analysis describes the potential changes needed to the observer program sampling and the need for changes in the management system, including an Incidental Catch Allowance (ICA) to account for discard mortality. The analysis also describes the increased stock assessment uncertainty and potential enforcement challenges that could result from this action. The SSC notes that it is difficult to precisely determine the extent of these uncertainties, and that some will be unavoidable, including uncertainty in future ABC utilization, future price trends and future price structure across fish size grades. The focus of this analysis was mainly on current conditions and did not consider major changes in the fishery, fleet behavior, markets, or price that might be expected to occur over the long term.

The SSC finds that this analysis is sufficient for the Council to evaluate Alternative 1 – the status quo, and Alternative 2, Option 2 – voluntary release of sablefish less than 22 inches in length, after addressing additional SSC suggestions in the final action draft. The SSC recommends releasing this document for final action with modifications as described below. The SSC recommends that if the Council wishes to consider Alternative 2, Option 1 – voluntary release of any size sablefish, additional analysis would be required.

The SSC expects that this analysis will be informative for the Council in the short-term (over the next three to seven years, depending on the extent of changes), but may not be reliable over a longer time horizon, because the focus of this analysis was on current conditions and did not consider major changes in the fishery, fleet behavior, markets, or price that are likely to arise over the long-term. Although beyond the scope of the current analysis, the SSC looks forward to a more detailed bio-economic approach as part of future IRA project work and recognizes that without it, the scope of inference is highly limited to current conditions. Specifically, a bio-economic model would be necessary to investigate more complex hypotheses about price responses to landed volume, size structure of the landings, fleet behavior, and the feedback between these factors with fishing practices and the underlying population structure.

The SSC has the following recommendations for changes prior to final action:

- Add the F_{ABC} for each of the simulations (e.g., Table 6) to compare the change in the reference points and implied change in fishing effort.

- Include some additional text (e.g., following some of the text in the slides) framing the social and economic analysis relative to the simulation analysis (that also included revenue impacts). Specifically, this should explain the benefits of the more detailed exploration of price impacts conducted in this section.

- The analysts should consider an additional analysis in the social and economic impacts section linking the potential effort adjustment results to revenue changes. This general methodology could be useful in the consideration of potential heterogeneity in revenue (and cost) impacts.

- To the extent possible, add an analysis and discussion of heterogeneity in potential revenue impacts. This could include consideration of heterogeneity in terms of vessel sizes, locations, different quota classes, and different fishing strategies. This discussion could also include identification of areas and gears with historically high encounter rates of small sablefish.

- Add further discussion of ICAs and how they would or would not be important under scenarios of full and partial ABC utilization.

- Synthesize existing discussion and add additional analysis as needed to summarize characteristics of any individuals or operations likely to be negatively impacted (e.g., catcher processors, operations that fully fish their quota who would have their allocations reduced because of the ICA).

- To the extent practical, include an additional abbreviated discussion regarding how market conditions could lead to more general changes in the sablefish fleet.

- In the Social Impact Assessment (SIA) of the Sablefish IFQ section of the document:

  - Add a table describing the demographics, income levels and other relevant population-related information, and a second table providing an institutional summary for those fishing communities substantially engaged in or dependent on the sablefish fishery similar to those provided in recent Council SIAs.

  - Add a subsection that provides the regulatory context for the economic and social impact analysis of potential impacts of the proposed alternatives and provides an understanding of why the requested tables are important to include in the analysis.

- Explore the potential for the differential distribution of impacts across the participating sablefish catcher vessel fleet related to vessel size, gear types, operational characteristics, area of activity, or similar factors. To the extent differences are found, map those differences onto the fishing communities identified as substantially engaged in or dependent on the sablefish fishery.

- Add a discussion of how the proposed action might affect on-deck operations and incentives to discarding behavior under different scenarios of encounter rates with small fish, price and observer presence.

The SSC recognizes that in a broad sense moving fisheries toward increased discarding is generally not consistent with many other Council actions and considered whether this specific action could set precedent for other fisheries experiencing revenue challenges.

If the Council chooses to continue consideration of Option 1 under Alternative 2, the SSC highlights the potential value in additional exploration of what is known about retention probability from the West coast sablefish fishery where discards are allowed and the observer coverage rate is higher. While the SSC acknowledges that the West coast and Alaska sablefish fisheries differ in many respects, including the primary gear types used, sablefish across these fisheries enter common markets and there may be useful insights about the impacts of allowing discards. More generally, the SSC highlights that other Council decision-informing analyses may benefit from examples from fisheries in other regions.

The SSC highlights that future evaluation of the success or failure of this potential action relies on developing clear measurable objectives that can dictate specific performance metrics. **The SSC encourages consideration of how and when such performance metrics might be developed at the time of action.**

D2 Bering Sea Aleutian Islands Crab Program Review

The SSC received a summary presentation of the 17 Year Crab Rationalization (CR) Plan Review from Sarah Marrinan (NPFMC), Darrell Brannan (Brannan & Associates LLC) and Mike Downs (Wislow Research Associates LLC). The SSC thanks the authors on a very thorough and extensive report, and for their inclusion of the elements requested by the SSC, the AP and public at the October 2023 Council meeting, especially the inclusion of dashboards and extensive community social and economic information.

The SSC received oral public testimony from John Iani (North Pacific Crab Association), Heather McCarty (Central Bering Sea Fishermen's Association), Mateo Paz-Soldan, (City of St. Paul), Jamie Goen (Alaska Bering Sea Crabbers; ABSC), and Frank Kelty (self). Written testimony was received from Heather McCarty (Central Bering Sea Fishermen's Association), Mateo Paz-Soldan (City of St. Paul), and Jaime Goen (ABSC).

The Magnuson-Stevens Act requires that each Limited Access Privilege Program undergo a formal review every seven years after the initial 5-year review. **The SSC finds that this document is sufficient to serve as the required program review and the Allocation Review required under NOAA Fisheries' Allocation Policy Directive.**

The SSC reviewed the workplan at the October 2023 Council meeting and recommended additional information focused on community impacts be included in the final report and the use of dashboards to focus on how the CR Program elements have or have not met the goals and objectives defined by the Council. The SSC also asked for an analysis to examine crew advancement over time. The SSC acknowledges and thanks the authors for including these additions and considers the document to be enhanced as a result.

In general, the review finds that the CR Plan has met many of the social and economic goals and objectives originally identified and, in addition, has realized several conservation goals. The authors indicated that the allocation of quota shares (QS) has provided a substantial benefit. By removing the derby fishing and excessive capacity and providing community protections, fishing has been able to continue, especially during low TAC years. Although many of the goals and objectives of the plan have been addressed, the authors note that some aspects of the plan have been more successful than others.

The review identifies several factors outside of the CR Program that have had significant impacts on the crab fisheries, those being recent low TACs and fishery closures, world markets which includes international trade, the dollar's value, supply and demand.

The review finds a significant decline in harvesting vessels and while reducing overcapacity was a goal, recent declines have had negative impacts. Harvesters have looked for new opportunities to fish under low crab TACs, but those opportunities have been limited by management measures implemented to protect

participants in other fisheries as well as vessel design (crab vessels are not always easily converted to other types of fishing).

Share matching and the binding arbitration process were noted in the review and public testimony as one of the more debated aspects of the program. Over time, the harvesting sector has generally supported the structure of the process, while the processing sector has had more concerns. Stakeholders expressed concern that certain costs associated with the arbitration process are incurred even when a fishery is not opened. Furthermore, public testimony identified outdated historical pricing data used in the price formula as a concern under the current arbitration process going forward.

The authors indicated that industry-led programs like the Right of First Offer (ROFO) have benefited active Bering Sea crab crew members by providing them an opportunity to purchase crab quota shares. However, crew wages as a percentage of ex-vessel value have declined and with some community QS being revoked, there has been concern about the continued protections for crew in the future. The review notes that the Council has begun to implement changes to address these issues.

The review points to relatively stable lease rates in recent years as stakeholders have generally agreed to limit lease rates. To address Council concerns regarding lease rates, cooperatives have asked members to consider voluntary caps on their lease rate asks and offers. This process may have had mixed success.

The authors point out that while community protections have had some success in meeting plan goals and objectives, the declining number of processors and the cascading effects of their departure from a community was identified as a general concern. Current market conditions and TACs appear to be the primary drivers of reductions in active processors. The authors note that regional and community protection provisions in the plan have had mixed results and are highlighted below:

- There has been a general shift in QS away from the state of Washington to Alaska but it has been concentrated in larger communities. The increase of CDQ program allocations from 7.5 percent to 10 percent of the TAC and the waiver of sea time eligibility requirements successfully increased engagement in the CR Program fisheries through expansion of CDQ ownership shares. In addition, these program features have recently led to Tribal acquisition of ownership interest in limited liability companies (LLCs) that own QSA.

- The North region QS designation for several crab fisheries designed to help keep shore-based processing activity in St. Paul and St. George was successful for St. Paul in maintaining processing capacity there, although it has not conferred resilience to recent closures.

- The ROFO element has functioned to help keep processor QS in some communities, even without being formally invoked.

- The creation of a West region designation for Western Aleutian Islands Golden King Crab (WAG) was to keep shore-based processing activity occurring in Adak and Atka. Since the implementation of the CR Program, shore-based processing of WAG has occurred in Adak but not Atka. However, while the Adak Community Allocation has provided resources to use toward building sustained participation in the CR Program fisheries this allocation has not been as successful due to multiple factors that are primarily external to the CR Program.

The plan review proposes that the program has been successful in meeting many of the management goals and objectives and realizing real conservation, however, recent outside factors seem to be testing whether the program is able to continue meeting those goals within the National Standards. The authors have noted that there is profound uncertainty in the CR for the future.

With that uncertainty, although the CR Plan has been successful in numerous ways, the SSC recognizes that the Council may consider future amendments to the program to accommodate a changing climate and the impacts that may occur as a result and have suggested changes to the document to highlight those concerns.

The SSC has the following recommendations for changes to the document going forward:

- Put key program elements in context with the program objectives and climate/environmental related instability highlighting both potential adaptive and maladaptive features of the program.

- In synthesizing outcomes associated with the program and elements, include discussion of outcomes that capture outcomes beyond crab fisheries (e.g., ease of diversification).

- Expand Table 2.7 to include a brief description of the action and how it may relate to the program review requirement objectives.

- Include some context in terms of the magnitude of change/consolidation in QS relative to the community reflected in Table 8-37.

- Include some reflection on how program elements have conferred resilience or been maladaptive to climate impacts experienced in this fishery.

- Emphasize the unexpected nature of events like COVID and extreme climate events that led to the collapse of several crab fisheries and how that relates to the program structure.

- Include rationale for why the collaborative research programs are important in the context of CR and, in particular, that identification of stakeholders through a CR program facilitates collaboration between industry and agencies.

- Identify whether the process of economic data reporting (EDR) data review was beneficial or could be improved in the future.

- Add a dashboard element that captures the portion of fished quota that is leased in each fishery, as a reflection of intergenerational turnover.

- Revise the executive summary with additional organization and synthesis that can summarize the main outcomes associated with the program.

- For the key program elements, ensure there is synthesis and discussion of the performance of the program element relative to the case where the program was implemented but the program element was not.

- Add language to recognize the use of LKTK in the qualitative analysis.

D5 Five-Year Research Priorities Recommendations

The SSC met virtually on May 17, 2024, to review the SSC Subgroup's recommended five-year research priorities. Chris Siddon (SSC Subgroup co-chair) provided a presentation outlining the work completed by the SSC Research Priorities Subgroup (Subgroup) and other review bodies. The Magnuson-Stevens Fishery Conservation and Management Act requires that regional fishery management councils develop "multi-year research priorities for fisheries, fisheries interactions, habitats, and other areas of research that are necessary for management purposes". The NPFMC updates Research Priorities (RPs) on a triennial cycle, and the last review was in 2021. Public testimony at the May SSC meeting was provided by Megan

Williams (Ocean Conservancy) and Lauren Divine (Aleut Community of St. Paul Island Tribal Government). Written public testimony was provided during the SSC's April meeting by Gordon Kruse (Bering Sea Fisheries Research Foundation), Marissa Wisneiwski (Alaska Marine Conservation Council), and Jamie Goen (Alaska Bering Sea Crabbers). Additional oral public testimony on RPs was provided by Cory Lescher (Alaska Bering Sea Crabbers) and Scott Goodman (Bering Sea Fisheries Research Foundation) at the February SSC meeting, at which time the SSC had RPs on the agenda but was not able to discuss this item due to time constraints.

Dr. Siddon reviewed the research prioritization processes (approved by the SSC at the June 2023 meeting) and presented a list of 12 recommended RPs for "top ten" consideration, as well as 12 alternative RPs.

The Subgroup's process for selecting their recommended RPs included reviewing the 2021 top-ten list, new top-five priority lists from each of the Plan Teams, the Social Science Planning Team (SSPT), the Bering Sea FEP team, new public submissions, and new RPs from SSC members. The Subgroup revised, combined, or added to these RPs to improve clarity, reduce redundancy, and broaden topics that spanned input from multiple groups. Care was taken to minimize any potential change of intent from the original RPs. See _Debrief on 2024 research priorities process_ for details.

The SSC discussed reducing the list to 10 RPs by removing *(1) the Norton Sound Red King Crab Case Study* and *(2) Improve discard mortality rate estimates for scallops, crab, and groundfish stocks by gear types.* However, after considerable discussion, there was strong support for retaining all 12 Subgroup-recommended RPs with minor additions in the form of parenthetical examples, several of which were drawn from public testimony, to provide clarification or emphasis. These are included in Table 1 (Appendix A) with SSC additions bolded.

The SSC continues to support the Norton Sound case study as a pilot study for the incorporation of LK, TK, and subsistence information in a relatively small-scale fishery that is experiencing challenges related to both stock and climate change factors. Additionally, as noted in several SSC February reports beginning in 2018, the NSRKC commercial and subsistence fisheries have incorporated multiple community protection measures in combination with conservation-oriented measures, none of which have been assessed for their efficacy in providing for the sustained participation of fishing communities and therefore their potential applicability to other fisheries. The SSC also noted that the recommendation for this study was well received by the LKTKS and Climate Change task forces, and thus may represent an important pilot study for ways to better incorporate LK and TK in Council decision processes. For the RP on discard mortality, the SSC notes that this RP was broadened from focusing on scallop to include crab and groundfish and determining accurate discard mortalities is critical for ongoing and planned analyses such as the small sablefish release analysis. The SSC also recommended that the Subgroup prepare brief descriptions to accompany the top RPs when they are provided to the Council in June and added to the database, consistent with past top-ten lists.

The SSC commends the Subgroup for refining and implementing the RP selection process and appreciates the structured input from Plan Teams, the SSPT, the FEP Team and the public. The SSC also highlighted the excellent contributions of Nicole Watson (former NPFMC Staff) to the Subgroup.

An overview of the Critical Ongoing Monitoring (COM) prioritization process was also provided. There were 21 COM priorities identified in 2021 and the Plan Teams provided a new list of 16 COM priorities, seven from the previous review and nine that were elevated from the Urgent or Important categories. The Subgroup reviewed and edited the COM priorities and, as with the RPs, revised, combined, or added to them to improve clarity, reduce redundancy, and broaden topics resulting in a total of 15 Subgroup-recommended COM priorities.

The SSC appreciates the Subgroup's work on COM priorities but noted that inclusion of RPs from the other categories (e.g., Urgent or Important) along with efforts to generalize input from multiple Plan Teams may result in a "watering down" of COM priorities. The COM category designates the highest priority for the Council, which is to create and maintain indispensable data collection programs that substantially contribute to the understanding and management of fish populations, fisheries, and the communities engaged in or dependent upon those fisheries. The SSC notes that further work is needed to address the framing of a number of the items on the Subgroup's updated COM list before they are ready for SSC review and prioritization as some of the COMs appear to reflect priorities for urgent process studies rather than monitoring. When reviewing the COM list, the SSC recommends the Subgroup review and consider the "Procedure for review of each research category: 1.1.Critical, ongoing monitoring research" from the SSC June 2021 Report: Appendix B. Given the limited time for in-depth review of the COM priorities at this meeting, the SSC agreed to retain the 2021 top COM priorities with no changes for this cycle. The SSC Subgroup will review and revise the COM priorities in the 2027 Research Priority cycle.

Based on the SSPT recommendation and the Council's overall goal to facilitate the increased use of Local Knowledge, Traditional Knowledge and Subsistence information (LKTKS) within the Council process, the Subgroup recommended the addition of a general statement to the COM category:

> *The Council has adopted the LKTKS Protocol and has committed to incorporating LKTKS information into ongoing management decision making processes when available and relevant. Research focused on ongoing monitoring of the incorporation of LKTKS would increase the transparency and identify gaps in inclusivity of the process. There are numerous ways Traditional Knowledge will strengthen all Research Priorities, including offering new frameworks for analysis and fostering relationships between Indigenous and Western scientific researchers and communities.*

The SSC supports the Subgroup recommendation to add this general statement.

The Subgroup also provided recommendations for the next (2027 – 2030) RP cycle process. The SSC concurred with the Subgroup's suggestions and offered several more, included below:

- Full review of both Research Priorities and COM priorities.

- Consideration of an additional opportunity for Plan Teams (or PT chairs) to review the SSC Subgroup efforts to consolidate, reduce redundancy, and maintain the core essence of the top RPs to ensure fidelity to the Plan Team intent before full SSC review.

- The SSC Subgroup, in collaboration with Council staff, reviews and recommends updates/revisions to the RP Database (e.g., when to "retire" an RP from the list).

- When the SSC subgroup reviews research priorities, consider the "Procedure for review of each research category" in the SSC June 2021 Report: Appendix B and Research Priority terms and definitions. In particular, there should be a clear distinction between Critical Ongoing Monitoring and other research needs (Urgent, Important or Strategic).

- Consider incorporating RPs from and engagement with groups outside the Council process (e.g., Alaska Scientific Review Group) to refine priorities specific to the Council mission.

- Consider expanding the list of top research priorities to include research on the use of socioeconomic information to support Council decision-making (e.g., TAC setting), and research to advance stock assessment core capabilities (e.g., state-space modeling).

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 2024 meeting, a number of SSC members acknowledged associations with specific agenda items under SSC review. Chris Siddon supervises Katie Palof (BSAI CPT co-chair; assessment author for BBRKC and co-author for SMBKC; D2 BSAI Crab Program Review contributor), and is a second-level supervisor of Caitlin Stern (SMBKC assessment author) and Tyler Jackson (AIGKC assessment author; D2 BSAI Crab Program Review contributor). Jason Gasper is a contributor to C4 Small Sablefish Release. Robert Foy is the second level supervisor for Jennifer Ferdinand (C1 Observer Report, C4 Small Sablefish Release) and third or greater level supervisor for contributors to the following agenda items: Geoff Mayhew (C1 Observer Report); Cody Szuwalski, Mike Litzow and AFSC members of the CPT (C2 BSAI Crab); Dan Goethel, Chris Lunsford, Ben Williams, Jane Sullivan (C4 Small Sablefish Release); Brian Garber-Yonts (D2 BSAI Crab program review). Mike Downs is a contributing author to D2 BSAI Crab Program Review. Dana Hanselman supervises Chris Lunsford (C4 Small Sablefish Release), is a second level supervisor to Dan Goethel and Ben Williams (C4 Small Sablefish Release), and is a third-level supervisor of Jane Sullivan (C4 Small Sablefish Release). Finally, Andrew Munro supervises Toshihide Hamazaki (NSRKC author).

Appendix A: Recommended Top 12 Research Priorities

Table 1. The 12 SSC-recommended Research Priorities for Council consideration. Bolded text indicates SSC additions at the May 17, 2024, meeting to provide clarification or emphasis. The Citations field provides reference to the sources of each RP and the Related RIDs field lists the ID numbers of other related RPs in the database. Asterisks (*) represent RPs that were on the 2021 "Top 10" list in some form. For full details see the D3 *List of Research Priorities 2024-2027* document provided in the April 2024 SSC Agenda.

Description	Citations	Related RIDs
Further research to reduce western Alaska salmon bycatch in Bering Sea groundfish fisheries **(e.g. research on salmon and drivers of salmon distribution, as well as drivers of groundfish fishery behavior including avoidance of other PSC species)** (808).	Public, SSCsub, GPT, SSPT (Supp)	N024 (155, 156, 157, 182), N029, N031, N034, N035c, 235, SSCSub001
Quantify the magnitude of fishing gear **(e.g., pelagic trawl vessels, derelict crab pots, and modified crab pots to reduce bycatch)** impacts on crab and their associated benthic habitat and develop fishing gear innovations where needed (809).	Public, BSFEP, CPT, SSCsub, Council, GPT (Supp)	N025, N028, N030, N033, N039d, CPT 004, SSCSub002, Council001, BSFEP006, 235
Evaluate direct marine mammal-fishery interactions (including feeding on discards and spatio-temporal trends in bycatch) and potential mitigation measures for marine mammal conservation (810).	Public, SSCsub (Supp), GPT (Supp)	N037b, N039f, SSCsub007, SSCsub008, GPT011
* Examine the economic, social, and cultural effects of fisheries and fishery management policy on coastal communities over time (including impacts from fishery policy changes and Tribal citizen and Tribal Nation reliance on, participation in, and impacts of federally managed fisheries) (811).	Public, SSPT (x3), BSFEP, CPT (Supp)	230, BSFEP009, SSPT003, 226, 731, N020
* Develop actionable ecosystem indicators relevant to single-species stock assessments and ecosystem assessments that address climate change impacts to managed stocks (812).	Public, BSFEP, GPT	N035a, 189, BSFEP10, GPT015

* Continue to acquire basic life history information with an emphasis on improved estimates of size/age at maturity to advance understanding of the mechanisms for how maturity changes over space and through time (813).	Public, ScPT, CPT, GPT	N008, 171, 592, CPT002, CPT003
* Increased understanding of the spatial distribution, habitat requirements, and movement of crabs relative to life history events and fishing (814).	Public, CPT, BSFEP	N003, N011, N035b, N039a, 148, BSFEP006
Develop predictive tools and models that evaluate the impact of multiple projected climate scenarios on managed resources to inform management options related to ecosystem production and resilience and adaptation of fishing communities (815).	BSFEP, GPT, CPT	223, 225, 733, BSFEP008, GPT016, CPT006
Retrospective and meta- analysis regarding whether, how, when and why objectives and goals of fishery management plans are or are not achieved over time (e.g., Bmsy proxy evaluation) (816).	Public, SSCsub, GPT (Supp), SSPT (Supp)	N027, N032, GPT014, 365
* Norton Sound Red King Crab case study (731).	SSPT, CPT (Supp)	731
Improve surveys in untrawlable habitat, particularly for rockfish, Atka mackerel, sculpins, and snow crab (817).	Public, GPT	N003, N017, N022, 146
Improve discard mortality rate estimates for scallops, crab, and groundfish stocks by gear types (818).	Public, ScPT	203, N035f