

**SCIENTIFIC AND STATISTICAL COMMITTEE
DRAFT REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
October 2nd – 4th, 2023**

The SSC met from October 2nd – 4th, 2023 in Anchorage, AK. Members present in Anchorage were:

Franz Mueter, Co-Chair <i>University of Alaska Fairbanks</i>	Sherri Dressel, Co-Chair <i>Alaska Dept. of Fish and Game</i>	Alison Whitman, Vice Chair <i>Oregon Dept. of Fish and Wildlife</i>
Chris Anderson <i>University of Washington</i>	Amy Bishop <i>University of Alaska Anchorage</i>	Curry Cunningham <i>University of Alaska Fairbanks</i>
Martin Dorn <i>University of Washington</i>	Mike Downs <i>Wislow Research</i>	Robert Foy <i>NOAA Fisheries—AFSC</i>
Brad Harris <i>Alaska Pacific University</i>	Dana Hanselman <i>NOAA Fisheries—AFSC</i>	Kailin Kroetz <i>Arizona State University</i>
Andrew Munro <i>Alaska Dept. of Fish and Game</i>	Chris Siddon <i>Alaska Dept. of Fish and Game</i>	Ian Stewart <i>Intl. Pacific Halibut Commission</i>
Patrick Sullivan <i>Cornell University</i>	Robert Suryan <i>NOAA Fisheries—AFSC</i>	

SSC members that attended remotely were:

Jason Gasper <i>NOAA Fisheries—AKRO</i>	Michael Jepson <i>Independent Contractor</i>
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SSC members absent were:

Kathryn Meyer
Washington Dept. of Fish and Wildlife

SSC General Comments

Socio-economic data products and information to meet National Standards

In reviewing the ESR previews relative to crab specifications and hearing from the CPT that adding a social science member would improve CPT ability to respond to stakeholder / SSC requests for improved social sciences information (currently the CPT only has social science expertise in fisheries economics), the SSC had a broader discussion about how to best bring socioeconomic information into the Council process. The SSC highlighted that using a more integrated and transdisciplinary approach that is consistent with the MSA guidelines would be beneficial. The SSC notes that the ESR process has matured over several decades to

effectively use ecosystem trends to inform annual specifications whereas the process and timelines for bringing socioeconomic information to the SSC for review remains unclear. The SSC discussed two main points related to how social and economic information should be integrated into the management process (see also previous SSC reports, including the October 2021 and February 2022 SSC reports). The first relates to effectively informing OFL/ABC determinations as social and economic data and information may be used for ABCs if the indicators provide information on population dynamics or distributions. Social and economic science presence on the plan teams could support the aim of using BSIA related to human behavior for informing OFL/ABC determinations. More detail on these recommendations is available in the recent NOAA Technical Memorandum NMFS-F/SPO-232: “The SocioEconomic Aspects in Stock Assessments Workshop (SEASAW) Report Recommendations for Increasing Assessment Accuracy and Improving Management Advice.”

The second relates to TAC setting and other Council actions. Social and economic data and indicators have been made available in various documents over time (Annual Community Engagement and Participation Overview (ACEPO), Economic Stock Assessment and Fishery Evaluation Reports (SAFEs), Ecosystem and Socioeconomic Profiles (ESPs), ESRs, risk tables), and new products are being developed under the Climate, Ecosystems and Fisheries Initiative (CEFI). However, in recent years, social and economic data has been taken out of ESRs and species-specific ESPs, which has drawbacks for informing TAC-setting for specific species or complexes.

The SSC reiterates that a schedule outlining when and where certain information should be presented to the SSC and Council would be helpful. This planning should include consideration of efficiency, but, importantly, it should also be responsive to National Standards 1 (a type of information to be used in determining OY), 2 (information used should be the best available), 4 (informing equity and allocation issues), and 8 (requiring explicit consideration of communities), among others. Taken together, the National Standards suggest an important issue with regard to timing: social and economic information that meets the threshold for BSIA should be provided contemporaneously to the Council with biological information at the time of TAC setting. Also important is the requirement that conservation and management measures take into account the importance of fishery resources to fishing communities. The SSC has expressed support for efforts to automate dashboards to facilitate more frequent presentation of social and economic data. Dashboards could provide a lower-effort pathway to incorporating status quo information into documents beyond the SAFEs and ACEPO. In constructing the dashboards, different aggregations could be implemented to correspond with the different scales of documents (e.g., ecosystem, community, fishery). Such efforts may be linked to staffing capacity, and the SSC noted that identifying what is needed for strategic and tactical management may be a potential starting point.

Additionally, the SSC notes a distinction between (1) reviewing the choice of what to prioritize and how to summarize social and economic data and information and (2) the final results with the most current data and information that would be used to support the TAC-setting process. This distinction has an analogy to the ABC setting process. Specifically, in the ABC setting process models are vetted by the SSC before final data is available. A similar process where the SSC vets an approach earlier than the final summaries are constructed could be used to help space review activities throughout the year.

SSC Administrative Discussion

Council staff provided the SSC with an overview of the Fiscal Responsibility Act (FRA) amended NEPA statute which went into effect on June 3, 2023. Staff indicated that the biggest change was to the time limits for completing Environmental Assessments (EA) or Environmental Impact Statements (EIS), which are now one year and two years, respectively. The time clock starts when the Agency publishes the Notice of Intent and ends when the agency makes a final determination. Further, the FRA amendment to NEPA

includes new page limit restrictions to 75 pages for EAs and 150-300 pages for EIS documents. The SSC understands that the Council and the NMFS are still determining how to adapt their procedures to comply with these new timelines, as they must demonstrate intent to keep to the statutory time limits.

The SSC recognizes that there are advantages to faster turnaround times. It is generally accepted that climate resilient fisheries management is characterized by more flexible policies and faster decision-making. Furthermore, slower management processes can undermine management goals such as sustaining fishing communities. For example, in the period between a measure being proposed and implemented, conditions leading to the proposed measure may be exacerbated.

However, the SSC expressed concerns that the truncated EA/EIS timeline has the potential to constrain the scientific review process. While relatively infrequent, the SSC has, at times, determined that the data products, analyses and/ or interpretations provided at the Initial Review stage are not sufficient to inform Council decision making and do not satisfy the Best Scientific Information Available (BSIA) requirement under National Standard 2. It is unclear to the SSC how these cases, which may require a subsequent review before being ready for Final Review, will be impacted by the amended timeline. Coordination with the SSC prior to formal initiation of an EA/EIS may help maintain the quality and rigor of scientific review, while enhancing efficiency.

The SSC recognizes that refinements to NPFMC's processes may be needed to support the expedited timeline for Council actions, and the SSC is concerned that these may adversely impact the peer review process. Further, the SSC notes that, concurrent with the implementation of these NEPA amendments, ongoing climate-related changes may result in increased complexity in evaluations of BSIA.

The SSC considers the robustness of the scientific review process as paramount and requests that it be safeguarded as the Council and Agency adapt their processes to accommodate the procedural NEPA amendments going forward.

IRA Funding Discussion

The SSC received presentations on Inflation Reduction Act (IRA) funding from Robert Foy (NOAA-AFSC) and Diana Evans (NPFMC). The presentation from Dr. Foy provided a high-level overview of IRA funding on a national level and also how funds allocated directly to AFSC will be utilized. This provided context for the presentation by Ms. Evans that focused on the subset of IRA funding that is being made available explicitly to the Regional Fishery Management Councils to submit a grant proposal that focuses on building climate readiness and resilience. The presentation centered on current and upcoming Council initiatives to help the SSC and Council consider what objectives, issue areas, or projects might be included in a proposal for IRA funding. The goal for this presentation was to solicit scientific input from the SSC on factors to consider in prioritizing potential projects for an IRA funding proposal.

The SSC had a broad and highly engaged discussion on many topics related to the IRA funding, which centered mostly on staffing capacity, a range of proposal topics, and the potential for integration/cooperation across the other Regional Fishery Councils. There was a clear consensus regarding the interplay of the proposal topic and the amount and type of additional staffing that may be required to meet project objectives. The SSC agreed that regardless of the project, having dedicated staff time will be necessary so as not to impact current responsibilities. The SSC is very supportive of the opportunity to improve the ability of the NPFMC to be more responsive to fishery and ecosystem changes into the future and facilitate more resilient communities in Alaska.

The SSC appreciates the overview in the staff document of ongoing activities under various initiatives such as the work of the Climate Change Task Force, the Programmatic EIS, Fishery Ecosystem Plans, the

upcoming SCS8, potential SSC workshops and others. The SSC highlights the need for any proposed project to coordinate with these activities to best complement ongoing work. The SSC supports the idea of first developing a strategic goal for what to achieve by the end of the funding period to help focus proposal development. SSC discussions on a potential project ranged from focusing on strategic changes to the Council process to more specific topics that might lead to specific actions. Specific proposal topics discussed by the SSC included: 1) review and revision of the Tier system, 2) review and revisions to harvest control rules and consideration of dynamic reference points, 3) re-examination of closure areas and how they could be more dynamic if needed, 4) how to make the TAC setting process more flexible, and 5) metrics needed to modify (add or delete) FMP species as species distributions and abundances continue to change. While these were a few topics that were explicitly mentioned, the staff presentation and report provided a number of additional avenues (e.g., coordinating with the programmatic EIS) that the SSC supported as topics worthy of additional funding. The SSC noted that some of these topics (e.g., changing the tier system) were likely too substantial to be able to be through Council action in 2026 and implemented by 2027 and that some of the funding might need to be focused on tactical improvements to Council processes like data streams and communications.

There was support for examining how the management process, and its scientific inputs, including ecological and socioeconomic information, could be modified to better react to abrupt rather than gradual changes; many of the significant fishery concerns (e.g. snow crab closures) have arisen as fairly abrupt changes that the current management process is less equipped to handle. The SSC supports the idea to look to other fields that specifically deal with emergency preparedness and disaster planning and preparedness for appropriate processes and procedures that may help the Council prepare for disruptions. The SSC generally supported the use of workshops (depending on the research topic) to be able to help review progress and achieve milestones towards overall project goals along the way.

The SSC also reiterated the need to consider a broader context, especially in regard to previous workshops and national SSC meetings, and potential benefits from integrating projects across the Regional Fishery Councils. Additionally, the SSC reiterated that any proposed project should be aware of and potentially leverage other IRA funded projects underway at the AFSC.

With regards to stakeholders and the public, the SSC highlights the need for communicating plans and outcomes clearly, engaging stakeholders in workshops as appropriate, considering equity and environmental justice, and making data products and tools that facilitate climate-ready fisheries planning accessible for decision-makers and management.

The SSC noted the current limitation in capacity, from stock assessment authors to review bodies, and expressed interest in how this funding might be used to relieve capacity limitations.

Overall, the SSC did not explicitly prioritize among many viable project ideas that would provide useful and needed outcomes but welcomes opportunities for providing additional input and support as this moves forward.

C1 BSAI Crab

The SSC received a detailed report on the September 2023 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 were detailed in the CPT report. Items on which the SSC provided comments are below.

General Crab Comments

The SSC recognizes the valuable contributions of Miranda Westphal (ADF&G) on the CPT and wishes her well in her future endeavors.

Risk tables have proven to be a valuable component of groundfish stock assessments in providing a rationale for making ABC recommendations that reflect concerns about the stock assessment, population dynamics, the fishery, and the ecosystem. In their June 2021 [motion](#), the Council supported delay of application of the risk table to the crab specifications process until further progress is made on groundfish. Based on the SSC preliminary guidance and recommendations in the Risk Table Workshop Report (p. 33 of June 2021 SSC Report, Appendix A) and further positive experience with risk tables for groundfish, the SSC recommends that risk tables be developed for crab assessments. Risk tables would be used to provide a more comprehensive, transparent, and defensible justification for CPT and SSC recommendations on ABC buffers. The SSC emphasizes that the use of risk tables does not change its overall approach to setting ABC buffers for crab and recognizes that it may take more than one assessment cycle to develop.

The SSC requests that the CPT develop a process for ensuring that authors have provided a response to all previous (including at least the last assessment) SSC recommendations, even those for which no work has been completed, so these requests can be more easily tracked over time.

The SSC requests that future BBRKC, Tanner and snow crab assessments routinely include a simple Tier 4 analysis that includes a smoothed time series of survey vulnerable biomass (legal size or smaller to accommodate discard mortality) using the REMA package and not adjusted for natural mortality. This model will provide a consistent alternative should the preferred Tier 3 approach fail in some way and also a point of comparison with Tier 3 and State methods used as a basis for TAC setting. The simple Tier 4 approach may also provide some value in identifying survey observations that are outside the level of process error observed in the rest of the time series. The SSC recommends that the CPT consider whether the method used for setting the buffer for the Tanner crab analysis, based on the terminal year's CV rounded to the nearest 5%, would be an appropriate method for all simple Tier 4 analyses.

The SSC also requests that all crab authors include uncertainty intervals when showing time series of biomass/abundance estimated by the stock assessment models so that alternative models and retrospective patterns can be evaluated in the context of the modeled uncertainty.

The SSC reiterates its February 2023 guidance:

- For the inclusion of trawl survey data, the SSC suggests crab assessment authors and the CPT be more explicit about best practices for which standard years are included for bottom trawl survey data. The SSC suggests that the years recommended by the Groundfish Plan Teams would be a good starting point, which specify using the following bottom trawl survey data years:
 - Aleutian Islands: 1991 - present (standard gear)
 - Eastern Bering Sea: 1982 - present (standard gear, grid, and design), 1987 - present for species that inhabit the northwest corner of the survey (which was added in 1987 for snow crab and walleye pollock)

The SSC suggests that the CPT and crab authors continue to evaluate whether VAST or similar approaches, when specified carefully for individual crab stocks (i.e., the choice of error distributions and number of knots) might provide more robust survey time-series.

Ecosystem Status Report Preview

The SSC received presentations by Elizabeth Siddon (NOAA-AFSC), Bridget Ferriss (NOAA-AFSC), and Ivonne Ortiz (U. Washington) previewing the Ecosystem Status Reports (ESR) for the Eastern Bering Sea (EBS), the Gulf of Alaska (GOA) and the Aleutian Islands (AI), with specific attention to indicators that may be influential to consider for crab stock assessments. The SSC appreciates the effort to provide this information at the October meeting as data are still incoming and being incorporated. The SSC looks forward to the full ESR in December.

Generalized summaries were provided for the GOA and AI ESRs. No ecosystem concerns were identified for the GOA, and the author noted ocean temperatures remain near the long-term average with mixed pelagic feeding conditions for adult groundfish. For the AI, warming conditions persisted, characterized by high sea surface temperatures, with the winter of 2022/23 representing one of the warmest on record since 2013. The strongest effects of this warming were present in the western and central AI. The SSC suggested information on which species are most vulnerable to these persistent conditions would be helpful for understanding ecosystem impacts.

For the EBS, specific to crab stocks, it was noted that oceanographic conditions in 2022/23, including regional sea surface temperature trends and cold pool extent, were near the long-term averages with no red flags, suggesting good conditions for both pelagic and benthic crab. In 2023, there was a shift in timing of sea ice, with delayed sea ice growth due to slow freeze-up in Chukchi and impact of ex-typhoon Merbok. Modeled output from ROMs suggest expansion of bottom water ocean acidification (OA) conditions in 2023 (aragonite and pH). The author noted while these OA values are concerning, they were not expected to be driving crab declines as snow crab are not sensitive to declining aragonite concentrations and the nearshore habitat in Bristol Bay appears to be buffered. The SSC looks forward to seeing future work ground-truthing the modeled OA indicators.

Biological indicators showed mixed conditions for pelagic and benthic crabs. For pelagic crab, prey conditions (e.g., chlorophyll-a biomass estimates, copepod abundance, and copepod lipid content) were low in summer and fall 2023. Pelagic foragers, which are predators on pelagic crab stages, were high in 2022. For benthic crabs, indirect measurements of infaunal prey based on the 2022 benthic forager guild indicated adequate availability, but competitors and predators of benthic crabs remained high in 2022. The SSC noted that the continued high abundance of motile epifauna biomass, driven by brittle stars and other sea stars, represents a trophic 'dead-end' for energy in the benthic community and these organisms also may have direct interactions with benthic crab. It is unclear if this may represent a new community state.

Broad-scale climate patterns reflect a transition from La Niña to El Niño conditions with anticipated warmer ocean temperatures arriving in early spring 2024. Ecological impacts of this transition remain unclear and will depend on the duration, depths, and timing of the warmer conditions. The ESR team expects to have updated forecasts of El Niño conditions for their December presentation.

Other notable observations included high bycatch of herring in the flatfish and pollock fisheries. A flatfish fishery exceeded herring PSC in 2023, the first time since 1992, and the pollock fishery was near the PSC cap. There were indications that herring were deeper and in more variable areas than in the past. This, along with predicted shifts in ice extent and phenology, highlight that the changing spatial and temporal dynamics of physical conditions may result in not only increasing or decreasing trends in biological components, but also in shifting distributions and changing biophysical interactions. The SSC discussed that even when physical conditions return to baseline, there may still be variability in the biological components, and supports the ESR authors' current efforts to develop spatio-temporal indicators of stratification and composite indices to better understand horizontal and vertical shifts in distribution that affect prey availability, species interactions, and interactions with fisheries.

Trawl Survey Updates

The SSC received an excellent presentation on the 2023 EBS and NBS bottom trawl survey results relevant to BSAI crab from Mike Litzow (NOAA-AFSC, CPT co-chair). There was no public testimony on the survey results specifically. **The SSC commends AFSC survey staff for completing the bottom trawl surveys in 2023 under what continue to be challenging logistical conditions.** Further, the SSC continues to be impressed with the rapid turnaround of the survey data and commends the crab assessment authors for updating model runs and assessment documents on the short timeframe necessitated by the survey timing.

Overall, many population components of BSAI crab on the surveys continue to decline or to remain close to all-time low levels. There were few exceptions to this. **The SSC continues to register substantial concern for the BSAI crab stocks as a result of these survey trends.**

All major components of the EBS snow crab male population continue to be at or near all-time survey lows. However, there appears to be some incoming recruitment of small snow crab (30-40 carapace width (CW)). Mature females are also at an all-time low. The survey size composition data show a decline in the larger size classes, which is expected as the population has seen little to no recruitment in recent years. Clutch fullness was higher in 2023 than in 2022. Results from the NBS survey continue to indicate that snow crab are not migrating north, with primarily small animals encountered in the NBS.

BBRKC male abundance declined compared to 2022 but mature female abundance increased substantially (46%). While this last note is encouraging, given the recent fishery closures, a large portion of this increase was from a single station (roughly 37% of the overall catch; 141 crab). Some caution interpreting these results is warranted, though it was noted that this patchiness is not atypical and the spatial distribution of mature females in 2023 was similar to previous years. Long-term, mature females continue to be at a relatively low point in the available time series. No re-tows were conducted in 2023, with a relatively low proportion of females having an incomplete molt-mate cycle.

Tanner crab abundance in the eastern area declined but increased in the western management area. The largest recruitment event on record was noted. There is some evidence for a shift to the northwest of Tanner crab. For example, more old shell crab were seen in the eastern management area and more new shell crab in the western area. The SSC encourages additional investigation into this apparent shift, noting that ADF&G has a couple of pilot projects to investigate Tanner crab movement, as this could impact management of this stock in the future.

No PIBKC mature males were encountered on the survey. The SSC encourages investigation of previous survey data, particularly the ADF&G pot surveys mentioned at the CPT meeting, to provide context for current survey results for this species. PIRKC male abundance was down from 2022 (49%) and mature females increased slightly (9%). SMBKC mature male abundance was similar to 2022 but mature females declined by 71% in 2023.

BSAI Crab Harvest Specifications and SAFEs

Table 1 includes the stock status determination criteria and Table 2 includes the October 2023 SSC recommendations. The SSC endorsed all of the OFL and ABC recommendations of the CPT, with the exception of EBS snow crab and Tanner crab (Table 2).

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October 2023

Table 1. Stock status in relation to status determination criteria for 2022/23. 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 _{MSY} proxy ¹	2022/23 MMB	2022/23 MMB/ B _{MSY}	2022/23 OFL	2022/23 Total Catch	Rebuilding Status
1	EBS snow crab	3	136.9	155.91	92.4	0.59	10.32	0.05	Overfished
2	BB red king crab	3	9.68	19.36	18.34	0.95	3.04	0.07	
3	EBS Tanner crab	3	18.19	36.39	74.17	2.04	32.81	2.62	
4	Pribilof Islands red king crab	4	0.85	1.71	3.88	2.27	0.685	0.004	
5	Pribilof Islands blue king crab	4	2.10	4.20	0.18	0.043	0.00116	0.00	Overfished
6	St. Matthew Island blue king crab	4	1.63	3.26	1.31	0.40	0.07	0.002	Overfished
7	Norton Sound red king crab ²	4	0.95	1.90	2.42	1.27	0.30	0.16	
8	AI golden king crab	3	5.83	11.66	13.60	1.17	3.76	2.61	
9	Pribilof Islands golden king crab ³	5					0.093	Conf.	
10	Western AI red king crab	5					0.056	<0.001	

¹ As estimated in the 2023 assessment

² For Norton Sound red king crab, all values in the table except 2022/23 total catch were projected using the January 2022 assessment. Stock status for NSRKC is determined in February (2022/23 MMB was projected for 2/1/23 and compared with the projection of B_{MSY} proxy for the 2022/23 year).

³ PIGKC specifications are set on a calendar year basis.

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Table 2. SSC recommendations for EBS crab stocks. Stocks for which specifications are rolled over between assessments (PIRKC and SMBKC) or were set in February (NSRKC) are included. Biomass values are in thousand metric tons (kt). Tier designations in this table are based on the projected stock status in 2023/2024. 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 is set in February.

Ch	Stock	Tier	F _{OFL}	B _{MSY} or B _{MSY} proxy	B _{MSY} basis years ¹	2023/24 ² MMB	2023/24 MMB/ B _{MSY}	Natural Mortality (M)	2023/24 OFL	2023/24 ABC	ABC Buffer
1	E. Bering Sea snow crab	3b	14.96	155.91	1982-2022	65.77	0.42	0.29	15.44	7.72	50%
2	Bristol Bay red king crab	3b	0.30	19.36	1984-2022	14.98	0.77	0.23	4.42	3.54	20%
3	E. Bering Sea Tanner crab	3a	1.16	36.39	1982-2022	48.77	1.34	0.23	36.20	28.96	20%
4	Pribilof Is. red king crab	4a	0.21	1.71	2000-2021	3.88	2.27	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	0.04	0.18	0.00116	0.00087	25%

¹ For Tiers 3 and 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 average catch for OFL is estimated.

² MMB is estimated on 2/1/2024 for NSRKC and on 2/15/2023 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

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Table 2 cont. SSC recommendations for EBS crab stocks. Stocks for which specifications are rolled over between assessments (PIRKC and SMBKC) or were set in February (NSRKC) are included. Biomass values are in thousand metric tons (kt). Tier designations in this table are based on the projected stock status in 2023/2024. 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 is set in February.

Ch	Stock	Tier	F _{OFL}	B _{MSY} or B _{MSY} proxy	B _{MSY} basis years ¹	2023/24 ² MMB	2023/24 MMB/ B _{MSY}	Natural Mortality (M)	2023/24 OFL	2023/24 ABC	ABC Buffer
6	St. Matthew blue king crab	4b	0.06	3.26	1978-2021	1.31	0.40	0.18	0.07	0.05	25%
7	Norton Sound red king crab	4a	0.18	1.98	1980-2023	2.40	1.21	0.18	0.31	0.22	30%
8	Aleutian Is. golden king crab ³	3	0.59 (EAG) 0.50 (WAG)	11.66	1987-2017	12.07	1.04	0.22	4.18	3.14	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 and 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 average catch for OFL is estimated.

² MMB is estimated on 2/1/2024 for NSRKC and on 2/15/2023 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

EBS Snow Crab

The SSC received written and oral comments relevant to EBS snow crab from Jamie Goen (Alaska Bering Sea Crabbers; ABSC), Scott Goodman (Bering Sea Fisheries Research Foundation; BSFRF), and Gretar Gudmundsson (self). Ms. Goen raised the issue that the PSC cap could be larger than next year's OFL and suggested that a lower PSC cap be considered to distribute the costs of rebuilding snow crab more equitably. She also noted that PSC cap is a tool to restrict both bycatch and unobserved fishing mortality. The SSC certainly supports snow crab rebuilding but did not make a specific recommendation since the PSC cap is a Council decision. Both Mr. Goodman and Mr. Gudmundsson expressed a lack of understanding as well as lack of confidence in the stock assessment modeling. It was suggested that preparing a simple stock assessment narrative that documents recent history on model development for stakeholders could improve comprehension and buy-in. The SSC understands that assessment methods are technical and complex and agrees that more effort is needed to communicate assessment methods and outcomes in a more accessible way.

Since the directed snow crab fishery was closed last year, the primary source of new information for the assessment was the 2023 EBS bottom trawl survey. Survey results indicated continuing low abundance of snow crab, with little evidence of stock rebuilding. There are some indications of recruitment to the population, but it will be several years before these crab are available to the fishery. A concerning feature of the 2023 survey results was the very low abundance of the mature biomass of both sexes, as well as the exploitable portion of the stock. All these estimates were the lowest in the survey time series.

The SSC acknowledges the stock assessment author's efforts and innovation in advancing stock assessment methods for snow crab. Several important changes were evaluated in stepwise fashion in this year's assessment. The first model change (Model 23.2) was to use the survey estimates of the probability of molt to maturity directly in the model, rather than to estimate the maturation curve in the model. Next, several models explored how the BSFRF survey data were used in the assessment to inform the selectivity and catchability of the summer EBS bottom trawl survey. One model (Model 23.3) included the derived selectivity/catchability estimates directly in the model, while another model (Model 23.3a) used these selectivity estimates as priors in the model. Both the change in modeling maturity and modeling survey selectivity brought information into the assessment in a more direct way. The use of a selectivity prior also allows the model to deal appropriately with the uncertainty in the BSFRF survey data. A final model (23.3b) looked at loosening the prior for natural mortality, but the resulting estimate was not consistent with snow crab longevity and this model was not considered further.

Model 23.3a did not show problems with model stability, model convergence (multiple minima), or strong retrospective patterns that have been a problem in previous snow crab assessments. The assessment author and CPT agreed that Model 23.3a should be the basis for providing management advice. Nevertheless, there are several aspects of the model fit that suggest additional refinements are needed. In some years, Model 23.3a overpredicts the larger males in the total and retained size compositions. In addition, results for Model 23.3a show a substantial revision upwards in the estimates of fishing mortality throughout the time series, in some years to very high levels. This suggests that historical exploitation rates for this stock have been much higher than intended. However, the catch over exploitable biomass ratio (called realized exploitation rate in the SAFE chapter) is not as extreme, though still relatively high. **The SSC acknowledges the substantial improvements to the assessment and agrees with the assessment author and the CPT that Model 23.3a should be used for management advice.**

Snow crab is classified as a Tier 3 stock because the assessment is a size-structured model that allows estimation of proxies for F_{MSY} and B_{MSY} . The OFL for a Tier 3 stock uses these proxies in a harvest control rule that specifies the fishing mortality as a function of mature male biomass. The F_{MSY} value sets the fishing mortality rate, while B_{MSY} is the inflection point where the fishing mortality is ramped down in response to

low stock size. B_{MSY} is also important for determining stock status: $\frac{1}{2}B_{MSY}$ is the minimum stock size threshold below which the stock is overfished. B_{MSY} is also the target stock size for rebuilding plans if the stock is overfished, as is currently the case for snow crab. The default proxy for F_{MSY} is $F_{35\%}$ and the default proxy for B_{MSY} is $B_{35\%}$, considered as 35% of unfished mature male biomass.

A major issue with Model 23.3a is that the value of $F_{35\%}$ is extremely high and would effectively remove all the industry preferred crab from the population. This occurs because snow crab mature at a smaller size than the size at which snow crab are retained by the fishery, so there is a component of mature males that are protected from fishing mortality. This was already an issue in the base model (23.1) but was further exacerbated in 23.3a as the effective maturity was moved to younger males and the length of full selection increased with the addition of the empirical terminal molt probabilities. The analysis that provided the basis for the $F_{35\%}$ harvest rate (Clark 1991¹) assumed that maturity and fishery selection curves were the same, but also considered scenarios where maturation occurred earlier than fishery selection. The extreme mismatch between maturation and selectivity seen for snow crab was not considered in Clark (1991). Furthermore, this mismatch was not found to be an issue when the analyses were done to support adoption of the tier system in the crab FMP. Therefore, potential alternatives to $F_{35\%}$ should be considered for snow crab in the future. It is important to note that this flexibility is built into the crab FMP, which indicates that alternative values to the default reference points $F_{35\%}$ and $B_{35\%}$ can be recommended by the SSC based on best available information.

The assessment authors and the CPT evaluated several options for setting the OFL and determining status, including using natural mortality (M) instead of $F_{35\%}$ and replacing $B_{35\%}$ with average MMB for 1982-2022. The terminology adopted by the assessment author and the CPT (and discussed at the Simpler Modeling Workshop) in referring to these alternatives is potentially misleading, in that the options represent modifications to the Tier 3 harvest control rule, rather than different versions of the Tier 4 control rule. A Tier 4 calculation was also provided using survey estimates of industry preferred biomass (>101 carapace width). Since the model was considered suitable for providing management advice, the CPT focused on options that used model estimated reference points, rather than the Tier 4 survey calculation. The SSC had previously requested the Tier 4 approach using survey biomass as a “fallback option” when the model has insurmountable problems and cannot be used for management, as well as a way to provide context for Tier 3 estimates. The authors used the terminal year survey MMB decremented for natural mortality instead of using the REMA model on male survey biomass. The SSC noted that this number was on a different scale than was requested and noted that the MMB used was much smaller than the model estimated MMB. The SSC requests for future years that the authors bring forward the Tier 4 estimate using vulnerable male survey biomass and the REMA model, and do not correct for natural mortality, as, for example, in the 2023 Tanner crab assessment (see also general crab comments).

The CPT and the assessment author recommended the option that used both M for $F_{35\%}$ and the average MMB (1982 - 2022) for $B_{35\%}$. The CPT put forward several arguments for their recommendation. They noted that both $F=M$ and $B_{MSY} = \text{Average MMB}$ are reference points for Tier 4 and are included in the FMP. They mentioned that the use of average MMB for B_{MSY} resulted in snow crab being below the minimum stock size threshold in the final year, which was better in alignment with their prior expectations of what stock status should be. They also noted that if the stock were fished at $F_{35\%}$ to equilibrium at $B_{35\%}$ there would be virtually no larger male crab that may have higher reproductive value.

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

The SSC did not support replacement of M for $F_{35\%}$ in the Tier 3 OFL control rule. Due to the delayed fishery selectivity pattern relative to size composition of the exploitable males, natural mortality may be an extremely conservative harvest policy, and it would not be advisable to adopt without further evaluation.

The SSC also finds weak support for moving to average MMB for the B_{MSY} proxy as $B_{35\%}$ provides a reasonable reference point. The stock has varied above and below $B_{35\%}$ primarily due to recruitment variability that does not appear directly associated with harvesting. Indices of female reproduction have remained high, and the proportion of large males in the population has remained stable even while overall abundance has declined.

The SSC recommends that the OFL be based on a Tier 3 calculation using Model 23.3a. Due to concerns about the very high fishing mortality rate for $F_{35\%}$, and uncertainty about the reproductive capacity of small males, the SSC recommends an ABC buffer of 50%. This buffer results in an ABC that is lower than last year's ABC. Addressing the concern about the high $F_{35\%}$ fishing mortality rate is the highest priority for the snow crab assessment.

Overfishing is not occurring for snow crab, and the stock is above the minimum stock size threshold but will remain under a rebuilding plan until it has rebuilt to the B_{MSY} level.

In addition, the SSC encourages the author to consider the following avenues for further improvements to the model:

- **The SSC strongly supports the plans of the CPT to evaluate other metrics for reproductive output.** The CPT may want to consider a multi-attribute measure of reproductive output. For example, both percent reduction in mature male biomass and percent reduction in large males could be evaluated as a function of fishing mortality.
- The SSC requests a yield analysis be done for snow crab, including the relationship between fishing mortality and catch, MMB, functional maturity, and the proportion of large males in the population. The stock production curve, i.e., yield as a function of MMB, should also be developed.
- The modeling approaches presented for snow crab were sophisticated and insightful. The SSC suggests that the authors consider greater use of the modeling structure to diagnose problems in how the data are being interpreted as opposed to more generally viewing resulting models as potential options for management. Sensitivity and other exploratory approaches using the model should be conducted and presented diagnostically to inform a smaller set of self-consistent models for management considerations.
- One idea for statistical exploration regarding the shape of the within-model empirical smoothed estimate of selectivity would be to examine to what extent the spatial distribution of differences in availability of small and large crab (or males and females) would be sufficient to explain the anomalous shape of the survey selectivity curve.
- The SSC still requests an analysis of the probability of maturing/terminal molt which treats years as random effects. A hierarchical fit to molt data might be better than annual independent GAMs.
- The SSC would like to better understand the sampling design for molt data and is concerned about the weighting of the spatial samples in the analyzing; weighting should be based on abundance if the sampling rate differs by area (which it would, unless abundance were uniform and/or the targets were in direct proportion to abundance). Hierarchical fit to molt data might be better than annual independent GAMs.

- Figure 23 on page 73 of the SAFE report shows the decline in CPUE over a season by statistical area and year. This represents a kind of depletion experiment, suggesting that total mortality (Z) could be estimated from the linear parameters representing each line. This might help determine spatial patterns in F , indicate the natural bounds for F and M , and assist in determining stock status.
- Providing a clear crab specification narrative would help the SSC and the public navigate the tiers, models, and justifications for both. In addition, it would be helpful to clearly identify models that are being explored for diagnostic purposes as opposed to models that are directly relevant for use in decision making. Public testimony indicated that help and financial support for developing such a narrative might be available.
- Regarding the missing socioeconomic indicators coded as NAs in Table 1b (page 123 of the SAFE report), while having all general socioeconomic indicators in one table would seem useful, the labels “low”, “neutral” and “high” are not ordered consistently enough across categories to provide a quick good/bad assessment as the stoplight approach does in Table 1a. So, in addition to considering remedies for that (is high good or bad?), consider separating quantitative metrics from qualitative metrics. Putting these two types of metrics in separate tables might help in interpreting the information, and if the stoplight coloring is used, putting the quantitative value within the colored box may also help succinctly present the information.

Recognizing the extensive work on major issues completed in this assessment this year, the SSC looks forward to a more complete document next year, including figures of composition residuals. The SSC also reiterates several recommendations from 2022 that were not addressed this year (these bullets are directly quoted from the October 2022 SSC report):

- VAST modeling of trawl survey data including both the NBS and EBS should be prioritized. This could help understand some of the inconsistent recruitment/growth trends observed in recent years as well as prepare for potential changes in stock distribution or productivity under future warming of the Bering Sea. VAST modeling should evaluate alternative error distributions and other model configurations as appropriate.
- Investigate whether there is information outside the assessment model (e.g., larval or post-settlement data) or in the model supporting estimated skewed sex-ratios at recruitment.
- Avoid connecting 2019 and 2021 when plotting survey time-series (e.g., Figure 14) as there were no data in 2020.
- Report the scale of standardized residuals where plotted (e.g., Figures 42 and 43).

Bristol Bay Red King Crab

The SSC received a summary of the CPT report as well as an overview of the BBRKC stock assessment. The SSC received written testimony from Jamie Goen (ABSC), Scott Goodman (BSFRF), Kristin Stahl-Johnson (Ocean People Resources) and Braxton Dew. There was no oral testimony.

Trawl survey results from 2023 indicated continued low biomass and abundance of the BBRKC stock relative to historical levels. Surveys observed a 22% decrease in mature male abundance from 2022, a 35% increase in immature males, and a 16% decrease in immature females. A 46% increase in mature female abundance was seen in the 2023 survey; however, 37% of the survey catch was attributed to a single survey station. Re-tows, intended to provide additional samples of mature females were not conducted, as only 6% of females sampled in June had not yet molted and mated. The directed fishery for BBRKC was closed by the State of Alaska during the 2021/22 and 2022/23 seasons based on mature female abundance below the State management threshold of 8.4 million.

Results and evaluation of three models were provided: the accepted model in 2022 using a newer version of GMACS (21.1b) and a fixed value of male natural mortality (0.18), an alternative model developed last year using 1985 as the start year (22.0), and a model estimating a base level of male natural mortality (0.23, with a very tight prior distribution, $SD=0.04$, centered at 0.18) for the entire time-series (23.0a).

In discussions of the pros and cons of truncating the time series, the SSC recognized the uncertainty in early survey methods, and the additional complexity needed to model the transition from high to lower biomass levels attributed to an elevated period of natural mortality in the early 1980s. The SSC noted that despite uncertainty in the actual dynamics during this period, the current status and reference point calculations did not depend heavily on the modeling choices (the recruitment period for calculating B_{MSY} is 1985-2022), as shown by the very similar results from Model 22.0.

The SSC supports the CPT and author's choice of Model 23.0a for specifications. The results of this model place the stock in Tier 3b. This stock is not estimated to have been experiencing overfishing, and the stock is not overfished. Based on the projections of recent low recruitment (2013-2022), the BBRKC stock is not approaching an overfished condition. The SSC recognizes that this stock has had sustained low recruitment over the last decade. The SSC acknowledges that there is a growing disconnect between the slowly shifting reference points estimated in the stock assessment, as each assessment adds one additional year of recruitment to the estimated B_{MSY} calculation, compared to the approach used by the State that does not annually update the recruitment series and includes a fixed mature female abundance threshold in place since 2003. Even with no change in biomass or recruitment, eventually the stock in this assessment will approach the decreasing estimate of B_{MSY} due to including additional (and recently very low) recruitments as they occur. This may lead to a potential continued divergence between federal stock status and State management thresholds.

The SSC supports the CPT recommended buffer of 20%, based on the large retrospective pattern, the very tight constraint on both M and Q and the poor fit to the BSFRF data as the major concerns in this model. The SSC recognized the importance of low biomass/abundance and recent recruitment but noted that it is already included in the assessment model results and control rule application and so should not be 'double counted' in the consideration of the ABC buffer. **The SSC requests that the author provide the basis for the extremely tight priors on M and catchability, and in the next assessment present models with more flexibility in both of these parameters.** Ideally these alternatives would be constructed after addressing the truncated size bin structure of the models which currently accumulates a much larger fraction of the large crab in the last bin than is preferable for these types of models and may be affecting the ability to estimate M and/or other dynamics. During the evaluation of catchability, the SSC encourages consideration of availability as it relates to the unknown stock structure (e.g., potential connection to the northern district) in addition to gear catchability, which appears to be the primary information currently informing the very tight prior.

The SSC thanks the author for providing the Tier 4 calculation using the REMA model and defining the vulnerable biomass as legal male biomass plus the crab within approximately one molt of legal size, exactly as requested, for comparison with the Tier 3 results.

The SSC had a considerable discussion regarding the potential value of geostatistical models for crab stocks, noting that initial work was problematic, but that unbalanced survey designs and highly skewed catch rates (such as the single large tow of mature females observed in 2023) might benefit from model-based estimators. As noted in the General Comments for Crab stocks, the SSC suggests that the CPT and crab authors continue to evaluate whether VAST or similar approaches, when specified carefully for individual crab stocks (i.e., the choice of error distributions and number of knots) might provide more robust survey time-series.

The SSC noted that some indicators showed predictive power in the Bayesian adaptive sampling results included in the ESP and suggested further consideration of when such promising indicators should be quantitatively investigated in the assessment model or used to inform assessment model inputs.

The SSC offers the following additional recommendations, including those from 2022 that were not addressed in this assessment:

- The SSC suggested tracking increases in Dungeness crab abundance in the EBS and discussion of whether/how this might affect BBRKC dynamics.
- Consider using the BSFRF data as a prior on selectivity/catchability as was done in the snow crab assessment
- Continue work on stock structure, possibly including a combined model of Bristol Bay and the northern district
- Explain why equal sample sizes are used for male and female composition data
- The SSC appreciates the MCMC outputs for examining the probability of going below reference points, but requests that some basic MCMC diagnostics such as autocorrelation plots and parameter chains be included.
- The SSC recommends investigation of the highly biased fits to the BSFRF index and suggests that the current approach of inflating the variance to account for lack of fit is inappropriate when obvious bias is present.
- The SSC suggests further exploration of the effects of the apparent recruitment observed in the 2011 survey that was not subsequently observed in later years, with particular attention to whether this could be contributing to the retrospective pattern and/or bias in the fit to other data.

Pribilof Island Blue King Crab

The SSC received a presentation on the stock assessment for Pribilof Island Blue King crab (PIBKC) and recommendations for harvest specifications. There was no public testimony.

The PIBKC stock is assessed biennially. The last full assessment was in 2021 and therefore, a full assessment was conducted in 2023. The assessment for this stock uses the R package *rema* to implement a survey averaging random effects model to smooth NMFS bottom trawl survey estimates in mature male biomass (MMB). The underlying model structure was the same as used in 2021 (approved in 2015) even though the implementation of the model switched from ADMB to TMB. The directed fishery has been closed since 1999/2000, and the stock was declared overfished in 2002. The survey MMB time series and related data for PIBKC were updated with results from the 2022-2023 NMFS EBS shelf bottom trawl surveys and the 2020/21-2022/23 crab and groundfish fisheries for retained and discarded catch. Status determination is based on the Tier 4 approach, while a Tier 5 approach is used for determining an OFL.

The B_{MSY} proxy for this stock is based on MMB at mating from 1980/81-1984/85 and 1990/91-1997/98. The projected MMB at mating for 2023/24 (0.18 kt) remains well below the MSST (2.1 kt), placing the stock in Tier 4c. There is no directed fishing. The stock remains overfished with no signs of recovery. Overfishing is not occurring.

Given continuing concerns for the stock with regards to lack of recruitment, the CPT recommended continuing with the 25% ABC buffer as used in previous years. The 25% buffer acknowledges the low

status of the stock, the accommodations made in the rebuilding plan to set the OFL, and the current status of low bycatch in non-directed fisheries. **The SSC agrees with this recommendation.**

These recommendations represent no change from the last specification and **the SSC agreed with the CPT-recommended OFL and ABC for 2023/24 and 2024/25.**

The population is at very low levels. Given the low survey catch levels, the SSC suggests that the frequency of full assessments might be reduced, with continued monitoring of survey catches. This could be discussed during the January CPT meeting, as part of a stock prioritization process across stocks.

The SSC had the following additional comments:

The SSC continues to look forward to the report on the blue king crab stock structure template in the near future.

The SSC recommends exploring the strengths and weaknesses of the current methods (bottom trawl surveys) for surveying PIBKC – acknowledging the capacity and budgetary constraints of implementing other survey methods.

There were no mature males caught in the 2023 NMFS bottom trawl survey and only seven mature females. The assessment is conducted using the *rema* model with an NA for mature males substituted for the zero that was observed in the survey. The author tried two alternative approaches. A simple work-around, replacing the zero with a small constant, such as the smallest non-zero value in the time series, was sensitive to the exact value used. The author also explored the use of the Tweedie distribution, as opposed to the lognormal, for the random effects model, and while it seemed to work for the single assessment, the model had trouble converging. The SSC noted that the Tweedie can easily be over-parameterized and that James Thorson (NOAA-AFSC) uses a reduced version known as a Compound Poisson Gamma (CPG). The SSC recommends continued exploration of the Tweedie or other alternative distributions for use in the *rema* smoother.

Tanner Crab

The SSC received a presentation on the 2023 stock assessment for the Tanner crab stock in the Bering Sea. Public testimony from Jamie Goen (Alaska Bering Sea Crabbers) suggested that the CPT-proposed 5% increase in the ABC buffer for 2023/24 was not justified, given that the concerns articulated by the CPT in support for the buffer increase are not new or elevated for 2022/2023 and therefore do not warrant increased precaution.

The SSC appreciates efforts by the author to address past SSC comments. The Tanner crab stock has been considered under Tier 3 since the 2012/13 assessment cycle given the informative nature of fishery, survey, and life history information for this stock. The SSC highlights that the 2022/23 TAC set for Tanner crab by the State of Alaska, when combined across east and west areas, remains significantly below the OFL.

The 2023 EBS shelf bottom trawl survey yielded promising signs for new recruitment, in terms of increased abundance of small male crabs in the area west of 166 longitude and female crab across the EBS shelf. However, the author and CPT discussion clearly highlight that caution is warranted given that several recent cohorts first observed as 25-50 mm carapace width crab in the 2017-2019 surveys, initially appeared strong but failed to materialize as older mature or industry-preferred crab.

The author proposed and the CPT endorsed Model 22.03b, which is the accepted model from 2022 with a small update to address a parameter describing the slope of the fishery retention probability curve (2005/06-

2009/10) that was formally estimated at a bound. The author has convincingly demonstrated that this small change has at most negligible impacts on model fits to data.

Overall, Model 22.03b exhibits reasonable fits to most indices of abundance and to removals in the directed and bycatch fisheries. Fits to length composition data in the recent period remain a concern, exemplified by large negative residuals in length composition fits for the largest observed length bin in recent years and as a strong positive retrospective pattern in recruitment. **The SSC supports using Model 22.03b for 2023/24 harvest specifications. Based on this model B/B_{MSY} is 1.34, placing this stock in Tier 3a.** The BSAI Tanner crab stock is not overfished, nor is it subject to overfishing.

The CPT recommended a buffer between maxABC and ABC for this stock of 25%, a 5% increase from the 2022/23 buffer, based on the uncertainty in recent recruitment events and overestimation of large crab, uncertainty in the population trajectory and a lack of recent cohorts reaching large size. However, the SSC recommends a buffer of 20% given that, despite uncertainty in recent recruitment events, the current influx of small crab is both high in magnitude and extensive across space beyond the southern extent of the cold pool. Moreover, the current assessment model structure seems to provide a reasonable fit to index, composition, and harvest data with limited bias.

With respect to the spatial distribution of Tanner crab captured in the NMFS bottom trawl survey, the SSC appreciates the inclusion of Figures 38-42 which highlight both the large number of small male crab encountered in 2023 and the spatially expansive nature of that increase in CPUE. The SSC encourages exploration of differences in the spatial distribution of small male crab in the NMFS survey, to identify if the distribution of small crab encountered in 2003-2005 and 2008-2010, which successfully propagated to larger sizes, showed differences in habitat use compared with the cohort first observed in 2017-2019, which did not propagate to larger sizes. Likewise, the SSC recommends that a comparison of environmental conditions experienced by small crabs during these periods may help to elucidate why some cohorts appear to propagate and others do not.

The SSC recommends the author consider the following avenues for further improvements to the assessment:

- Explore what might be driving the residual pattern in the fit to the NMFS survey data.
- Consider using the Bering Sea Fisheries Research Foundation (BSFRF) survey data to inform selectivity and catchability, as implemented in the EBS snow crab assessment, as an alternative to fitting these data as a separate index
- Consider directly incorporating annual molt to maturity data, as implemented in the EBS snow crab assessment, if sufficient data are available.
- Briefly summarize the history of the GOA Tanner crab fishery and stock dynamics, given the possible value of this information for the interpretation of BSAI Tanner crab stock dynamics.

The SSC appreciates the author's development of a simplified Tier 4 model for use as a backup in the event that extreme and insurmountable issues are encountered by the Tier 3 assessment model in the future. The SSC supports the structure of the Tier 4 model as presented, based on the estimate of vulnerable male crab biomass from the NMFS EBS bottom trawl survey and including the use of the coefficient of variation in projected biomass as a reasonable basis for defining the ABC buffer. **With respect to the reference time period for calculating B_{MSY} , the SSC concurs with the CPT recommendation to use the entire time series since 1982.**

The SSC continues to support development of a parallel or simplified version of the Tanner crab assessment model in the GMACS platform, and the author's proposed development timeline in fall 2023.

Overfishing Status Updates

The SSC received overfishing status updates for Aleutian Islands golden king crab (AIGKC), Pribilof Island golden king crab (PIGKC), Pribilof Island red king crab (PIRKC), Western Aleutian Islands red king crab (WAIRKC), and St. Matthew blue king crab (SMBKC). Total catch mortality for each of these stocks was below the OFL, so overfishing did not occur in 2022/2023 (2022 for PIGKC because specifications are on a calendar year basis). Estimated MMB for SMBKC is below MSST; therefore, this stock remains in an overfished status and under a rebuilding plan. The next full assessment of SMBKC will be in 2024. PIRKC and AIGKC estimated MMB are above MSST and are not overfished. Both WAIRKC and PIGKC are Tier 5 stocks, and an overfished status determination cannot be made.

Norton Sound Red King Crab Model Runs

The SSC received a presentation on the Norton Sound red king crab (NSRKC) model runs proposed for consideration in January 2024. The NSRKC assessment employs a length-based model with 8 male length classes. Abundance estimates are made for males with $CL \geq 64$ mm to $CL \geq 134$ mm portioned by 10-mm length intervals (8 length classes). The model treats new shell and old shell male crab separately but assumes they have the same molting probability and natural mortality.

The author proposed to bring forward two models for review. Model 21.0, the status quo model, uses a length dependent M, fixed at 0.18 for crab with $CL < 124$ mm and estimated for crab > 124 mm CL. Model 23.0 is identical except that M is fixed at 0.41. **The SSC endorses the CPT's recommendation that both of these models be brought forward for review. The SSC concurs with the CPT recommendation to remove shell condition from the models owing to challenges with accurately identifying new and old shell animals.**

The SSC supports the CPT's recommendations regarding the sampling approach used in the ADF&G survey. These include providing maps of all of the survey years in all future assessments, adding a figure that shows how many stations were used for each year to develop the index of abundance, comparing the index of abundance currently used to an index of abundance based only on stations that were consistently sampled over the length of the time series, and a comparison of the current index of abundance to one developed using the VAST model.

The CPT and the SSC questioned the use of 0.18 as a fixed natural mortality for crab with $CL < 124$ mm. This value is no longer used for other RKC stocks. The SSC supports the CPT recommendation to explore using existing tagging data to estimate maximum age and use it in the Barefoot Ecologist's natural mortality calculator. This may provide a prior with which to estimate natural mortality within the assessment.

The SSC discussed the limited resources available to support the development of a small-scale observer program aimed at improving catch accounting and discard mortality estimates. The SSC continues to have concerns about this but understands the choice to prioritize the Norton Sound ADF&G trawl survey at this time given its importance in the assessment.

The SSC appreciates the efforts of the author to address our previous recommendations and continues to encourage the implementation of GMACS in the near future for NSRKC.

BSFRF Research Update

The SSC appreciates the updates provided on research conducted by the Bering Sea Fisheries Research Foundation (BSFRF) and their written comments submitted under C1 BSAI crab. The research conducted by this group provides critical information needed to improve management of BSAI crab stocks and is currently incorporated into several assessments in a variety of ways. Current BSFRF work is focused on a cooperative winter pot survey for BBRKC. The SSC looks forward to seeing additional results from this survey, as scheduling dictates. Planning for a second pot survey in 2024 is underway. The SSC appreciates the direct connections between the NPFMC research priorities and this group's research focus. This is a great example of these connections. With regards to the questions addressed specifically to the SSC on the BSFRF's priorities provided in the written comments, the SSC notes that their questions align with recent SSC requests and discussions, and that the Council as a whole is making some progress on these questions.

Crab Plan Team Vacancies

The SSC notes that the CPT has some key team vacancies in management expertise and stock assessment, as well as a social scientist. The SSC supports the CPT filling these gaps in the team as soon as possible. The SSC also noted that a stock assessment scientist that is familiar or involved with groundfish assessments would be valuable for sharing expertise across Plan Teams.

C3 BSAI/GOA Groundfish Specifications

The SSC received a series of presentations from Kalei Shotwell (NOAA-AFSC, BSAI GPT co-chair), Jim Ianelli (NOAA-AFSC, GOA GPT co-chair), Diana Stram (NPFMC), and Sara Cleaver (NPFMC) that included items from the September 2023 Joint Groundfish Plan Team (JGPT), BSAI Groundfish Plan Team (BSAI GPT), and GOA Groundfish Plan Team (GOA GPT) meetings. Recorded presentations were provided by Jim Ianelli (NOAA-AFSC) and Steve Barbeaux (NOAA-AFSC) on the EBS pollock and the EBS Pacific cod assessments, respectively. The SSC received public oral testimony for BSAI/GOA groundfish specifications, detailed in the JGPT, BSAI-GPT and GOA-GPT sections below. Written comments were provided by Jim Armstrong and Chad See (FLC), Julie Bonney (Alaska Groundfish Data Bank), Linda Behnken (Alaska Fisherman's Longline Association), and Malcom Milne (North Pacific Fisheries Association).

General Groundfish Comments

The SSC recognizes that the transition of stock assessment models from AD Model Builder (ADMB) to Template Model Builder (TMB) is likely to become increasingly common in the future. The GOA pollock stock assessment transition represents an initial test case, and the SSC appreciates the efforts by the author to demonstrate comparable estimation results between parallel implementations of the assessment model. The SSC supports the GPT recommendation that a model transition from ADMB to TMB does indeed reflect a model change and associated change in model number. While the SSC does not expect that this change in estimation platform should appreciably influence estimation or parameter estimates, it highlights that any recoding of a model in a separate platform introduces the potential for unintentional errors and should be reviewed by the Plan Teams. While duplication of model structure and likelihoods in TMB, as was done for GOA pollock, would provide the most definitive comparison, the SSC understands that this may not always be possible or even desirable given potential issues with legacy code. When comparisons are made between similar models, a reasonably close match should be considered adequate support for transitioning to the new modeling platform. The SSC recommends that for any transition of a parallel model structure from ADMB to TMB, the Plan Teams should minimally review:

- The percent difference in annual estimates of spawning stock biomass, recruitment, and annual instantaneous fishing mortality.
- Comparison of key parameters, and associated uncertainty estimates, including log mean recruitment, survey catchability parameters, and natural mortality if estimated.

This transition should also be viewed as an opportunity to refine coding algorithms and improve model structure.

The SSC notes the new research on rockfish stock structure presented by Wes Larson to the JGPT is broadly applicable to a number of stocks. The SSC suggests the GPT assessment authors coordinate with Dr. Larson to determine if there are results relevant to their species and how any new information might impact the assessment and management of these species.

When there are time-varying biological and fishery parameters in the model, the SSC requests that a table be included in the SAFE that documents how reference points are calculated.

The SSC had difficulty discerning in the Plan Team reports what were proposed model changes for December and what were recommendations for future research exploration. Additionally, it was not clear what changes were recommended for inclusion in an update assessment or in a base model for a full assessment, versus those which were proposed as alternative models. **For future Plan Team reports, the SSC requests that the Plan Teams include a table that shows what is being brought forward for November/December, including the tier, type (catch report, harvest projection, update, or full), and which, if any, alternative models would be considered for management advice in full assessments.**

The SSC appreciated the organization of the presentations and the report and including the links to each topic within them.

Joint Groundfish Plan Team Report

The SSC received a presentation from Kalei Shotwell (NOAA-AFSC, BSAI GPT co-chair) on the September 2023 JGPT meeting. Oral public testimony for the JGPT report included Todd Loomis (Ocean Peace Inc.), Linda Behnken (ALFA) and Erik Velsko (NPFA).

Research Priorities

The SSC appreciates the efforts by the JGPT to develop a timeline for development and review of research priorities under the revised timeline and process, and supports the JGPT plan to track the progress of AFSC-led projects that address identified Council research priorities moving forward.

SAFE Guidelines and Update on Scheduling

The JGPT requested clarification from the SSC on its recommendation regarding what is expected for Tier 4/5 assessments on a 4-year cycle in “off” years when new survey data are available. Specifically, whether a catch report prepared by Council staff is sufficient or that the *rema* model should be re-run each time new survey data are available. The JGPT highlighted that re-running the *rema* model has implications for area apportionments. SSC discussion considered whether additional survey information should be provided in the “off” year with new survey data, or whether the 4-year cycle products as presented by the JGPT for Tier 4/5 stocks were appropriate for species that exhibit a history of exploitation below sustainable thresholds and for which limited variation in biomass across time is observed. The SSC discussed whether Tier 4/5 stocks for which there are additional concerns necessitating a review of updated survey information should be shifted to a 2-year cycle. After some discussion the SSC concluded that while the current JGPT proposed

products schedule seemed appropriate, it would value an update on topics raised in the SSC's February 2023 review of stock prioritization. The SSC would like an opportunity to review the revised definitions of the assessment categories, a summary of which stocks currently have area apportionments, as well as the revised SAFE guidelines currently under development before making final recommendations.

Ecosystem and Socioeconomic Profile (ESP) Update

The SSC continues to support development of ESPs as a practical way to connect stock-specific ecosystem information, and social and economic indicators, with the stock assessment process. The SSC further supports continued consideration of how to offset the timing of initial development for specific ESP components with crab and groundfish stock assessment cycles to ease the burden on stock assessment authors.

The SSC appreciates the extensive work done on the Reproducibility Project to make information available to a wide audience. The SSC encourages authors of the ESP and ESR to consider collaboration on future climate readiness initiatives and making data and report products accessible.

Ecosystem Status Report (ESR) and Recent CIE Review

The SSC highlights its appreciation to the ESR team for their efforts to collaborate with a wide range of contributors in developing these regional products each year on an operational timeline. The SSC highlights the importance of these products in informing ecosystem-based fisheries management. **The SSC supports efforts to make ecosystem indicator time series, which are not confidential, available via the AKFIN portal to further support consideration within the stock assessment and fishery management processes.**

Rockfish Genetic Stock Structure

The SSC highlights the findings presented to the JGPT regarding the limited genetic stock structure exhibited by demersal and offshore rockfish, when compared with pelagic and slope rockfish species. The SSC highlights the value of this information in consideration of risk in the context of spatial management practices for specific species, as was highlighted in public comment.

Longline Survey

The SSC encourages the longline survey team to develop a list of potential candidate species for which abundance or biomass indices from this survey may be appropriate for informing stock assessments, and that authors intending to use longline survey indices within assessments should consult with the survey team to assess whether they feel a particular species is appropriately indexed given the habitats and depths sampled, and other considerations including hook competition. **The SSC encourages further research, to the extent practicable, by the survey team to evaluate the impact of escape ring size on pot gear selectivity.**

GOA Trawl Survey

The SSC commends the survey team on working with stock assessment authors to determine where efficiencies in otolith sampling may help reduce repetitive motion injuries for survey participants, while also highlighting the critical nature of these age composition data for informing stock dynamics.

EBS BTS Survey Modernization Plans

The SSC appreciates efforts by the survey group to evaluate methods for modernizing both EBS bottom trawl survey design and survey gear, while carefully considering the paramount importance and comparability of survey products, including both abundance indices and biological samples. Recognizing that this process is just beginning, **the SSC requests opportunity for periodic review of planned changes in survey methodology as they move forward including planning for field-based gear intercalibration experiments, statistical methods for intercalibration, and survey gear design.** The SSC looks forward to a summary report describing outcomes from the public workshop planned for October 2023.

Ecosystem Surveys

The SSC highlights that NOAA-AFSC ecosystem surveys provide a wealth of valuable information on production at lower trophic levels and changing environmental conditions. It was highlighted in the JGPT minutes and in SSC discussion that ecosystem survey data products currently exist in a variety of repositories. The SSC encourages efforts to compile these important data into consolidated, accessible, and publicly available formats to the extent practicable.

Alaska Sablefish

The SSC appreciated updates on future sablefish model development and ongoing research to evaluate alternative methods for addressing the rapid and ongoing transition from hook and line to slinky pot gear in the GOA sablefish fishery, both in the context of the assessment fleet structure and fishery-dependent indices of abundance. The SSC also reiterates its recommendation from December 2022 to incorporate additional sources of mortality within the assessment (e.g., recreational and survey/ research removals).

Ongoing Research

The JGPT minutes highlighted a range of ongoing stock assessment research topics that were presented during the September 2023 meeting, including: a new package for developing natural mortality estimates and priors based on phylogenetic relatedness of species, development of statistical methods for informing individual movement based on archival tagging data, the value and use of one-step-ahead residuals in place of simple Pearson residuals for evaluating assessment model fits to compositional data, exploration of alternative and potentially more appropriate likelihoods (e.g. generalized gamma) for fitting indices of abundance, use of bootstrapping methods to evaluate the significance of assessment model retrospective patterns, new approaches to better quantify acoustic trawl survey uncertainty, and approaches to calculating input sample sizes for survey age and length compositions in a standardized way. The SSC is encouraged by the breadth and innovation of stock assessment research being conducted to support fisheries management in the North Pacific. **The SSC appreciates receiving updates on ongoing research topics with potential application to stock assessments even though these are not action items, and highlights the importance of informing the SSC and the public about development of new methods that may be incorporated in stock assessments in the near future.**

Given the role retrospective patterns for individual assessments often have to inform Risk Tables and resulting maxABC buffer recommendations, the SSC supports continued research to better resolve what represents a concerning retrospective pattern (see Legault and Poos 2020² for additional examples). In the

² Legault, C. M., and J. J. Poos. 2020. Rose vs. Rho: a comparison of two approaches to address retrospective patterns in stock assessments. *ICES Journal of Marine Science* 77:3016-3030.

context of research to evaluate alternative index likelihood for stock assessment, the SSC highlights this important area of future research especially given that many assessments are now being informed by model-based (e.g., VAST) survey indices of abundance that make specific distributional assumptions in index standardization. There was some SSC discussion with the presenter about Dr. Monnahan's (NOAA-AFSC) recommendations regarding the use of one-step-ahead as opposed to Pearson residuals for evaluating compositional data fits within stock assessments. It was clarified that while this is an area of ongoing research, the JGPT did not have a formal recommendation for use or a process for updating SAFE guidelines at this time.

BSAI Groundfish Plan Team Report

The SSC received a presentation from Kalei Shotwell (NOAA-AFSC, BSAI GPT co-chair) and Diana Stram (NPFMC) on the September 2023 BSAI GPT meeting. Oral public testimony was provided by Jim Armstrong (FLA) and Scott Hansen (F/V Beauty Bay).

Yellowfin Sole Model

BSAI yellowfin sole is managed as a Tier 1 stock and is assessed annually. The author proposed a new model configuration for the yellowfin sole stock assessment for the BSAI. The new model, based on last year's accepted model, removes the split-sex time-varying fishery selectivity and incorporates a single time-varying fishery selectivity curve. This change to a single-sex selectivity is meant to address poor estimates of male and female fishery selectivity in the early years in the time series and reduces the number of parameters estimated by the model.

The SSC agrees with the BSAI GPT and author recommended approach to reducing parameters and simplifying the model by replacing split-sex selectivity with a single time-varying selectivity and supports the author's recommended model being brought forward in November.

AI Pacific Cod Model

AI Pacific cod are managed as a Tier 5 stock that is assessed annually. Continued work exploring a Tier 3 model included sensitivity tests evaluating conditional age-at-length and bootstrapping input sample sizes, and including time-varying fishery selectivity, inclusion of longline survey abundance estimates, and time-varying growth. The retrospective pattern was moderately improved with some level of time-varying fishery selectivity and is supported by changes in past fishing patterns. The retrospective pattern was greatly improved by including time-varying growth; however, error tuning is needed to constrain the level of variability of the annual deviations in selectivity and growth as these two processes are often confounded. The BSAI GPT also discussed the potential impact of the Pacific Cod Trawl Cooperative program on this stock. The SSC encourages the AI cod authors and EBS cod authors to continue to collaborate and use similar methods when modeling processes like time-varying growth.

The SSC agrees with the BSAI GPT recommendation to bring forward three models for November: 1) Tier 5 base model, 2) Tier 3 model with time-varying growth using the low variability option, and 3) Tier 3 model with time varying growth and time blocks for fishery selectivity. The SSC also supports the BSAI GPT and author recommendation for error tuning on time-varying growth.

EBS Pollock Model

EBS pollock is a Tier 1 stock assessed on an annual cycle. Model explorations included using the revised acoustic vessels of opportunity (AVO) index, using the random effects model for spawning weight-at-age, expanding model capacity for using aging errors on different data components in preparation for FT-NIRS pollock aging, and comparing process and observation errors related to the acoustic trawl survey. If further

explorations of the biomass index error distribution are conducted, it is recommended to consider what distribution they were generated from in VAST.

The SSC supports the BSAI GPT recommendations to adopt the new full AVO index, evaluate process-error weights, and include random effects model estimates of spawning weight-at-age for November.

EBS Pacific Cod Model

EBS Pacific cod is a Tier 3 stock assessed on an annual cycle. The SSC received an overview of explorations of alternative stock assessment models for EBS Pacific cod. The ensemble model accepted in 2022 incorporated four models based on three concepts: 1) dome-shaped survey selectivity, 2) using fishery CPUE, and 3) time-varying catchability for the survey index. The assessment author has identified several issues with the ensemble models including the requirement to fix values for length composition to ensure model convergence; autocorrelation in length and age composition; troubling patterns in model residuals potential confounding of aging bias, annually varying growth, and annually varying selectivity; and high sensitivity to changes in catchability and natural mortality. The author investigated a series of models beginning with a simplified model (23.1.0.a) and then sequentially added complexity in the form of annually varying growth (23.1.0.b), annually varying selectivity (23.1.0.d), changing maximum age from 20 to 12 years (23.1.0.e), including catch back to 1964 (23.1.0.g), and using conditional age-at-length (CAAL, 23.1.0.h).

The SSC appreciates the authors' work on exploring a simpler modeling option and adding features in a stepwise approach. **The SSC agrees with the author and BSAI GPT to not pursue the ensemble modeling approach at this point due to the model performance issues noted above.** Given the time commitment required to develop multiple models under the ensemble approach, the SSC agrees that better approaches to addressing issues with variations in growth, selectivity, catchability and mortality can better be addressed using a single model. The SSC also notes that the single-model approach will facilitate collaborations across the EBS, AI and GOA assessments and encourages the authors to attempt to model biological processes similarly. Despite the drawbacks of the seasonal distribution of fishery ages being collected throughout the year, which might preclude the value of using them as CAAL to contribute to growth estimation, the SSC continues to recommend the authors explore using the marginal fishery ages for contributing to improved selectivity estimation. Model 23.1.0.g explores a longer model period and dropping the regime recruitment offset parameter, the SSC recommends exploring the removal of this parameter for all future models.

The SSC also concurs with the BSAI GPT recommendation that the authors bring forward the status quo ensemble model, Model 23.1.0.a as a sensitivity to better understand uncertainty, Model 23.1.0.d (not included in BSAI-GPT recommendation) and model 23.1.0.d with the following changes: use CAAL data from the survey, remove marginal age compositions for the years with CAAL, and include all length composition data, fix M at 0.3866 based on a maximum age of 14, and at the discretion of the author estimate growth CVs.

The SSC notes the challenges associated with multiple time-varying parameters that are confounded and will require appropriate constraints.

Northern Rockfish Stock Structure analyses

Northern rockfish is a Tier 3 stock on a biennial cycle. The SSC received an overview of a re-evaluation of stock structure for BSAI northern rockfish. The catch of BSAI northern rockfish has increased five-fold over the last decade and the assessment author has continued to note spatial concerns with this stock, as the

estimated spatial scale of the stock (< than 200 km) is much smaller than the current management areas. This is the 3rd re-evaluation of stock structure for this stock.

The analysts noted that recent genetic work by the NMFS indicates high stock structure in northern rockfish relative to other rockfish species. The BSAI GPT expressed concerns over potential risks to stock biomass and productivity from disproportionate harvesting.

The SSC supports the BSAI GPT recommendation that the stock structure information be included in the risk table for November and to continue to monitor the stock for potential spatial concerns.

BSAI Preliminary Groundfish Harvest Specifications

The SSC recommends approval of the proposed 2024/2025 BSAI groundfish specifications as provided by the BSAI GPT. The SSC supports the BSAI GPT's recommendation to approve the Halibut DMR Working Group recommendation for proposed halibut DMRs for 2024/2025.

GOA Groundfish Plan Team Report

The SSC received a presentation from Jim Ianelli (NOAA-AFSC, GOA GPT co-chair) and Sara Cleaver (NPFMC) on the September 2023 GOA GPT meeting. Oral public testimony was provided by Julie Bonney (AGDB).

The SSC commends the authors on the quality of their documents prepared for the September Groundfish Plan Team meeting describing data and model changes proposed for the November Groundfish Plan Team meeting.

GOA shortraker rockfish survey weighting

GOA shortraker is a Tier 5 stock on a biennial cycle. The SSC supports the author and GOA GPT recommendations to implement the *rema* model in TMB and to remove the 1984 and 1987 bottom trawl survey estimates from the survey dataset, both of which are consistent with other stock assessments and have been supported previously by the SSC.

Presenters shared that an update assessment is planned for this stock. Due to some confusion in the transition to stock prioritization and recommendations in the GOA-GPT report, the SSC requests that the following changes be brought forward as part of an alternative model(s) for the SSC in December (a full assessment), if possible for the authors and agency.

The SSC appreciated the author's descriptions of weighting the longline survey and the bottom trawl survey. **The SSC recommends exploring, in an alternative model for December, the author and GOA-GPT recommendations to weight the longline survey and bottom trawl survey equally within the *rema* model and to estimate additional observation error for the longline survey only.**

The SSC supports the new apportionment approach using the *rema* model. The new apportionment approach recommended by the author and GOA-GPT averages the predicted biomass apportionment from the bottom trawl survey and the RPW apportionment from the longline survey. The longline survey and bottom trawl survey data produce conflicting indices, and the proposed approach strikes a balance between these conflicting indices with respect to apportionment.

Other Rockfish

The other rockfish complex is currently a combination of Tier 4, Tier 5, and Tier 6 assessments and is on a biennial cycle. A full assessment will be brought forward in November.

The Council is considering a motion to change the spatial management of demersal shelf rockfish (DSR), by moving DSR species out of the other rockfish category to a GOA-wide assessment. **The SSC supports making this change to the DSR complex in the 2024 stock assessment for implementation for the 2025 fisheries** and looks forward to examining the area apportionment at that time.

The authors updated the random effects model used in the 2021 assessment with the *rema* model and compared biomass estimates from the two models resulting in negligible differences. The SSC supports the authors and the GOA-GPT recommendation to move the assessment to the *rema* model for the GOA other rockfish assessment.

The authors expanded the catch time series for Tier 6 GOA other rockfish from 2013–2016 to 2013–2022, to represent a fuller time series for these long-lived non-target rockfish species and capture increased catches since 2020. In addition, an expanded time series that includes the most current catches would better represent what the fishery is encountering, if any species distribution shifts have occurred, if there were major changes in abundance due to ecosystem changes, or if shifts in fishing patterns have occurred. This resulted in a ~2% overall increase for the GOA other rockfish OFL. The SSC supports the authors and the GOA-GPT recommendation to use the years 2013–2022 for the Tier 6 catch time series.

The authors evaluated whether the trawl survey adequately represents the Tier 4/5 GOA other rockfish biomass, and whether the survey biomass used in the *rema* models provide “reliable biomass”. The authors used *rema* as a model diagnostic tool, examining the proportion of hauls with positive catch and also looked at CVs. **The SSC supports the following author and GOA GPT recommendations:**

- **Move twelve Tier 5 species in the other rockfish complex to Tier 6 management.**
- Leave redstripe and harlequin rockfish in Tier 5, as recommended by the author, but continue to explore these Tier 5 biomass estimates which have CVs >0.50.
- Re-evaluate tier specifications if they have been in place for several years and/or there have been changes in stock dynamics and fishery.

As previously requested by the SSC, the authors re-evaluated the current method of weighted M biomass estimates to calculate OFL, because large changes in survey biomass have occurred leading to large changes in OFL values. To decrease the sensitivity to single survey variability for these poorly sampled rockfish, **the SSC supports the authors’ and the PT recommendation to use the most recent 3-year average survey biomass for estimating M (the alternative weighted M biomass).**

Rougheye/blackspotted Rockfish

Rougheye/blackspotted rockfish will be a full assessment in November. **The SSC supports removing the 1984 and 1987 bottom trawl survey estimates from the survey index**, which is consistent with other stock assessments and have been supported previously by the SSC. This resulted in an overall slight drop of scale in abundance estimates because catchability is sensitive in this model.

The SSC concurs with the GOA-GPT recommendation for the author to continue investigating M and to explore the application of the prior variance used for M .

The SSC supports incorporating maturity data not previously used that comes from both rougheye and blackspotted rockfish determined through visual species identification and supports exploring alternative methods that account for skip spawning.

The SSC supports the author and GOA-GPT recommendation to incorporate new data for the aging error matrix, the size-at-age matrix, and weight-at-age vector.

The SSC supports the author and GOA-GPT recommended new apportionment methods (the same approach proposed for shortraker rockfish) that incorporate *rema* model estimates of area-specific catchability (q), has a single, shared process error, and starts in 1990. This method averages proportions of both the *rema* predicted biomass from the bottom trawl survey and the *rema*-predicted relative population weights from the longline survey and helps balance the data conflict between the two surveys.

GOA Pollock

GOA pollock is a Tier 3 assessment on an annual schedule. A full assessment will be brought forward this year.

The authors transitioned the GOA pollock model from ADMB to TMB and proposed using the TMB version as the base model this November (Model 23.0). The SSC supports the GOA-GPT recommendation to use a new model number when a new software framework, such as TMB, is used to replace the base model from previous years. **Due to the virtually identical results between the two model implementations, the SSC supports the author and Team recommendation to use the TMB version as the base model (Model 23.0) in November.** As this is the first statistical catch at age model to move to TMB, the SSC provided recommendations (see General Groundfish Comments in this report) for what authors of other species should bring forward as bridging analyses for PT review when transitioning from ADMB to TMB.

The SSC supports the exploration of alternative flexible fisheries selectivity forms within the TMB model as alternative models in November. The SSC appreciates the exploration into alternatives to the parametric time-varying approach and supports the GOA GPT recommendation to examine the large drop in selectivity from age-9 to the age-10+ and consider what biological underpinnings would cause that. The SSC also supports the GOA GPT recommendation that the author consider exploring a 2d age-cohort effect when modeling selectivity to compare to the age-year effect as there appears to be a cohort influence within the age composition data.

The SSC supports the GOA GPT recommendation that additional examinations are necessary to determine best method(s) for projecting near term trends when time-varying and auto-correlated selectivities are used in assessments. The SSC directs the authors and GOA GPT to the December 2021 Report (see General Groundfish Stock Assessment Comments, SSC Dec 2021 report p 31) and December 2022 Report (BSAI Atka mackerel section, p. 37) that note that the choice of what selectivity to use in projections, when time-varying selectivity is estimated, is an issue for several Tier 1-3 assessments. The SSC continues to agree with the GPTs recommendation to prioritize research on best practices for specifying the selectivity schedules used in Tier 1-3 assessments that employ time-varying selectivity and encourages the development of general guidance to assessment authors based on performance evaluations.

Pacific cod model considerations

GOA Pacific cod is a full assessment in 2023. The SSC supports the GOA GPT recommendation that an alternative model be brought forward where the input sample sizes are set so that all of the conditional age at length data are fit (the minimum sample size in the Stock Synthesis assessment model was previously

inadvertently set too large, which resulted in 64% of the conditional age at length data being removed from the model). The SSC also supports the PT request for a clear depiction of what aspects of the objective function changed before and after the sample sizes are added since adding the missing data into the model resulted in a lower negative log-likelihood (contrary to expectation).

The SSC supports the GOA GPT recommendation that existing environmental links for longline survey catchability be continued but that fits of the model with white noise random variability be explored to evaluate the strength of the identified Climate Forecast System Reanalysis temperature links. The SSC echoes the GOA GPT concern over a lack of biological mechanisms to explain improved fits and whether the improved fits were due to mechanisms that may be expected to persist into the future. The SSC supports a hypothesis-based approach for biological mechanisms as the basis for using temperature information in the model for improved estimation of catchability and/or growth. Regarding the use of environmental links for growth parameters, the SSC supports the GOA GPT recommendation that this exploration be deferred until the new post doc (Krista Oke) examines this issue over the next two years. The SSC looks forward to Dr. Oke's work.

Pacific ocean perch model considerations

Pacific ocean perch will be an update assessment in November. The SSC supports continued research, including explorations of M, selectivity, and composition weighting.

GOA Preliminary Groundfish Harvest Specifications

The SSC recommends approval of the proposed 2024/2025 GOA groundfish specifications as provided by the GOA GPT. The SSC supports the GOA GPT's recommendation to approve the Halibut DMR Working Group recommendation for proposed halibut DMRs for 2024/2025.

C4 Chum Salmon Bycatch – Preliminary Review

The SSC received a presentation from Kate Haapala (NPFMC) and Diana Stram (NPFMC) on a preliminary analysis in response to the April 2023 Council motion on chum salmon bycatch where the Council is considering new management measures to minimize chum salmon bycatch, but particularly the bycatch of Western Alaska-origin chum salmon in the Bering Sea pollock fishery. In addition, the SSC was provided information on how recent NEPA procedural changes influence the timeline for completing this Environmental Impact Statement. The SSC appreciates the well-developed alternatives provided by the Council that help streamline the process and analysis. The SSC acknowledges that this is a complex problem, with interconnected information and data linked to the alternatives being considered, and that the alternatives (and options within) are not necessarily mutually exclusive. The SSC thanks the analysts for a well written document and informative presentation. Written testimony was received from Jordan Head (Bristol Bay Science and Research Institute) and oral testimony was received from Jordan Head, Merrill Rudd (Sea State, Inc.), Austin Estabrooks and Stephanie Madsen (At-sea Processors Association), and Glenn Merrill (Glacier Fish Company). The SSC appreciates the public testimony that was provided.

The purpose of this document was to provide an analysis of the relative feasibility of the various alternatives proposed, given the purpose and need statement adopted by the Council. As such, there are many policy considerations in the analysis that are beyond the purview of the SSC. The SSC was tasked with reviewing the preliminary analysis to provide advice on whether there are considerations about the relative scientific uncertainty of management options under consideration that the Council could take into account in selecting alternatives for analysis. Specifically, analytical staff were seeking input on:

1. What measure of ocean temperature should be used and what are the implications of linking levels of chum PSC to ocean temperature?

2. ADF&G’s recommendation on what is feasible for developing an index of Western Alaska chum abundance based on information from three management areas – the Yukon, Kuskokwim, and Norton Sound.
3. The level of uncertainty of incorporating escapement goals and Amounts Necessary for Subsistence (ANS) alongside estimates of historical abundance.

Ocean temperatures and linking to levels of chum salmon PSC

The Council’s motion asked for “potential ranges for average PSC levels during warm/cold years from 2011 through 2022”. This information could help determine if there is a relationship between the magnitude of chum salmon bycatch and ocean temperature. Changes in temperature may influence the spatial distribution of groundfish, such as pollock, and chum salmon (e.g., they may move on to the Bering Sea shelf following prey). For this analysis, sea surface temperature (SST) and bottom temperature data were compared to chum salmon bycatch levels in the Bering Sea. Average annual SST does not seem to have a relationship with annual bycatch level, although in a finer scale spatial comparison, Barry et al. (2023)³ reported that mothership and inshore catcher vessel sector are further northeast in the Bering Sea on the shelf in years with lower sea surface temperature. There was a stronger relationship between annual average bottom temperature and annual bycatch numbers. The data and analyses suggest that, if there is a relationship, it is more complex (possibly dependent on interaction of distribution of pollock and chum salmon and fleet effort and behavior). **However, the SSC cautions against relying upon coarse, weak broad-scale environmental relationships that are likely driven by complex biophysical processes (including fishing effort and behavior). In addition, broad-scale environmental relationships may break down in the future, as appears to be the case in more recent years (since approximately 2016).**

If pursued, the SSC suggests examining finer scale interactions (e.g., Barry et al. 2023 or finer) with a longer time series of data and exploring other metrics (e.g., bycatch rate) rather than just the magnitude (number) of bycatch. This may be a better representation of potential interactions of chum and pollock distributions during cold versus warm years, but also recognizing there appears to be a shift in bycatch dynamics since 2016.

Specific recommendations on what temperature measure to use, and analysis to conduct, depend on knowing how this information will be used (i.e., as a predictive tool or as a means of helping to set PSC limits during warm vs. cold ocean conditions). One challenge, as noted by the analysts, is that the bottom temperature is not available in-season, and so it could only be evaluated retrospectively. The SSC did note that model projections of full water column temperatures and other oceanographic metrics are available several months in advance and might be useful to investigate if temperature is to be used for predictive or forecasting purposes.

Western Alaska chum abundance index

Analysts worked with ADF&G to develop this portion of the analysis. ADF&G provided data and information regarding what is feasible for developing an index of Western Alaska chum abundance for the three management areas identified – the Yukon River, Kuskokwim River, and Norton Sound. Each area comprises a different metric of abundance. Yukon River has run reconstructions for both summer and fall chum in terms of total run size or abundance, Norton Sound is a minimum standardized index (i.e., not a measure of total accounting of abundance), and Kuskokwim uses the CPUE from the Bethel test fishery as index of abundance. The SSC concurs that this is the best scientific information currently available for understanding abundance of chum salmon in these three areas. However, developing a single index and an

³ Barry, P., Kondzela, C., Whittle, J., D’Amelio, K., Karpan, K., Nicolls, D., Larson, W. 2023. Genetic stock composition analysis of chum salmon from the prohibited species catch of the 2022 Bering Sea walleye pollock trawl fishery, preliminary report.

appropriate weighting scheme to combine the three areas based on abundance would be challenging. Therefore, the SSC concurs that treating each area as an ‘independent’ test for low abundance is a reasonable approach. **The SSC recommends that all further analysis include variance estimates for each of these indices, if available, in order to permit evaluation of how meaningful the observed interannual differences are, and how sensitive a management approach relying on these indices may be to observation error versus actual changes in the populations.**

The analysts highlighted the need to consider how to address missing data, should data to inform the indexes not be consistently available. The SSC recognizes that this is a significant challenge and will need to be considered carefully moving forward. The SSC noted that there are methods available to estimate or interpolate missing data that could be explored, but these would be useful for occasional missing data (e.g., an escapement estimate is not available because a weir was inoperable due to high flows through the season) as opposed to data chronically not available.

The SSC was asked to also weigh in on whether to include earlier years and environmental regimes for some stocks, recognizing that the length of the time series available varies among stocks, as well as whether 2023 data should be included in the analysis. The most meaningful indices and thresholds will be derived from longer time series containing periods of both low and high abundances. Therefore, the SSC recommends using the full time series available including 2023 estimates to the extent possible.

ANS and meeting escapement goals to help define low abundance

The motion stated that the Council may be interested in defining low abundance based on estimates of historical abundance in conjunction with whether each area has met escapement goals and ANS. The SSC concurs with the conclusion of the preliminary analysis that these metrics should not be used independently from measures of abundance; however, the SSC agrees that they are critical for providing context to the options being considered. It is important to understand what not meeting ANS means in context of the ANS ranges provided in Table 3-13 and when trying to evaluate it in context of determining what a low run or index might be. **Therefore, the SSC recommends including details about the ANS determinations and guidance on how to interpret not meeting the lower end of the ANS range relative to subsistence harvest, being within the range, or exceeding the range.** Whether ANS is met or a certain percentage of escapement goals are met in a given year are very contextual and may depend on factors that may or may not be related to low abundance.

The SSC found the amended Tables 3-8 to 3-11, where the data were sorted by index size, to be very useful for visualizing the relationship between each of the abundance indices and whether ANS or a certain percentage of escapement goals were met. For example, there are several instances where ANS was not met for some of the larger Yukon River fall chum runs in the time series. **The SSC recommends including information on management actions (specifically fishing restrictions or liberalizations) for each year to help provide additional context to the metrics of ANS met/not met and percentage of escapement goals met. The SSC also recommends the analysts include estimated subsistence removals in context with the ANS status (met or not met) in the analysis tables, as appropriate.** Also, it is important to be clear how individual escapement goals are evaluated as being met or not. Escapement goals are periodically reviewed, updated and revised as assessment methods change, additional data become available, or methods evolve. The department manages to the escapement goal in place at the time and, when evaluating historical performance, often evaluates whether escapement for a given year met the goal based on the escapement goal in place at the time. This differs from the preliminary analysis which compares the current escapement goal to historical escapement. However, for the purpose of providing context for what constitutes low abundance, the approach taken in this analysis is appropriate.

The SSC recommends that when setting a threshold for what constitutes low abundance the objectives for what the threshold is intended to achieve are clearly stated (i.e., are the objectives for sustaining salmon, or communities, or both).

Additional Considerations

The SSC appreciated the information in Appendix 2: Causes of Chum Salmon Declines, including the use of the LKTKS [search engine](#) to identify sources of social science information based on LK and TK with a focus on Western Alaska chum salmon. Given time and resources, the SSC suggests that the analysts explore whether social science of TK information could provide a more nuanced interpretation of the causes of previous fluctuations in chum salmon abundance over a longer time horizon than was presented in the preliminary analysis.

The Council's motion and the preliminary analysis both acknowledge the potential tradeoffs between trying to reduce chum bycatch with other conservation considerations (e.g., Chinook avoidance). The SSC appreciated the public testimony that provided additional information on fleet behavior and potential interactions and tradeoffs when trying to limit PSC for multiple species. **The SSC received public testimony about the need for the draft analysis to consider individual vessel and operational constraints under various cap scenarios. This has been an important feature under Amendment 91 (Chinook PSC management) and the SSC recommends these types of constraints be considered for this analysis.**

Discussion included the lack of an AEQ and impact analysis for Bering Sea chum salmon and the SSC recognizes that this is partly because of the high uncertainty in the available data and incomplete enumeration of adult chum returning to freshwater. However, this leaves the Council without a clear indication of whether, or how effectively, bycatch avoidance will increase chum salmon returns. The SSC encourages the analysts to use the genetic and other information available to explore estimates of maximum thresholds (i.e., know that AEQ is below a certain maximum number).

The preliminary analysis focused on ocean temperature and bycatch levels for a specific time frame. The SSC recommends exploring a broader suite of additional information (e.g., juvenile chum abundance index from surface trawl surveys) to explore what might be possible in the future, particularly in terms of providing forecasts that could be used to inform management actions pre-season.

The SSC discussed the importance of learning from and building upon past experiences and, therefore, recommends that any future actions should include specific, measurable, and objective metrics that could be used to monitor results and success of outcomes, which in turn can be used as a learning tool and help to inform any future actions.

The SSC looks forward to the opportunity to review and provide feedback on the Initial Review analysis at a future meeting, pending action by the Council to move this action forward.

D2 BSAI Crab Program Review Workplan

The SSC received a presentation from Darrell Brannan (Brannan & Associates) on a draft workplan for the 17-year review of the crab rationalization program. Oral public testimony was received from Heather McCarty (CBSFA), Mateo Paz-Soldan (City of Saint Paul), and Jamie Goen (Alaska Bering Sea Crabbers). Public testifiers emphasized the importance of evaluating the social impacts of the program. Jamie Goen offered to solicit information about social impacts of the program from ABSC members.

The SSC expresses its appreciation to the Council for offering this opportunity to review the workplan with the SSC and the public.

The SSC has developed, over several years, a preferred format for program and allocation reviews, in an effort to improve public accessibility and efficiency of preparation. This format involves identifying dashboard metrics for each element of the Council's original Purpose & Need, along with a tabular summary of metric performance included in an Executive Summary. The main document then provides

greater depth and narrative, along with discussion of newer issues in the fishery. The 10-year review of crab rationalization predated this practice; thus **the SSC recommends the analyst follow the format in the LAPP review for the rockfish program.** Within this format, measures for the specific elements of the Purpose & Need of the crab rationalization program should be incorporated including, especially, performance of key community and sector protection measures.

As the crab rationalization program has matured, important effects have arisen, which may be associated with rationalization program features. **The SSC recommends including measures and descriptions of the following outcomes in the review:**

- As the program has matured, and original quota holders moved through their careers, how program elements have supported or inhibited intergenerational transfer has emerged as an important outcome.
 - The 2022 Crab Economic SAFE report includes new information on quota ownership, which can be tracked through time and integrated with data about career paths through the fishery, from crew to captain and vessel or quota owner.
 - As quota leasing has become more prevalent, the review should reflect how crew compensation practices have evolved in their handling of quota lease costs.

An environmentally driven stock collapse has caused the closure of the fishery in the most recent years, a first for mature LAPP programs nationally. While this program review is not the forum for documenting and analyzing all effects of the extended closure, communities and businesses whose sustained participation was a goal of the rationalization program are affected by the absence of fishing. Furthermore, an element of evaluating program performance is examining how program design impacts performance in the face of a rapidly changing fishery, including stock collapses. **The SSC recommends drawing on fishery and community-level data and information in order to document effects of the closure to the extent that the rationalization program mitigates or exacerbates them:**

- It is essential that the review distinguish effects stemming from the stock collapse and effects associated with rationalization, and how they might interact.
- The review should seek to identify community level measures that may not be typically incorporated in fishery analyses and track how the loss of crab fishing has impacted substantially engaged and substantially dependent communities.
 - Communities with small numbers of harvesting or processing operations may be willing to waive confidentiality so that these impacts are better reflected.
- Consider the role of rationalization-driven fishery specialization of individual operations and communities in conferring or reducing resilience.
- Consider how CDQ groups who were allocated, or have since purchased, crab quota are adapting, and using resources from diverse fisheries to support crab-dependent communities.
- Incorporate tables of key community demographic and institutional summary indicators, such as those included in the recent Halibut ABM Social Impact Assessment (SIA), to support discussion of differential distribution of impacts if and as relevant among tribal, minority, low-income, and other communities of potential equity and environmental justice concern.

The SSC discussed how to incorporate social, economic and community impacts of the rationalization program, key elements of an SIA, into a section of the review document itself, without a stand-alone SIA. In addition to the more specific suggestions above, this could include a synthesis of information from past

management documents and could be supplemented with information from public comments and informal conversations with members of the fishing industry and impacted communities.

The SSC also discussed how capturing these social impacts will require types of data and information that are not the typical focus of these reviews. An important consideration in the discussion was the fact that due to the stock collapse, many standard quantitative measures relied on in past reviews will be zeros (not missing), reflecting fisheries closures. Therefore, these traditionally included measures will need to be supplemented with quantitative data from other fisheries to understand program-driven outcomes tied to current fishing activity (if any) and questions related to program impacts on diversification/specialization and subsequent resilience to shocks. Furthermore, qualitative information will be required to understand program-driven decisions related to past and current fishing and non-fishing activity and broader program-driven community outcomes.

D4 IFQ Program Review Workplan

The SSC received a presentation from Marcus Hartley (Northern Economics) on a draft workplan for a review of the Pacific Halibut and Sablefish Individual Fishing Quota (IFQ) Management Program. Oral public testimony was received from Jaeleen Kookesh (Sealaska Corporation), Courtney Carothers (University of Alaska), Linda Behnken (Alaska Longline Fishermen's Association), and Heather McCarty (CBSFA). Public testifiers emphasized the importance of evaluating the social impacts of the program and noted the extensive work that has been done on the social impacts of IFQs worldwide and in Alaska.

The SSC expresses their appreciation that the Council offered this opportunity to review the workplan with the SSC and the public.

The SSC has evolved, over several years, a preferred format for program and allocation reviews, which is briefly described in the previous section (D2 BSAI Crab Program Review Workplan). The 20-year IFQ program review, which was also the program's initial review, was completed in 2016, predates this practice. Thus, **the SSC recommends the analyst follow the format in the LAPP review for the rockfish program.** Within this format, measures for the specific elements of the Purpose & Need of the IFQ program should be incorporated including, especially, performance of key community and sector protection measures.

As the IFQ program has matured, important effects have arisen which may be associated with program features. **The SSC recommends including measures and descriptions of the following outcomes in the review:**

- As the program has matured, and original quota holders moved through their careers, how program elements have supported or inhibited intergenerational transfer has emerged as an important outcome. The review should use quantitative measures (e.g. age, tenure in the fishery) to document social issues, such as “graying” of the fleet. It will also be important to document challenges for new entrants.
- The review should seek to identify community level measures that may not be typically incorporated in fishery analyses and track changes through time. This exploration should include identification and documentation of any communities formerly substantially engaged in or substantially dependent on the halibut and/or sablefish fisheries that have experienced a marked decline in local ownership of IFQ over the years since program inception and initial allocations.
- Consideration of how IFQ and CDQ programs have interacted in communities in the Bering Sea halibut management areas with CDQ reserves, including the outcomes of initial allocations to individuals that included compensatory shares.

- Consideration of how the pattern of Community Quota Entity (CQE) formation and acquisition of IFQ shares has varied across communities with different demographic and institutional characteristics.
- Incorporation of tables of key community demographic and institutional summary indicators, such as those included in the recent Halibut ABM SIA, to support discussion of differential distribution of impacts if and as relevant among tribal, minority, low-income, and other communities of potential equity and environmental justice concern.

The SSC noted that there is considerable academic literature on topics relevant for the review, particularly for the halibut fishery. The SSC suggests undertaking a literature review focused on social, cultural, and economic beneficial and adverse impacts of the IFQ program on sectors and communities. Additionally, if possible, leverage existing expertise that might exist under the Council's umbrella of existing committees and plan teams.

The SSC discussed the necessity of including a formal, stand-alone SIA in the review. The SSC attained consensus that social, economic and community impacts of the IFQ program, key elements of an SIA, could and should be incorporated into a section in the review document itself rather than in a stand-alone SIA.

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 October 2023 meeting, a number of SSC members acknowledged associations with specific agenda items under SSC review. Chris Siddon noted that he supervises Katie Palof (CPT co-chair, BBRKC and SMBKC assessment author) and that he is married to Elizabeth Siddon (ESR co-author). Andrew Munro supervises Toshihide "Hamachan" Hamazaki, NSRKC proposed model runs author (C1 BSAI Crab). Ian Stewart and Jason Gasper are members of the Halibut DMR working group report (C3 Groundfish). Brad Harris supervises a post doc working on the GOA Pacific cod assessment and has collaborative funding with the lead assessment author (C3 Groundfish). Robert Foy is the third or greater level supervisor for contributors to the following agenda items: AFSC members of the CPT and GPT and AFSC authors of groundfish and crab stock assessments; Elizabeth Siddon and Mike Litzow (C1 ESR and BSAI Crab); Steve Barbeaux (C3 BSAI Groundfish co-chair), and Jim Ianelli (C3 GOA Groundfish co-chair). Dana Hanselman is the first level supervisor of Groundfish Plan Team report contributors and members Wes Larson and Chris Lunsford (GOA Groundfish co-chair). Sherri Dressel and Curry Cunningham contributed to the ESR. Dr. Hanselman is also the second or greater supervisor of other Plan Team members and contributors, including Elizabeth Siddon, Dan Goethel, Pete Hulson, Jane Sullivan, Kristen Omori, and Kevin Siwicke. Finally, Dr. Hanselman is also married to Dr. Shotwell.