NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
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Crab Plan Team

REPORT

September 9-12, 2024 Alaska Fisheries Science Center Seattle, WA

Plan Team Members in attendance:

Katie Palof, **Co-Chair** (ADF&G-Juneau)*
Mike Litzow, **Co-Chair** (AFSC-Kodiak)*
Anita Kroska, **Coordinator** (NPFMC)
Andrew Olson (NMFS-Juneau)*
Ben Daly (ADF&G-Kodiak)*
Brian Garber-Yonts (AFSC-Seattle)*
Cody Szuwalski (AFSC–Seattle)*
Erin Fedewa (AFSC-Kodiak)*
Ethan Nichols(ADF&G- Dutch Harbor)
Ginny Eckert (UAF/CFOS-Juneau)
Krista Milani (NMFS- Dutch Harbor)*
Tyler Jackson (ADF&G-Kodiak)*
William Stockhausen (AFSC-Seattle)*
Bill Bechtol (UAF-Homer)
Vacant, quantitative expert

**Indicates a presenter*
Members absent: André Punt (Univ. of Washington)

Members of the public attending in person and online are included at the end of the document.

Summer Trawl Survey Results

Mike Litzow (NOAA-AFSC Kodiak) presented 2024 NOAA summer trawl survey results for eastern Bering Sea (EBS) crab stocks including survey effort, bottom temperatures, abundance estimates, and spatial distribution data for the following stocks: red king crab (Bristol Bay, Pribilofs, Northern District), blue king crab (St. Matthew and Pribilofs), Tanner crab, snow crab, and *Chionoecetes* hybrids. Additionally, an update was provided on slope/shelf gear comparison efforts as part of survey modernization fieldwork. Out of the 375 survey stations in the EBS, 349 were sampled, and high-density corner stations around the Pribilof Islands and St. Matthew Island were not sampled in 2024. The Northern Bering Sea (NBS) was also not sampled in 2024. These reductions in sampling effort were made to allow time for fieldwork necessary to modernize the survey, including 15 minute vs. 30 minute comparison tows and comparisons of the 83-112 and Poly Nor'eastern gear in slope and shelf habitats. The cold pool was reduced in size and extent relative to 2023 and categorized as intermediate in 2024, but still close to the 1975–2023 time series mean.

Bristol Bay red king crab mature male abundance was up 40% relative to 2023, but mature female abundance did not change relative to 2023. Legal males were more broadly distributed in Bristol Bay than in recent years, with the center of distribution for legal males and mature females similar to results from 2023. Fifteen percent of mature females had not completed the molt/mate cycle at the time of the survey. After consultation between NOAA, ADFG, and BSFRF, it was concluded that the value of possible retows for the assessment (resampling on areas of high mature female density after the molt/mate cycle

was complete) would not justify the cost in terms of foregone survey modernization fieldwork, and no retows were conducted.

Pribilof Islands red king crab mature male abundance decreased by 64% and mature females decreased by 75% relative to 2023. Northern District mature male abundance decreased 5%, while mature female abundance increased 32% in 2024. No Pribilof Islands blue king crab (PIBKC) were captured on the 2024 survey for the first time in the survey time series. CPT discussed the implications of zero PIBKC survey catch in 2024 for the stock rebuilding plan. Given that the PIBKC rebuilding plan does not specify a timeline for being rebuilt, survey efforts will continue and there are no new management measures resulting from the zero survey catch. Saint Matthew Island blue king crab mature male abundance decreased 9% and mature female abundance decreased 77% relative to 2023.

Tanner crab survey abundance in the eastern management area (east of 166° W longitude) increased in 2024, with mature males up 37% and mature females up 145% from 2023. Survey abundance in the western management area (west of 166° W longitude) also increased in 2024, with mature males up 86% and mature females up 275% from 2023. The abundance of total females in 2024 is the highest in the survey time series. Legal and industry-preferred male Tanner crab were more broadly distributed than in recent years with the highest densities observed in the western management area. Both industry-preferred male and mature female Tanner crab showed a center of distribution much more to the NW in 2024 compared to previous years. Shell condition for mature females in both the eastern and western management areas was dominated by new shell crab in 2024.

Snow crab survey abundance increased in 2024 across all components of the population. Small males (<95 mm) increased 176%, large males (≥95 mm) increased 49%, legal males (≥78 mm) increased 164%, and industry preferred males (≥102 mm) increased 47%, relative to 2023. Similarly, immature females increased 309% and mature females increased 166% relative to 2023. Industry-preferred males showed a broad distribution compared to recent survey years and both mature females and industry-preferred males showed a large shift to the SE in their center of distribution. It was noted that the size composition of females in 2024 was remarkable, given the dramatic increase in abundance across all sizes from the previous year. Also noted as unusual was the high abundance of large sized, but still immature, female snow crab. Male snow crab shell condition was dominated by new shell crab in 2024. *Chionoecetes* hybrid survey abundance increased in 2024, with large males (≥95 mm) up 173% and mature females up 2,096% from 2023. The proportion of all hybrids relative to total *Chionoecetes* abundance is approximately 1.3% in 2024.

Preliminary results of the 2024 slope/shelf gear comparison were shared. One of the goals of the NMFS survey modernization is to combine the EBS, NBS, and slope surveys into one survey using one survey net. Thirty minute side-by-side tows were conducted using the 83-112 net (shelf) and poly Nor'eastern net (slope) in northern and southern areas of the Bering Sea slope. Slope catches of Tanner crab were orders of magnitude higher than snow crab, and there was no evidence for high snow crab abundance in the northwestern slope area.

Fishery Summary

Ben Daly (ADF&G Kodiak), Andrew Olson (NOAA-AKRO Juneau), and Krista Milani (NOAA-AKRO Dutch Harbor) summarized catch and bycatch in the 2023–2024 EBS crab fisheries starting with a summary of the State regulatory observer coverage in the directed BSAI crab fisheries. Observer coverage varies by fishery and is discretionary for NSRKC but otherwise ranges from 20–100%, with observed trips in partially-observed fisheries randomly selected. The percentage of pots observed in crab fisheries is much less than the percent of boats observed. Observer coverage for groundfish observers also varies by vessel, fleet, and fishery: (1) full coverage, (2) partial coverage, and (3) no coverage. In 2024, the partial coverage category was revised to vary by FMP, resulting in more and better data. Public comment noted that listing EM vessels in an EFP fishery as no coverage is somewhat misleading because a camera is recording when fishing and with subsequent video review. Crab discard mortality rates in groundfish fisheries are 50% for fixed gear and 80% for trawl gear, but total reported discard can vary by fishery year, which is generally the crab fishing year of July 1 – June 30 except for calendar years for PIGKC and NSRKC fisheries. Public comment noted that a discard mortality of 20% in directed crab fisheries seemed inconsistent with a 50% fixed gear discard rate in other pot fisheries. The CPT noted we have more data on discard survival in directed crab fisheries, but lack discard mortality data from non-directed crab fisheries, and we must work with the available data.

The WAIRKC directed fishery has been closed since 2004/2005 due to depressed stock status. Bycatch mortality of WAIRKC has been relatively low in recent years at <60 kg in the AIGKC fishery, and <125 kg in the groundfish trawl fisheries, with trawl fisheries shifting from targeting Atka mackerel to rockfish in recent years.

Retained catch in the BBRKC fishery has generally declined since the late 2010s, with the fishery being closed in 2021 and 2022. The BBRKC fishery opened in October 2023 with a 2.15 million lb quota, with most crab harvested in two weeks, and with legal male CPUE near the 2005–2023 average. Fishery CPUE of legal males increased from the 1990s until a 2015 decline, and has since been variable. Discard mortality biomass in the directed BBRKC fishery has generally declined since the mid-2000s, although the ratio of discard mortality to retained catch remained relatively stable over that time period. Bycatch of BBRKC in the Tanner crab fishery has generally been negligible in recent decades and substantially less than bycatch in groundfish fixed gear fisheries, notably Pacific cod pot in the fall, with some trawl bycatch, mainly yellowfin sole but changing to rock sole recently due to market shifts.

Snow crab retained catch declined over time and closed in 2022 and 2023 because B/B_{MSY} was <25% (15% in the 2023 survey and 19% in the model). Morphometric maturity is used in the harvest strategy; although functional maturity should be examined. Snow crab bycatch in the Tanner western area fishery has been relatively low in recent years when the Tanner crab fishery was opened. Most snow crab bycatch occurs in trawl fisheries, particularly in those targeting yellowfin sole throughout the year, whereas fixed gear bycatch is substantially lower and primarily occurs in fall and winter in the Pacific cod pot fishery.

The Tanner crab fishery has been closed for a total of 5 years during 2010–2023, closed in the eastern area an additional 4 years, and had low TACs when opened in recent years. Retained catch CPUE has generally been higher since rationalization compared to the 1990s, and often higher in the east when both east and western areas were open. The fishery occurred earlier in the east in 2023/24. The ratio of discard

mortality to retained catch tended to be similar between areas over the past decade at around 15–30%. While the industry-preferred size is ≥5-inch CW, the proportion of smaller crab increased during 2021-2023, likely due to market replacement of closed snow crab. The snow crab fishery has produced substantial (around 1 million lb) Tanner crab bycatch mortality in some years, although that bycatch was reduced in recent years due to low Tanner TACs and closures. In the eastern area, the Pacific cod pot fishery generated most of the Tanner crab bycatch in fixed gear fisheries, whereas the largest component of trawl bycatch has been the yellowfin sole fishery. In the western area, fixed gear bycatch is mainly from hook-and-line and Pacific cod pot fisheries, although the magnitude of bycatch is much smaller than in the east. Tanner crab trawl bycatch in the western area occurs year-round, notably in the yellowfin, flathead, and rock sole fisheries.

The AIGKC fishery was historically managed for retained catch levels that were fixed in regulation until 2018 when abundance estimates became based on length-based stock assessment models. Retained catches have generally been stable in the eastern area (EAG), but have declined since the early 2010s in the western area (WAG). The TACs and retained catches in recent years have been higher in the EAG. The CPUE for legal crab in the EAG climbed from the mid-1990s until stabilizing in the 7 years following crab rationalization, then climbing to a variable, but higher, level beginning in 2011 during which at-sea observed CPUE was slightly higher than reported retained catch CPUE values. In the WAG, legal crab CPUE also climbed from the mid-1990s until the 8 years following crab rationalization but has since shown a general decline, with the average WAG CPUE since rationalization about half of that in the EAG. The ratio of directed fishery bycatch mortality to retained catch for male AIGKC in both the EAG and WAG declined from the mid-1990s until generally stabilizing with crab rationalization, then increased somewhat until declining again in 2022 and 2023. Most of the EAG bycatch in the groundfish fisheries over the past decade was associated with the Pacific cod pot fishery extrapolated into adjacent state waters which lacked observer/EM coverage. For the WAG, total groundfish bycatch has been relatively low compared to the EAG and has been comprised primarily of trawl bycatch. One exception to this general trend was an implied high level of bycatch in the 2022 Pacific cod pot cod fishery based on extrapolation of data from other sablefish observed trips when observer coverage for the state Pacific cod fishery was not available.

Only two vessels participated in the 2023 PIGKC fishery, so harvest data are confidential. Historically, most of the catch occurred in the Pribilof Canyon area. A relatively small amount of PIGKC fixed gear bycatch occurs in the Pacific cod pot fishery, with most of the total bycatch coming from trawl fisheries targeting a variety of species.

The SMBKC fishery has been designated as overfished with no open directed fishery since 2014/15. There has been little bycatch of SMBKC in other crab fisheries in the past decade, and little bycatch in trawl fisheries, with some bycatch occurring in fixed gear (pot) fisheries.

The PIRKC stock, with a fishery closure since 1999, occurs in and around the Pribilof Islands Habitat Conservation Zone (in place to protect PIBKC). Bycatch mainly occurs in the trawl fishery targeting yellowfin sole in November and rock sole in May.

The overfished PIBKC stock experienced low trawl bycatch in 2023 compared to levels over the past decade, particularly for trawl vessels targeting yellowfin sole and rock sole. There has also been variable bycatch in the Pacific cod pot fishery.

The NSRKC stock has experienced little groundfish bycatch and no trawl fisheries operate in this area.

Alaska Climate Overview and Ecosystem Status Report - Aleutian Islands

Ivonne Ortiz (UW-CICOES Seattle) presented on the Alaska Climate Overview and the Aleutian Islands Ecosystem Status Report (ESR). Ivonne noted that she worked with Emily Lemagie to prepare the climate overview, who has taken over for Nick Bond in that role.

Climate Overview

The North Pacific started 2024 under El Niño conditions, transitioned to the current neutral conditions and is expected to transition to weak La Niña conditions by mid-fall this year. The Eastern Bering Sea in 2024 saw dominant winds from the Arctic with sustained sea ice extent through May, near average for the 30-year (1991-2020) climatological baseline. Strong eastern winds characterized the Aleutian Islands region from late 2023 through summer 2024, opposing the regular North Pacific warm water transport through eastern passes to the Eastern Bering Sea shelf. Sea surface temperatures (SST) in the Gulf of Alaska shifted from a previous multi-year period of cool-to-average ocean temperatures to warmer SSTs across the Gulf beginning winter 2024, and to date remaining above the 30-year average in the eastern Gulf. Ivonne summarized key elements of the Alaska climate system in terms of three pressure systems, noting that the transport of warm, moist air from the North Pacific to the Arctic is facilitated by the strength and position of the Aleutian Low and modulated by the Beaufort High, and that storms tend to follow the northern edge of the North Pacific High. Key features of the system that drive interannual variability in weather patterns include the speed of winds, driven by the relative intensity and size of the respective pressure systems, and wind direction and storm tracks, driven by the relative positions of the pressure systems. During 2024, the Aleutian Low was relatively weak, which tends to result in a northward shift of the storm track, in contrast to storm tracks running south of the Aleutians during strong Aleutian Low years. Ivonne showed a series of slides that spatially depicted the monthly progress of SST, sea ice, and wind patterns through the year.

The SST projections from the National Multi-Model Ensemble (NMME) indicate that ENSO-neutral conditions are expected to continue for the next several months, with La Niña favored (66% probability) to emerge in September-November and persist in the Northern Hemisphere through the winter on 2024-25 (74% chance in November-January). Near-normal SSTs are predicted across most of Alaska's marine ecosystems, with cool anomalies during the winter over the eastern Gulf of Alaska, expanding over the western Gulf into spring. In response to a question about the skill of SST projections based on the NMME, Ivonne characterized the projections for the Bering Sea as generally reliable, but less so for the Gulf of Alaska and Aleutians regions.

Aleutian Islands Ecosystem Status Report

Ivonne gave an overview of crab-relevant ecosystem information from the forthcoming Aleutian Islands Ecosystem Status Report, co-authored with Stephanie Zador (NOAA-AFSC Seattle), addressing indicators relevant to pelagic/larval stages and benthic juvenile and adult stages (noting that larval stages for golden king crab can be benthic as well as pelagic) across four categories: environmental processes, prey, competitors, and predators.

Observations from ERSSTv5 for 1900-2024 show annual mean SST increasing monotonically over the last 100 years. This increasing trend is observed in both winter and summer, and the Aleutians are the only large marine ecosystem in Alaska to exhibit this trend in both seasons. Average winter SST during 2023/24 declined from the previous winter, but was still among the warmest 10 winters on record; summer SSTs during 2024 declined from 2023 to slightly below the long-term median. More detailed monthly results broken out by wester- central- and eastern Aleutians subregions indicated that SSTs were above the long-term (1985-2014) mean in the western and central subregions over most of the year to-date, SSTs in the eastern Aleutians started above the long-term mean, but have been near average since spring. The SST time-series from 1985 to 2023 indicates a step increase in 2014, after which nearly all monthly SSTs in all three subregions have been >1 standard deviation above average. Moderate marine heatwave (MHW) events occurred across all three subregions during the winter of 2024, and in late summer in the western Aleutians, which also saw greater intensity and spatial extent of MHW than the other subregions. Bottom temperature data from the summer trawl survey during 1994-2022 exhibited a similar step change beginning in 2014 to above long-term mean temperatures across all subregions of the Aleutian Islands. Winds from the Arctic from late 2023 through spring 2024 consistently reduced SSTs across the Aleutians throughout the year, and consistently dominant eastward winds south of the Aleutian Islands from late 2023 through summer 2024 tended to counter mean ocean currents that typically flow north and west through the Gulf of Alaska. Eddy kinetic energy for three key centers indicated 2024 was below the long-term mean across the Aleutians, associated with near-average levels of transport of heat, nutrients, and salinity through Aleutian passes.

Continuous plankton recorder information through 2023 provides three prey indices for the Aleutian Islands and Southern Bering Sea. The mean large diatom abundance anomaly, a measure of the deviation from the mean, was positive for 2023. The copepod community size anomaly was negative for 2023, and has tended to be negative since 2015, potentially indicating a true increase in smaller species of copepods, which are usually linked to higher temperatures. Mesozooplankton biomass was positive in 2023. The 2023 spring bloom, derived from satellite chlorophyll-*a* data, was below the long-term average value, continuing a negative trend that has characterized the time series since 2016. A strongly above-average bloom has not been observed since 2009 and mostly negative anomalies are evident since 2016. The biennial pattern of relatively higher and lower phytoplankton may be associated with the biennial pattern of Kamchatka pink salmon abundance, with the low pink salmon abundance in 2024 potentially contributing to an increase in phytoplankton for 2024 (final 2024 results forthcoming). Asked about potential explanations for the longer-term downward trend in spring bloom, Ivonne suggested that one leading hypothesis is that strong growth in pink salmon abundance since 2009 has been a driver. Survey data through 2022 on sponges and echinoderms, and on assorted invertebrates through 2023, encompassing prey species for adult golden king crabs, all show generally higher abundances in the

central and eastern subregions than in the western Aleutians and southern Bering Sea; however, declining trends across all time series may indicate true population declines in invertebrate prey species.

No indicators for golden king crab competitors are available and Ivonne invited suggestions from the CPT for developing this section of the ESR. Regarding prey indicators, Ivonne noted that there are relatively few data available showing king crab in stomach contents available in the Food Habits database, with shortspine thornyheads and Pacific cod representing the most observations. Jellyfish abundance data from the summer trawl survey and from the groundfish fishery indicate contrary trends through 2023, with uncertain implications for predation on king crab. Pelagic forager (rockfish, Atka mackerel, and pollock) biomass increased across the three Aleutians subregions in 2022, but Ivonne noted that these species do not prey heavily on king crab. Apex predator biomass, including Pacific cod, generally decreased across species and subregions in 2022; more recent results for pelagic and benthic predator indicators were not available.

Ecosystem Status Report - Bering Sea

Elizabeth Siddon (NOAA-AFSC Juneau) provided an update on ecosystem information relevant to crab for the Eastern Bering Sea Ecosystem Status Report (ESR). Her presentation was divided into ecosystem information relevant to pelagic and benthic stages, environmental processes, prey, competitors, and predators. Data for 2024 are included where available.

In summary, ecosystem conditions reflect a transition from El Nino to La Nina conditions. The marine heatwave index suggests that heatwaves were brief and infrequent from January 2022 to the present. Sea surface temperatures (SST anomalies) in the recent year were within 1 SD of the long-term mean (baseline 1985-2014). The SSTs have been cooler since 2022, following a warming during 2014-2021, and were near-average relative to the time series mean (1985-2014) in the outer, middle, and inner domains in 2024. Bottom temperatures (from ROMS models) suggest unusual warming in the NBS outer region, while temperatures were closer to the long-term mean in other regions. In 2023-2024, sea ice extent was delayed in fall, then increased in mid-December and through the winter/spring. May sea ice extent was the highest observed since 2013; however, the 2023-2024 maximum sea ice extent that occurred in late March was 14% smaller than the long-term (1991-2020) mean. Early season sea ice extent (Oct-Dec) has decreased 63% over the 46 year time series (1979-present). Ice generally advances with northerly winds and retreats with southerly winds, although there was a weak correlation with wind and sea ice this past year because of short-term variability in weather patterns. Ice thickness in most regions of the Bering Sea (measured the third week of March) was slightly lower than in 2023. The NOAA Coastwatch/Polarwatch programs have developed a new sea ice Shiny app that end users can use to view real-time sea ice data. The app includes sea ice extent time series, sea ice extent anomalies, sea ice data and graphs, and original code in R and Python. Feedback from stock assessment authors and fishery biologists is welcomed on this new tool. The cold pool extent from bottom temperatures, as well as the cold pool index in 2024, were near the long-term average, but 11% smaller than in 2023. The index of ocean acidification in Bering Sea shelf bottom water showed an aragonite saturation state approaching 1, similar to 2023, with low pH that is most prominent in the northwest region of the Bering Sea.

The measure of the spring bloom, chlorophyll-*a* biomass, was below the long-term average in 2024 and some regions had later bloom timing. The zooplankton spring survey indicated that small copepod abundances were lower than recent warm years, but higher than observed in previous cold years. Large copepods were low, similar to other cold years that follow warm periods. The 2023 continuous plankton recorder data showed positive diatom abundance in 2023, positive copepod community size, and a negative mesozooplankton biomass. Echinoderms are both prey and competitors with crab and comprise 50% of the motile epifauna. Motile epifauna biomass remained above the long-term mean. Sponge catch rates were low in the Southern EBS and variable in the Northern BS. Pelagic foragers (e.g., pollock and herring) decreased from 2022 to 2023 and remained below the long-term mean. Apex predators (e.g., Pacific cod and arrowtooth flounder) are stable at their long-term mean. Adult Pacific cod condition indices (length-weight residuals) were negative in 2023 and lower than 2022. In the NBS, Pacific cod condition increased from 2022 to 2023. Jellyfish indices increased in 2023 in the NBS and were average in the Southern EBS. The Bristol Bay sockeye salmon forecast in 2024 declined from the record high in 2022 and was similar to the long-term average. The Borealization index (comprising nine independent metrics) was at the time series mean (1972-2024).

The ESR team stands ready to provide information for risk tables for EBS/AI crab as this process is implemented. For groundfish (as a reference), the ESR team meets with the stock assessment authors in October to create risk tables for groundfish stock assessments. If there is an ESP, then the ESP lead participates as well. The CPT responded that they are still developing risk table standards, and will reply to ESR leads after looking at draft risk tables this week. One suggestion was that the consultation could occur after the May Plan Team and PEEC meetings.

Overfishing Status Updates

Western Aleutian Islands Red King Crab (WAIRK)

Ben Daly (ADF&G-Kodiak) summarized catch in relation to overfishing limits (OFL) for WAIRKC (2023/24), which are on a triennial cycle with the last stock assessment in May 2023. The OFL and ABC for WAIRKC will remain in effect until the next assessment cycle, which will be in May of 2026. Overfishing did not occur in 2023/2024.

Pribilof Islands Golden King Crab (PIGKC), Aleutian Islands Golden King Crab (AIGKC)

Tyler Jackson (ADF&G-Kodiak) provided an overview of the catch in relation to overfishing limits (OFL) for PIGKC (2023) and AIGKC (2023/24). Since total catch was below the OFL for both stocks, overfishing did not occur. The PIGKC stock is on a triennial assessment cycle with the last assessment in May 2023. The OFL and ABC for PIGKC will remain in effect until the next assessment cycle in May 2026.

The AIGKC stock is on an annual cycle and last assessed in May 2024. At that time, the fishing year (July 1 to June 30) was not completed and overfishing could not be determined until the September CPT meeting. The updated catch was provided at the September CPT meeting and the SAFE intro for AIGKC revised accordingly.

Pribilof Islands Blue King Crab (PIBKC)

William Stockhausen (NOAA-AFSC Seattle) summarized catch in relation to the overfishing limit for the 2023/24 PIBKC fishery. Total catch was below the OFL, therefore overfishing did not occur. The PIBKC stock is overfished and the status has not changed since 2002. This stock is on a biennial cycle and last assessed in May 2023. The OFL and ABC for this stock will remain in effect until the next assessment in September 2025. After 2025, the frequency of this assessment is expected to be every four years.

Pribilof Islands Red King Crab (PIRKC)

Cody Szuwalski (NOAA-AFSC Seattle) summarized catch in relation to the overfishing limit for the 2023/24 PIRKC fishery. Total catch was below the OFL, therefore overfishing did not occur. This stock is on a triennial cycle last assessed in September 2022. The OFL and ABC for this stock will remain in effect until the next assessment in September 2025.

AIGKC proposed model runs

Tyler Jackson (ADF&G-Kodiak) presented results from twelve GMACS models for the May 2025 Aleutian Islands golden king crab (AIGKC) assessment for both the EAG and WAG, as well as two additional GMACS models for the EAG that incorporated the EAG cooperative pot survey. Model 23.1 (Base) was the model accepted in May for the 2024 assessment. Models 23.1 (Update) and 23.1 (SeModels 23.1 (Data) addressed CPT requests for model explorations related to the 1993/94 data included in the EAG and WAG models. Previous models for the EAG did not include any observer data on total catch for 1993/94, but did include data on retained catch and retained catch size compositions. Tyler clarified that observer data is available for 1993/94 in the current EAG management area (east of 174°W longitude) but, strictly speaking, these data are from the 1992/93 WAG fishery (the boundary of which was extended to 171°W longitude at the time). Tyler felt it was appropriate, as in past models, to exclude this data on total catch from the model. For the WAG, the 1993/94 observer size composition included in previous models was substantially different from adjacent years. Tyler explained that observer size data from various uncommon or non-target pot types had been excluded from size compositions in previous models for both the WAG and EAG, although most of these data were from rectangular pots (albeit with unknown dimensions). Including the data from all rectangular pots had little effect in ason) were intermediate bridging models that documented potential changes in model performance associated with updating the version of GMACS used to create the model from 2.01.M.10 to 2.20.16 (Update) and expanding the number of seasons defined in the model from 5 to 6 in order to export the end-of-year N matrix (Season). As an aside, the CPT discussed the timing of growth in the model, and GMACS in general, with respect to when the fishery occurs and MMB is determined. This has been raised for other stocks and was flagged as an issue to be discussed at the January modeling workshop. Molting and growth occur throughout the year for golden king crab, but modeling multiple seasons for growth correctly would require modifications to GMACS. As expected, there were no changes in model results with respect to the progression from 23.1 (Base) to 23.1 (Season).

most years on the resulting size compositions for either the EAG or WAG, with the exception of the WAG in 1993/94 where the inclusion reduced the differences with other years because it increased the sample size substantially. The changes had very little impact on model results. Tyler thus recommended including

the additional data from the rectangular pots for size compositions, but noted that only the standard pot types were included in the CPUE standardization.

After re-labeling the 23.1 (Data) models as "23.1", Tyler presented results from models which implemented alternative approaches to initialization. Model 23.1 started in 1960 from an equilibrium size structure, with data to inform the model starting in 1981. Recruitment deviations across the entire model time frame were bias-corrected. Following a previous CPT recommendation, Model 23.1c implemented a revised bias correction strategy for recruitments during the "spin-up" period prior to 1981 to address a perceived bias in "early" recruitment deviations. This strategy consisted of removing the bias correction on recruitments in the "spin-up" period. CPT discussion suggested this was not really necessary because the initial equilibrium population size was simply larger than the population size in 1981, thus forcing negative recruitment deviations in order to better fit the 1981 data. Tyler noted that the new strategy did not really resolve the issue, in any case. Following another CPT suggestion, model 25.0 eliminated the "spin-up" period and estimated the initial size structure starting in 1981, which reduced the overall number of estimated parameters by 4. Overall, model results from 23.1, 23.1c, and 25.0 for recruitment and MMB after 1985, when retained catch size compositions became available, were extremely similar except that recruitments in the EAG for 25.0 were slightly higher than in the other two models.

In response to CPT and SSC concerns regarding potentially over-weighted size compositions in the model-fitting process, models 25.0a, 25.0b, 25.0b2, 25.0c, and 25.0d explored different data-weighting implementations relative to 25.0. In the latter model, retained catch was assigned a cv of ~3% while total catch cv's scaled with the number of observed pots (up to 250) with non-zero catch, bycatch was assigned a cv of 1.3, and cv's for the CPUE indices were derived from the index standardization models. Additional variances were also estimated for all of the CPUE indices. Sample size was the number of vessel days in the directed fishery for retained catch size compositions, the number of observer days in the directed fishery for total catch size compositions; and the number of tag returns for tagging data. Model 25.0a placed equal emphasis factors on all likelihood components, whereas 25.0 (and 23.1c) increased the emphasis on fitting retained catch and total catch by factors of 4 and 2, respectively. In addition to the changes in 25.0a, model 25.0b used a bootstrapping analysis to determine input sample sizes for the size composition data. The means from the bootstrapped sample sizes were very large compared to the original sample sizes, so an upper limit of 2000 was placed on these as input sample sizes. The CPT noted that several groundfish assessments use the harmonic or geometric mean of the bootstrapped distributions, rather than the arithmetic mean, to determine input sample sizes. Models 23.1c, 25.0, 25.0a, and 25.0b fit the size composition data using multinomial likelihoods and used Francis iterative weighting to determine stage 2 sample sizes. Models 25.0d (otherwise identical to 25.0a) and 25.0c (otherwise identical to 25.0b) fit the size composition data using Dirichlet-Multinomial likelihoods, which include a parameter related to effective sample size. Model 25.0b2, which doubled the weight on the index data, was a sensitivity test to explore the tradeoffs with forcing an improved fit to the index data and was not considered a potential model for the final assessment. It required increasing the penalty on groundfish bycatch F's to reduce erroneously high estimates of these parameters in some years.

None of the changes to data weighting, other than increasing the emphasis in 25.0b2, resolved the poor fits to the post-rationalized CPUE indices in the EAG. Model 25.0c stood out from the others with regard to poorer fits to the post-rationalized observer data. For the WAG, all of the models (including 25.0b2)

exhibited similar fits to the index data. All of the models fit the size composition data well for both the EAG and WAG. The Dirichlet-Multinomial parameters estimated in models 25.0c and 25.0d tended to give larger weights to the size composition data compared with those from the Francis re-weighting. Using the bootstrapped input sample sizes did not have a large effect when combined with the Francis re-weighting because the latter simply further reduced the larger bootstrapped sample sizes to end up with equivalent stage 2 sample sizes.

Tyler presented plots of observed and model-predicted mean size from the size composition data as an additional diagnostic tool to judge model fits. The models using the Dirichlet-Multinomial likelihoods exhibited closer estimates to observed mean size, reflecting the greater weight these models placed on the size compositions, whereas model 25.0b2 estimated mean size much more poorly. Tyler pointed out that residual patterns for retained catch mean sizes were good for all models for both the EAG and WAG in the pre-rationalization period but that, with the exception of 25.0c and 25.0d, these exhibited runs of positive or negative residuals in the post-rationalization period. Residual patterns for total catch mean sizes did not exhibit these runs, except for 25.0b2.

In the EAG, Tyler characterized the variation in estimated recruitment in model 25.0b2 as "biologically implausible" relative to the other models, while all of the models exhibited similar variation in estimated recruitment in the WAG. The CPT questioned whether the variation in EAG model 25.0b2 was really "biologically implausible" given what is known for crustacean stocks in general. Other members of the CPT agreed with Tyler that it probably was, given the associated changes in MMB. It was also noted that "recruitment" here did not reflect settlement from the larval phase but rather much older crab growing into the first model size bin. The CPT and author agreed that the size composition data was probably more informative than the index data for this stock, in contrast to typical assessment situations. The CPT suggested that the apparent conflict between the CPUE and size composition data might reflect changes in crab weights-at-size, but that there was little data to evaluate that idea. On the whole, EAG models were more sensitive to data weighting than WAG models. Tyler suggested that 25.0b was the best of the data-weighting models, but that there was some spatially or temporally-varying process in the EAG post-rationalized period that was unaccounted for which manifests as estimates of large additional variance (and poor fits) on the index data.

Models 23.1c and 25.0b exhibited similar poor retrospective patterns in MMB (Mohn's rho > 0.38 for both models) for the EAG, with peels positively biased with respect to the model estimates from the complete time series. This was not the case for retrospective analyses for these models in the WAG.

Tyler also presented results from likelihood profiles on R0 and Rbar from Models 23.1c and 25.0b, respectively, for the EAG and WAG. Although "messy", the results suggested fits to size compositions were more sensitive to the values of these parameters in the EAG, while fits to index data were more sensitive in the WAG. The CPT suggested there might be convergence issues in some of the profiling runs and that the profiles indicated there might be a second minimum in the likelihood surface. Tyler noted that this was a work-in-progress that he would revisit in the future using simulated data.

The CPT noted that changing emphasis factors amounted to rescaling the associated cv's or input sample sizes and thus, for sensitivity studies involving data weighting it might be helpful for easier comparison to

rescale the base model such that all emphasis factors are 1. The CPT also suggested that plotting the time series of temporally-varying cv's and sample sizes might be informative.

Finally, for the EAG only, Models 25.1 (based on 25.0b) and 25.1b (based on 25.0c) included fitting data from the cooperative survey as an additional fleet (with catch but no retention) in the model optimization. The survey index was fit without estimating additional variance and assumed catchability was independent of the fishery and selectivity was logistic. Input sample sizes were based on bootstrapping. Tyler reviewed several aspects of the survey, which is described in detail in Appendix A of the proposed models document, including its spatial coverage, station selection, sampling protocols, and index standardization. Zero catch stations were added to the CPUE index standardization this year for the first time; the standardization previously used the same negative binomial GAMM model as the fishery CPUE standardization and included smooths on soak time and depth. Previous standardization results eliminated depth as a smooth factor, but with new data for 2023 both soak time and depth were identified as significant smooth factors. However, diagnostics for residuals were unsatisfactory and suggested that data with soak times greater than 30 days were an issue. When these data were removed, the standardization identified both depth and soak time as linear effects and diagnostics were improved. Because the depth and soak time effects were linear, Tyler re-fit the data with a GLMM using a Tweedie distribution, which produced the residuals with the best characteristics. The observer and survey CPUE indices generally follow the same trends, with the latter exhibiting larger fluctuations and greater uncertainty. Survey size compositions were similar to the observer size compositions, except for 2018. The two GMACS models (25.1, 25.1b) fit the survey CPUE indices fairly well, other than in 2021 where there is a large decrease in the observed index. The models fit the other indices similarly to 25.0c, in particular overestimating the post-rationalization observer CPUE index at the start of the time series and underestimating at the end. Fits to the survey compositions were good, except for 2018, while fits to the fishery size compositions were almost identical to the other models compared (23.1c, 25.0b, and 25.0c). Recruitment estimates were noisier with the survey data at the beginning of the model time series compared with the other models, while 25.1 and 25.1b followed estimates from 25.0c at the end. Similarly, estimates of MMB from 25.1 and 25.1b tended to follow their counterparts without survey data until the start of the survey data, after which the results were similar to those from 23.1c, although both 25.1 and 25.1b ended estimating terminal year MMBs even lower than 23.1c.

Summarizing the status of models incorporating the survey data, Tyler felt that the handling of the survey data was an improvement over what he presented in January, and that several issues had been resolved. However, he also felt that a number of issues still remained before the data could be used in an assessment model to set harvest specifications. Tyler also noted that the 2024 cooperative survey had encountered logistic issues and that many fewer stations were sampled than had been planned. The CPT requested that Tyler provide maps that overlay the spatial extents by year for the EAG survey and fishery as an aid to address concerns he expressed regarding conflicting stock trends indicated by the survey and fishery indices.

Based on the results presented, Tyler recommended bringing two models forward in May as candidates to evaluate for the 2025 assessment: 23.1c and 25.0b. He felt that Francis weighting provided better second stage weights for the size composition data than the Dirichlet-Multinomial likelihoods did, and that the bootstrapping analyses provided a good basis for the input sample sizes. Tyler noted that model 25.1 for

the EAG could also be included for May, but was unlikely to be selected for specifications if the issues surrounding the apparent data conflicts with this model could not be resolved and thus he recommended putting 25.1 on the "back burner".

Finally, Tyler proposed that future work would include simulation studies, revisiting the appropriate size at maturity to use for calculating management-related quantities, and examining spatial/vessel effects in the post-rationalization fishery data to identify potentially time-varying processes such as catchability or selectivity. He requested any guidance the CPT could give to resolving the data-weighting issues that remain with the EAG models and suggested that simulation studies might help shed light on some aspects of this problem. The CPT will include an agenda item on simulation studies at the January 2025 Modeling Workshop.

The CPT expressed its appreciation to Tyler for the amount of work he devoted to addressing the issues with the data and GMACS models. The CPT agreed with Tyler's recommendations for models to consider for setting specifications in May 2025 and recommended that he bring forward models 23.1c and 25.0b. The CPT discussed whether it might be helpful to bring any other models forward in May if Tyler was able to make progress in terms of resolving the remaining data weighting issues or questions regarding the best use of the cooperative survey data. The consensus was that it would be worthwhile, but not necessary, to bring any such models forward in May to provide context for model uncertainty in determining an appropriate ABC buffer, but that any such models would not be considered for specification purposes because they would not yet have been reviewed. The CPT also requested that a risk table for AIGKC be brought forward in May.

SMBKC final SAFE

Caitlin Stern (ADF&G-Juneau) presented the Saint Matthew Island blue king crab (SMBKC) stock assessment, which occurs on a biennial cycle with the last full assessment in September 2022. SMBKC was declared overfished in 2018 and there has not been a directed fishery since 2015/16. The stock has been in a rebuilding plan since 2020. Since the last assessment, there have been no changes to fishing regulations and analyses have focused on recruitment expectations. A substantial change in the NMFS summer bottom trawl survey sampling occurred in 2024 with the "corner stations" not sampled. Corner stations were introduced as a high-density sampling stratum in 1983 with the intention of better characterizing BKC abundance around Saint Matthew Island. However, because of the need to allocate effort to survey modernization fieldwork, the corner stations were not sampled in 2024, and their role in future surveys remains doubtful. To characterize the effects of this change, Caitlin presented the impacts of corner station removal from the historical time series of biomass and size composition data. The SMBKC densities at corner stations tended to be somewhat higher than at other stations and, as such, excluding corner stations from the historical time series resulted in a reduction of mean biomass. In contrast, there was little change in size compositions when corner stations were removed. Survey index standardization to better account for the lack of sampling the corner stations is in progress for biomass and size composition data.

Catlin presented results from five model scenarios. These consisted of 16.1 – May (the May 2024 recommended model), 16.1 (with updated data and GMACS version), 24.1 (16.1 using $M = 0.23$ from the

BBRKC 2023 SAFE), 16.1a (16.1 with corner stations removed from the trawl survey data), and 24.1a (24.1 with corner stations removed from the trawl survey data). Models which dropped the corner stations were provided as sensitivity tests and were not intended to be used for management. Dropping the corner stations from the historical trawl survey time series resulted in lower estimated MMB and OFL. The models fit the trawl survey data better when the corner stations were included, but fit the ADF&G pot survey data better when they were excluded. It was noted that the time series with and without corner stations are two separate datasets, so that the associated log-likelihoods were not directly comparable as measures of fit. The model fits for both trawl and pot surveys were better with $M = 0.23$ than $M = 0.18$. The model fits for size composition data were worse for survey data without the corner stations included. Model MMB trajectories were similar between models with $M = 0.23$ and $M = 0.18$, and both model scenarios showed retrospective patterns. Model MMB estimates were lower without corner stations included.

The CPT agreed with the author's recommendation to use model 24.1 for the final assessment, due to the better fits to the data with $M = 0.23$, as well as indications from the recent BBRKC assessment that this is likely a better estimate than 0.18. The CPT recommended the ABC buffer remain at 25% because, although the removal of the corner stations results in lower estimates of MMB, the CPT considered this to be added bias, not added uncertainty. Consideration of the increased *M* relative to the ABC buffer was discussed, but the increased *M* was thought to be a better estimate, and did not warrant additional ABC buffering. Caitlin noted that work on standardizing the survey index to better account for the elimination of the corner stations from future surveys is underway, using both sdmTMB and VAST methods for comparison. The CPT confirmed that model-based approaches such as VAST would be appropriate for this and suggested that sdmTMB might be considered as an "easier" alternative to VAST.

The 2023/24 stock size for status determination (i.e., the MMB) is below the MSST, and as such, the stock remains overfished. However, the projected 2024/25 stock size is above the MSST. Total fishing mortality was below the OFL for 2023/24, thus overfishing did not occur. Low recruitment persists, with the estimated 2024 recruitment below the 1978-2023 mean and near the lower end of the recruitment time series. Population projections considered for rebuilding greatly depended on the range of historical years for recruitment used in the projections (projected future recruitment uses values that are randomly selected from the range of historical recruitment estimates). Inclusion of high recruitment estimates in the early years of the full time series (1978–2023) yielded a more optimistic population projection than when drawing recruitment from a truncated time series (1999-2023) .

It was noted that elimination of the NMFS trawl survey corner station sampling increases the importance of future ADF&G pot surveys. The CPT discussed the selectivity of the pot survey vs. the trawl survey. It was noted that relating the two gears is difficult, but that the pot survey covers the spatial footprint of the population more accurately. Additionally, it is believed that the ADF&G pot surveys better sample SMBKC due to limitations of the NMFS trawl survey gear in some habitats, such as rocky bottom and nearshore areas. The CPT discussed timing of the ADF&G pot surveys relative to the assessment, noting that the ADF&G pot survey did a better job of capturing the recent population decline, and that future ADF&G pots surveys will help to better understand the stock status. While annual pot surveys are ideal, a 3-year cycle is likely effective in capturing broad population trends. The next ADF&G pot survey will tentatively be conducted in August-September 2025.

BBRKC report card

Erin Fedewa (AFSC-Kodiak) and Brian Garber-Yonts (AFSC-Seattle) presented the most recent ecosystem and socioeconomic profile (ESP) for Bristol Bay red king crab (BBRKC). The full ESP was completed in 2020 and abbreviated report cards have since been updated each year. The ESPs are a standardized format for compiling and evaluating relevant stock-specific ecosystem and socioeconomic indicators and communicating linkages and potential drivers of the stock within the stock assessment process. The ESP process creates a traceable pathway from the initial development of indicators to management advice and serves as an on-ramp for developing ecosystem-linked stock assessments.

Ecosystem indicators are summarized across larval, juvenile, and adult life stages, and are collected from a variety of data sources including the NMFS trawl survey, satellites, oceanographic models, and fishery-dependent data. Erin brought forward three new ecosystem indicators for adult BBRKC: 1) female reproductive potential defined as the proportion of new shell mature female red king crab caught on the summer Eastern Bering Sea (EBS) bottom trawl survey with empty clutches; 2) Northern District ratio defined as the ratio of total red king crab abundance in the Northern District to total red king crab abundance in the Bristol Bay Management District; and 3) protected area proportion defined as the proportion of total mature male model-based abundance during the summer EBS bottom trawl survey located in year-round closure areas. In addition, the previous reported indicator on juvenile sockeye salmon abundance was discontinued and replaced with the annual inshore run size of Bristol Bay sockeye salmon.

In 2024, ESP indicators highlighted a number of severe ecological and economic challenges for BBRKC and the BBRKC fishery. Bottom water pH in Bristol Bay increased from 2023 to 2024; although pH has generally declined over the past two decades, potentially threatening juvenile red king crab growth, shell hardening, and survival. The 2024 increase in pH, however, is a positive step toward better conditions. The cold pool did not extend into central Bristol Bay in 2024, but bottom temperatures are well within the preferred thermal range of juveniles. There is also concern over reduced post-larval feeding conditions and survival due to low chlorophyll-*a* concentrations. The BBRKC population showed an increase in mature male spatial extent since 2021, indicating an expanding northward range and summer movement outside management boundaries, with 68% of mature males located in closure areas during the 2024 summer survey. In contrast, mature female spatial extent has contracted in recent years, indicated by high survey catches north of Port Moller and an overall southeast shift in abundance since 2019. Additionally, a slight increase in mature females with empty clutches (~4%) suggests potentially lower reproductive potential that should continue to be monitored under depressed population levels. The suite of ecosystem indicators were compared across years using a traffic light table that evaluates the current year trends compared to previous years.

Public comment attributed the cold pool as an underlying mechanism that helps explain distribution shifts of crab and requested that spatial indicators or BBRKC densities be overlaid on top of the cold pool. Members of the public also inquired about drivers of the decadal decline in pH. While human-induced climate change and sea ice dynamics are likely key drivers, more work is currently underway to investigate spatiotemporal variation in pH.

Socioeconomic indicators are summarized across fishery performance, economics, and community impacts. The BBRKC fishery was open for the 2023/24 season with the active fishing fleet further consolidating from 47 vessels in 2020 to 31 vessels in 2023. This persistent consolidation of the BSAI crab fleet results from financial pressures on vessel owners associated with recent crab fishery closures. A trend of declining ex-vessel value over the most recent five open BBRKC seasons coincided with upward-trending, and historically high, ex-vessel price, which culminated in an unprecedented extreme high value in 2023. This record-high ex-vessel price reflects the contemporaneous closure of the snow crab fishery and limited availability of other fishing targets for the BSAI crab fleet. Community indicators are provided by the Alaska Bering Sea Crabbers (ABSC) Skipper survey where there was 42% participation from skippers during the 2023/24 BBRKC fishery. The skipper survey highlighted that most participants changed their fishing behavior this season by using longer soak times to reduce sorting of sub-legal males and females, reduce bycatch, and increase catch of legal males. Participants' perception of abundance varied likely due to skipper experience and area fished, and they worked collectively to move away from known areas of mature females while fishing.

The CPT recommended that socioeconomic figures be broken down into pre- and post-Crab Rationalization periods to display the range of variation in the modern period relative to the long term mean.

Erin also noted to the CPT that the Tanner crab generalized ESP was completed for the 2024 risk table. For the May 2025 CPT meeting she will also present on snow crab/BBRKC secondary stage indicator importance test methods development and results, and at the 2024 October Council meeting, an ESP summary will be provided alongside the ESR summary. Furthermore, the CPT was informed that further methodological development of socioeconomic indicators is going to be focused on groundfish stocks due to total allowable catch (TAC) decisions being made by the Council, whereas for crab stocks TAC decisions are made by the ADF&G.

BBRKC final SAFE

Katie Palof (ADF&G-Juneau) presented the final SAFE for Bristol Bay red king crab. Two models were presented, including the accepted model from 2023 (model 23.0a) and a model that differs from 23.0a only in that it removes a time block for molting probability from 1975-1979 (model 24.0c). The impact of this removal was minimal, so the CPT endorsed model 24.0c for use in specifying the OFL and ABC on the grounds of parsimony. The CPT endorsed the author's recommendation for a 20% buffer based on distributional shifts in the cold pool, a declining trend of mature biomass, and lower than average recruitment over the past decade. Given these recommendations, the CPT-recommended OFL for BBRKC during 2024/2025 was 5.02 kt, with an associated ABC of 4.02 kt.

Fixed gear bycatch mortality rates were discussed extensively with useful input from stakeholders present at the meeting. Stakeholders suggest that the 50% mortality on pot bycatch is much too high, but the assumed longline mortality is likely too low. Whether or not the fixed gear components should be split into their own fleets in the model was also discussed, but without resolution. It was unclear what impact adjusting bycatch mortality rates would have in the model, given they are small relative to other sources of mortality. In spite of what may be small changes in the model, stakeholders noted the figure for discard

mortality in the pot fisheries has been a point of political contention and addressing this would be useful in communicating the relative effects of fisheries on one another at the Council level. The CPT recommended that the author explore the impacts of assuming different fixed gear mortality rates for the next CPT meeting.

The CPT also discussed two topics that are applicable to several stocks during the presentations for BBRKC: jittering and risk tables. A need for a common methodology for presenting jittering output was identified and it was suggested that the quantities that go into and come out of the harvest control rule are key quantities for which output would be useful. The biggest question around risk tables explored was whether or not the level of concern noted in the risk table should be relative to last year or relative to 'no concern'. The CPT consensus was that it should be relative to 'no concern'. Other questions around risk tables included how to address lags in indicators, whether or not including population and ecosystem concerns is 'double dipping', and whether or not there is a 'minimum buffer' by tier. The CPT did not resolve any of these questions, but emphasized that the risk table process will be iterative and its ultimate goal is to organize and codify the currently used information for the buffer setting process.

The author has an ongoing list of issues to explore, including removing shell condition from the model, the use of the BSFRF data as a prior on survey selectivity, and expanding the range of sizes included in the model. The CPT continues to support these endeavors.

BSFRF update

Scott Goodman gave an overview of several ongoing Bering Sea Fisheries Research Foundation (BSFRF) activities. In 2024, BSFRF conducted Collaborative Pot Sampling 2 (CPS2) using two crab pot vessels and one trawl vessel to sample Bristol Bay red king crab (BBRKC) to study stock distribution and crab condition in the spring. The trawl vessel was added due to the lack of female RKC found in the previous pot study (CPS1, 2023). The results of CPS2 and a comparison to the NOAA bottom trawl survey will be released soon. BSFRF plans on completing CPS3 in 2025, hopefully with the assistance of disaster relief research funding.

In May 2024, BSFRF hosted an opilio workshop in order to collaborate with international partners. The workshop aimed to share information with Canadian scientists regarding possible stock overlap, stock condition, and exploitation. A publication is in process detailing the workshop and outcomes.

An opilio pilot project concluded in the BS last week and some raw data were presented. One vessel using nephrops trawl and one crab pot vessel were chartered to sample opilio. The objective of this project was to inform ongoing survey calibration research, gain an improved understanding of BS male opilio distribution near the shelf-slope margin, employ crab vessels, and evaluate the logistics of future studies. Although the project planned to survey several areas in the NW, weather pushed the pot vessel out of the area after completing S-31. The vessel was also able to complete Q-28 and set some deep-water pots, but weather was a continuous problem. The vessel sampled 93 pots total, short of the 100-150 pots planned. Preliminary results show a high number of male opilio and low number of female opilio in the pot gear. It was also noted that very few Tanner crab were seen in these areas. The trawl vessel completed 27 tows, 19 of which were side-by-side with the NOAA survey. Four tows maximum were completed per grid. The area sampled that resulted in the most opilio (males and females) was just north of the Pribilof Islands.

Scott noted that there were more female than male opilio seen overall in the trawl gear, and that there were some large immature females present which was consistent with the NMFS trawl survey data. Tanner crab were also seen in the trawl gear but were more widely dispersed than opilio. Data have not yet been fully analyzed.

Scott outlined BSFRF's research strategy for 2025-28. BSFRF will be receiving research funds from the snow crab and BBRKC disaster relief spend plans that can be used to further study opilio, and results of the pilot project will inform the design of future studies. The objectives of these future studies are still being developed, but there will likely be a project in 2025. Bairdi funds should also be available shortly and will likely fund a PhD project and other research. BSFRF is planning on prioritizing crab research that is high on the Council's research priority list and coordinating funding with North Pacific Research Board (NPRB). One particular area of interest is unobserved fishing mortality.

Tanner crab final SAFE

William "Buck" Stockhausen (NOAA-AFSC Seattle) presented the final assessment for the Bering Sea Tanner crab for 2024. The Bering Sea Tanner crab fishery was open in both ADF&G management areas in 2023/24 with retained catch that was similar to the ADF&G TAC (344 t east, 597 t west). The 2024 NMFS survey biomass increased for all size-sex categories for Tanner crab in both the east and western area. Overall, this is the first sign in several years of a pseudo-cohort that has recruited to smaller size classes and then surviving and growing to larger sizes in subsequent years. This has been a persistent concern for this stock the last few assessments. The overall catch mortality was much less (1,090 t) than the 2023/24 OFL (36,200 t), therefore, overfishing did not occur. The 2024 assessment estimates this stock to be in Tier 3a ($B>B_{MSY}$), therefore the stock is not overfished.

As recommended by the CPT in May 2024, Buck brought forward an updated base model (22.03d) that included new 2018 BSFRF side-by-side (SBS) selectivity study data and an updated analysis for these data. Both the CPT and SSC recommended bringing this model forward in the May/June cycle, but requested that the author explain a parameter that was hitting bounds in the updated model and the differences in the SBS analysis output with the addition of new data. Appendix B summarizes these updated data, both the 2018 data point and the updated analysis, and the effects of these updates on the model.

The bridging analysis detailed in Appendix B for the BSFRF data explains that the GAM model fit to estimate BSFRF survey availability curves originally used a Gaussian error distribution, but the new analysis uses a binomial distribution. This change in GAM parameterization, along with the addition of the 2018 data, visibly changed the estimated empirical availability in 2017 and 2018 (see Figure 7, Appendix B). Estimates of annual availability for the BSFRF surveys from this new model were deemed more appropriate than previous estimates and were used in model 22.03d.

The author then walked the CPT through the annual data updates to model 22.03d since the May/June meetings, with a step-by-step process to incorporate each data source (Appendix C). Overall the model performed as expected from May 2024 with the addition of new survey, catch, and bycatch data. Besides new data inputs the only change to this model was fixing the effective sample size parameters for the

Dirichlet-Multinomial likelihoods used to fit the BSFRF size composition data to large values, with the result that the likelihoods were equivalent to multinomial likelihoods. The resulting model 22.03d5 is recommended for specification setting by the CPT. Buck also presented a Tier 4 fallback model and an associated ABC buffer recommendation.

Based on a jittering analysis, model 22.03d5 converged with no concerns and no estimated parameters hit bounds. Overall, this model is based on the previously adopted assessment model and fits similarly to the 2023 assessment. The model continues to overestimate large crab and the OFL appears wildly optimistic. Retrospective analysis revealed a pattern in recruitment, but the Mohn's rho for MMB was low compared to other crab stocks.

Specifications for model 22.03d5 result in an estimated OFL of 41.29 mt. The author and CPT recommended a 20% buffer, the same as 2023, for reasons similar to those expressed in 2023. Those reasons include: concern over model performance (the overly-optimistic nature of the model), concern over the appropriateness of $F_{35\%}$ and $B_{35\%}$ as metrics for a sustainable fishery (similar to snow crab issues, but less severe), and some remaining concern over the movement of recruits into larger size classes (although this concern was reduced in 2024).

The high priorities for future work includes completion of the BSFRF selectivity analysis to incorporate into the assessment model and work towards an acceptable GMACS Tanner crab model. The author plans to present work on both of these topics at the January Crab Modeling Workshop.

NSRKC proposed model runs

Toshihide “Hamachan” Hamazaki (ADF&G-Anchorage) presented proposed models for the 2025 final assessment for Norton Sound red king crab (NSRKC). Total fishery mortality in 2023/24 was 0.474 million lb, which is less than the ABC of 0.513 lb, so overfishing did not occur. Work since the January final assessment largely focused on transitioning the 2024 accepted model to GMACS, but also addressed SSC comments requesting more information on trawl survey data.

The assessment uses three survey data sources: the NMFS EBS trawl survey from 1976 – 1992, the ADF&G trawl survey from 1996 – present, and the NMFS NBS trawl survey from 2010 – present. NMFS surveys use a 83-112 eastern otter trawl net and target a 30 min tow, whereas the ADF&G survey uses a 400 eastern otter trawl net and is standardized to a 1 nm tow (~ 20 min). Survey grids for the historic NMFS survey and the ADF&G survey are 10 nm^2 (though covering different areas with some overlap), while the NBS survey uses a 20 nm^2 grid. The ADF&G survey spatial footprint has varied throughout the time series. In recent years, completing the survey in the core areas has been the priority of ADF&G, followed by tiered adjacent areas. The 2024 ADF&G survey covered all tier 1 stations and most core area stations. Not all core areas were sampled due to weather conditions and logistical constraints.

The GMACS model was based on the 2024 assessment base model (21.0), which has been in place for three cycles. The GMACS model contained six seasons which were aligned as best possible with the annual structure of model 21.0. To accommodate the summer surveys occurring during the summer fishery, Hamachan used variable timing of surveys all within season three of the GMACS model. The GMACS models fits to trawl survey and summer fishery standardized CPUE data were very close to

those of model 21.0. Size composition data also fit very closely, though both models fit poorly to NBS trawl survey size composition data. Fits to tagging data were also nearly identical between models. Size transition matrix and estimated selectivity closely followed model 21.0. Estimated abundance and MMB of the GMACS model were close to model 21.0; the GMACS estimated greater abundance and MMB in recent years. Uncertainty around MMB was similar to model 21.0.

Hamachan identified an issue with the GMACS implementation of the tier 4 F_{OFL} control when there are multiple directed fleets – each fleet was being assigned the full F_{OFL} resulting in an erroneously large OFL. Hamachan instead presented reference points that used GMACS terminal year MMB and the tier 4 reference point calculation which has been used by the NSRKC assessment previously (see SAFE document). All reference points and stock status were slightly higher for the GMACS model, though similar to model 21.0.

The CPT appreciated Hamachan's work to transition the model to GMACS and recommended that both models presented here be brought forward for the 2025 assessment, with the anticipation that the GMACS version will likely be accepted. Since the data for the final assessment were complete at this meeting, it was noted that the Plan Team could recommend final 2025 specifications at future September meetings should full data be available again, though more advanced public notice would need to be given.

For the final assessment at the upcoming November meeting the CPT requested the following:

- Plots separating fits to trawl survey indices
- Retrospective and jittering analysis of the GMACS model

Snow crab report card

Erin Fedewa (AFSC-Kodiak) and Brian Garber-Yonts (AFSC-Seattle) presented the most recent ecosystem and socioeconomic profile (ESP) for Bering Sea snow crab. The full ESP was completed in 2022 and since that time abbreviated report cards have been completed annually with updates. The ESPs are a standardized format for compiling and evaluating relevant stock-specific ecosystem and socioeconomic indicators and communicating linkages and potential drivers of the stock within the stock assessment process. The ESP process creates a traceable pathway from the initial development of indicators to management advice and serves as an on-ramp for developing ecosystem-linked stock assessments.

Ecosystem indicators are summarized across larval, juvenile, and adult life stages, and are collected from a variety of data sources including the NMFS trawl survey, satellites, oceanographic models, and fishery-dependent data. Erin brought forward two new ecosystem indicators for adult snow crab which include: 1) female reproductive potential defined as the proportion of primiparous mature female snow crab with full clutches, and 2) operational sex ratio defined as the ratio of large males (95 mm and greater) to mature female snow crab abundance throughout the EBS.

In 2024, ESP indicators highlight ecological and socioeconomic concerns for snow crab. Low chlorophyll-*a* concentrations in 2023 and 2024 and a less pronounced spring bloom indicate poor larval

feeding conditions and reduced food supply to the benthos. Juvenile snow crab energetic composition (% DWT) in 2024 remains high compared to the starvation-level conditions observed in 2019 during the snow crab population collapse. Temperatures occupied by juvenile snow crab in 2024 were less than 1 °C and indicate the return of cold water habitat critical for recruitment. Pacific cod consumption in 2023 was low and visual prevalence of bitter crab disease (BCD) was low in 2023 and 2024. Erin noted that 2024 Pacific cod stomachs are still being processed, and that Pacific cod predation on snow crab is likely higher outside the summer sampling period, which is consistent with anecdotal observations from the fishing fleet. Pacific cod predation has been an important indicator for snow crab and Buck Stockhausen (AFSC-Seattle) requested this information also be available for Tanner crab. New information on BCD prevalence using molecular PCR assays indicates that visual diagnostic methods may substantially underestimate BCD prevalence. There was a decline in spatial extent and southward shift of the center of abundance of mature male snow crab, which is consistent with a depressed abundance of large males that are occupying a smaller space on the shelf. Ninety percent of females had full clutches in 2024, which is about the long-term mean for this new measure of reproductive capacity. The operational sex ratio is skewed heavily towards females. Overall, the status of ecosystem indicators for 2024 were neutral, emphasizing the return of cold-water conditions and ecosystem stabilization following the 2018-2019 marine heatwave. The suite of ecosystem indicators were compared across years using a traffic light table that evaluates the current year trends compared to previous years, and the traffic light table, overall, indicates largely neutral conditions as a result of a return to average conditions.

Due to the continued closure of the snow crab fishery since the 2022/23 season, a second year of missing values for most socioeconomic indicators does not adequately capture the worsening social and economic stresses experienced by the crab industry and associated communities. The ongoing economic pressure on the crab industry and stakeholder communities necessitate improved data collection and analyses to guide future management decisions. Socioeconomic indicators in the snow crab ESP highlight the added difficulty in communicating vulnerabilities associated with declining TACs and fishery closures within the ESP framework. The CPT recommended that fishery performance and economic indicators need to be updated to reflect negative impacts as a result of the snow crab fishery collapse and continued fishery closures.

Snow Crab final SAFE

Cody Szuwalski (AFSC-Seattle) presented the final SAFE for Bering Sea snow crab. Cody began his presentation by reviewing current indicators of stock status. While the survey-estimated biomass of industry-preferred males (≥102 mm carapace width [CW]) is up slightly from last year, it is at the fourth-lowest value in the time series, and the last eight years are the lowest eight years on record. However, there are encouraging signs of smaller males entering the population. The 2024 survey also returned surprising and generally positive results for females, with immature female abundance at an all-time high, and a particularly high abundance of larger females (mode ~60 mm CW). Most of these larger-bodied females were still immature, and a preponderance of immature females at this size has not been previously observed in the survey. Recruitment of both males and females has been very strong in recent years.

Cody also reviewed decadal-scale trends for the stock (i.e., at a longer time scale than the post-2021 collapse dynamics that have dominated considerations for this stock in recent years). These trends indicate both positive and cautionary interpretations of stock status. On the positive side, both female biomass and total male biomass have been relatively stable at decadal time scales. On the more cautionary side, the biomass of industry-preferred males has persistently declined since the high point of the 1990s, and total male biomass and industry-preferred biomass have been on divergent trends since about 2015. There has also been a steady decline in CPUE since the fishery was rationalized. There have also been recent suggestions of density-dependence in size at maturity, with a higher probability of molting to maturity at smaller-than-normal sizes for males in recent years, coinciding with the low abundance of larger mature males in the population. The CPT noted that this suggestion of density dependence is supported by Canadian research (Mullowney and Baker 2021) demonstrating an inverse relationship between average size at maturity and the abundance of large males in the population. Estimated exploitation rates for Bering Sea snow crab have been increasing since the early 2000s and exceeded 75% for males >105 mm CW in 2019 and 2020.

Cody brought forward five models for evaluation. Model 23.1 is last year's accepted model, and 24.1 is the same model with updated data. Models 24.1a, 24.1b, and 24.1c are all based on the same formulation in GMACS, with differences in the currency of management and selection of B_{MSY} proxy. Model 24.1a corrects an issue with the indexing of molting probabilities in 24.1, uses the biomass of morphometrically mature males as the currency of management, and $B_{35\%}$ as the B_{MSY} proxy. Model 24.1b is model 24.1a, but uses the biomass of males ≥95 mm CW (i.e., a proxy for functional maturity based on research in the Gulf of St. Lawrence) as the currency of management. Model 24.1c is model 24.1b, but uses $B_{45\%}$ as the B_{MSY} proxy.

In addition, Cody brought forward two Tier 4 "fallback" options that use REMA fits to the survey time series estimates of MMB. Both of these options use the biomass of industry-preferred males as the currency of management and M as the proxy for F_{MSY}. Tier 4 "author" uses the sloping harvest control rule from the crab FMP with the average biomass from 1982-2022 as a B_{MSY} proxy and also decrements survey biomass by a prorated fraction of M prior to the fishery. Tier 4 "SSC" does not use the harvest control rule from the FMP and does not decrement biomass by M over the period between the survey and the fishery. Cody noted that using M as a proxy for F_{MSY} to derive harvest specs from the GMACS model is a poor option, as the fisheries selectivity curve would apply this mortality to a small proportion of the population, potentially resulting in an exploitation rate that is not equivalent to natural mortality for smaller size classes of exploitable males. He did not bring this option forward for consideration by CPT.

Cody then presented concerns over the performance of the GMACS model that serves as the basis for managing the stock under Tier 3. First, a poor fit to the male survey size comps in recent years results in a strong underestimate of industry-preferred survey biomass in 2024 (the model estimates approximately 20% of the survey point estimate). In addition, jittering produced a larger-than-expected scatter in management quantities, with only a single jitter run converging to the lowest negative log likelihood. The cause of this result is unclear and under investigation. Cody indicated that this convergence result was a lower-level concern in terms of accepting the model for use in management than was the poor fit to the size comps.

The author presented an analysis for informing the selection of the B_{MSY} proxy given uncertainty over the size of functional male maturity in this stock (i.e., the size at which males successfully reproduce). Snow crab undergo a terminal molt to maturity, after which they cease growing. In many years, the size at 50% maturity may be as small as 70 mm CW, much smaller than the size of males exploited by the fishery (≥102 mm CW). Because of this disconnect, a large fraction of the morphometrically mature males in the population are protected from ever being retained by the fishery, and F is applied disproportionately to the largest size classes, potentially resulting in very high exploitation rates on the largest males in the population. Because the size of functional maturity in the Bering Sea is unknown, there is concern that high exploitation rates on the largest males may be deleterious.

Cody addressed uncertainty over the size of functional maturity, and the implications for selection of a B_{MSY} proxy, using an extension of the Clark (1991) yield curve analysis that was originally used to establish $B_{35\%}$ as the proxy for B_{MSY} in BSAI crab stocks (Appendix A). He calculated two solutions for the yield curve analysis, one for a scenario in which morphometrically mature males determine recruitment and one in which males ≥95 CW mm determine recruitment. The 95 mm threshold is assumed to be a reasonable proxy for size at functional maturity based on a single Canadian study that observed mating pairs *in situ* (Conan and Comeau, 1986). Yield curves derived from the morphometrically mature spawners supported aggressive harvest rates, suggesting the "maximin" solution for B_{MSY} (the maximum of the minimum sustained yield given uncertainty over multiple spawner-recruit relationships) occurred at ~13% of unfished spawning biomass per recruit [SPBR]. Cody noted that if morphometric maturity is used as the currency of management, it is impossible to reach this proxy value of B_{MSY}; even removing all of the industry-preferred males from the population will not reduce MMB to B_{MSY}. Curves based on functionally mature spawners resulted in maximin B_{MSY} at ~48% of unfished SBPR. Overlaying yield curves from the two maturity definitions resulted in a maxmin of ~45%.

Cody then led the CPT through the considerations affecting the choices among the three models for managing the stock in Tier 3, or the two "fallback" options for managing in Tier 4. Model 24.1a (morphometric maturity and $B_{35\%}$) was plagued by the issue that has affected management using this currency during recent years. The disconnect between size at morphometric maturity and the fisheries selectivity curve means that even a 65% ABC buffer on the OFL from model 24.1a would result in an OFL equal to the biomass of all of the large males estimated by the model. On the other hand, changing the currency to functional maturity resulted in very conservative management outcomes for models 24.1b and 24.1c. Both models estimate MMB below 25% of B_{MSY}, and would result in bycatch-only OFLs. Management under model 24.1b would have resulted in an "overfished" declaration for the stock in 2014, and would have closed the fishery since 2018.

The Tier 4 "author" approach would result in an OFL of 660 t. This was the author's preferred alternative. This recommendation was justified both on concern over performance of the GMACS model (as outlined above) and concern over the very conservative management outcomes of models 24.1b and 24.1c.

In making its recommendations for setting reference points, the CPT first took up the issue of the best currency of management. The CPT voiced concern over the very high ABC buffers that appear to be necessary to produce reasonable values of F for the fully selected portion of the stock now that the probability of undergoing terminal molt is well captured by the model. Discussion centered on the selection of the ABC buffer in this situation as being largely arbitrary, and it was felt that the continued

use of large buffers was a poor approach for addressing the disconnect between typical size at morphometric maturity and selectivity by the fishery. The CPT recommended changing the currency of management to Cody's preferred proxy for functional maturity (≥95 mm CW). This recommendation is based on: 1) the Canadian study indicating that small mature males (<95 mm CW) were excluded from mating by larger mature males; 2) indications from Canadian research, supported by recent EBS survey results, that size at the terminal molt to maturity is density-dependent and inversely related to the abundance of larger males in the population; 3) long-term declines in CPUE and the biomass of large males in the population, and 4) the desire to focus management on the fraction of the male population that the fishery interacts with.

The CPT highlighted several considerations that underlie this recommendation for a change in currency. There are two overarching considerations that drive the recommendation to change the currency of management to ≥95 mm CW. The first is the uncertainty over the actual size of functional mortality, and barring limited research from Canada there is little data to inform that definition for the Bering Sea stock. The second consideration is the decline in large males over time, and the relative increase in smaller mature males. There is less uncertainty for this point - both the survey data and directed fishery CPUE clearly document the decline in industry-preferred biomass. Members of the CPT voiced concern that status quo approaches based on morphometric maturity as the currency for MMB creates a situation where impacts on the stock, and particularly on the industry-preferred size classes, can be underestimated. The CPT also discussed the very unusual increase in abundance of immature, large (mode ~ 60mm CW) females in the 2024 survey in the context of the availability of large males for mating in the coming year.

The CPT then took up the decision of either continuing to manage the stock in Tier 3 based on estimates from the GMACS model, or to utilize the Tier 4 fallback. The CPT requested a version of Tier 4 "author" using >95 mm CW as the definition of MMB in order to have choices for Tier 3 and Tier 4 using the same currency of management, and Cody provided this Tier 4 analysis. Ultimately, the CPT decided that the decision of using a Tier 4 "fallback" should be reserved for situations where there are extreme problems with a Tier 3 modeling approach that preclude useful biomass estimates from the model. The CPT appreciated Cody's description of the shortcomings of the current iteration of GMACS, but ultimately decided that these shortcomings were not very severe, and that the current model performs quite well when compared with the range of population dynamics models that the CPT uses. This is particularly true given the work that Cody has accomplished in recent years to improve the treatment of survey selectivity and terminal molt probabilities. The decision was therefore made to retain GMACS for setting specs, and not to utilize the Tier 4 fallback option.

While the CPT was careful to make the decisions that were scientifically most defensible when making these recommendations, there was also discussion of the management outcomes that these decisions would imply. The CPT did not enter into a direct conversation about the relative merit of one set of management outcomes or another. But concern was again noted over the long-term declines in both CPUE and the abundance of large males, which might indicate that past exploitation rates on large males have been too high to maintain a steady abundance of industry-preferred sizes in the population.

The CPT then took up the issue of the B_{MSY} proxy. Some concern was expressed by CPT members as to whether MSY in Cody's analysis might have been contingent on evaluating spawner-recruit relationships with the strongest density dependence, when the available evidence was most consistent with weak

density dependence, if any. However, there were also expressions of satisfaction with the analysis that was presented, both in terms of being consistent with the task outlined by the CPT and SSC at the May/June 2024 meetings, and in terms of providing a clear rationale for changing the B_{MSY} proxy to $B_{45\%}$ if the currency of management is changed to ≥ 95 mm CW. Ultimately, though the CPT hesitated to recommend two major changes to management in the same year, and recommended retaining $B_{35\%}$ as the B_{MSY} proxy. The CPT recommends continued evaluation of the information that would be required to change the B_{MSY} proxy.

The choice of ≥95 mm CW as the currency, along with a B_{MSY} proxy of $B_{35\%}$, led the CPT to recommend model 24.1b. This model estimates MMB at time of mating at 11.3 kt, which is below the 25% of B_{MSY} threshold for opening the directed fishery. The bycatch only-OFL from this model as originally presented to the CPT was 50 t. However, a member of the CPT noted that the FMP does not provide specific guidance as to the selection of reference years for bycatch fishing mortalities (F) that inform the proportion of the total F_{OFL} that is attributed to bycatch for the OFL projections. It was noted that positive biomass trends for the Tanner crab stock west of 166°W longitude, along with a distribution to the north and west of what has been historically typical for Tanners, implies the potential for increased snow crab bycatch in the 2024/25 Tanner crab fishery. The CPT requested that the author provide an addendum to the SAFE that used a year with high bycatch in the Tanner crab fishery, such as 2015, for use in the projections for setting the OFL. This information will be available to the SSC when reviewing CPT recommendations, but the different OFL values that might be possible using model 24.1b were not evaluated at the CPT meeting.

The CPT recognizes that the questions surrounding the currency of management and selection of a B_{MSY} proxy are likely best addressed in a MSE (Management Strategy Evaluation). The CPT also requests guidance on the information that would be needed to evaluate a proposed change in currency of management if the SSC does not recommend that change in this cycle.

Finally, the author brought forward a draft risk table for organizing information to inform the selection of an ABC buffer for the stock. In the Assessment category, he highlighted recent improvements in the model depiction of snow crab biology as a positive consideration. As negative considerations he highlighted uncertainty over the currency of management and B_{MSY} proxy, poor fits to recent male size comps, and concerning jittering results. He scored this category as “increased concern”. For the Population Dynamics category he highlighted the downward trajectory of large male biomass, the recent population collapse, and evidence of density-dependent effects on terminal molt dynamics as negative considerations, and highlighted this category as an “extreme concern”. For the Environmental/Ecosystem category he highlighted mostly neutral ESP scores as justification for a “normal” score. And for the Fishery Performance category he highlighted long-term declines in CPUE and recent fishery closures as the justification for an “extreme concern” score.

The CPT discussed these scores and determined that the sources of uncertainty that were present last year were largely continued this year. Accordingly, the CPT recommended that the 20% ABC buffer that was recommended last year be retained this year. This results in a recommended ABC of 40 t, based on the 50 t OFL from model 24.1b, though as noted above the CPT requested that OFL and ABC values calculated with different input bycatch data years be brought forward as an addendum to the SAFE for consideration by the SSC.

Research updates

Jared Weems (ADF&G-Kodiak) presented preliminary results from a NPRB-funded project examining RKC settlement in Bristol Bay. Motivation for the study was driven by decade-long declines in BBRKC recruitment, which may point to early life history bottlenecks such as larval/juvenile supply and settlement habitat availability. Primary objectives of the project include: 1) characterizing settlement habitat using benthic image analysis from a CamSled; and 2) quantifying post-larval red king crab supply using artificial collectors. Additional project objectives include supporting data collection such as oceanography and ocean acidification data, pelagic larval sampling, sediment grain size, benthic infaunal community characterization, and BBRKC female tagging. Field work in 2024 consisted of a spring charter where artificial collectors and the Camsled were deployed, and a fall charter to retrieve artificial collectors.

Spring deployment of the CamSled consisted of 34 station tows for sea floor image transects, and Jared showed photos of the first direct scientific evidence of juvenile podding behavior in BBRKC. Overall, the CamSled performed well, observing BBRKC mating pairs, vertical habitat structure, and groundfish and flatfish. Forty-eight artificial collectors were also deployed on the spring survey, and 40 were recovered during the fall survey. In total, the collectors caught 1,558 individual juvenile RKC, 94% of which were found in the NE Bristol Bay region. Collectors also caught 38 age-1 BBRKC, indicating that artificial habitats are still useful to assess age-1 RKC distribution. Jared mentioned that preliminary "predator tag" deployment and glider detection was successful on a small sample size of juvenile RKC tagged. Overall, the project suggests potential for the development of a BBRKC recruitment index.

Sean Hardison (UAF/NOAA-AFSC Kodiak) provided a research update on improving seasonal predictions of BBRKC spatial distributions with movement-integrated Species Distribution Models (SDMs). This project specifically aims to resolve seasonal BBRKC distributions when groundfish fisheries are operating to inform understanding of unobserved fishing mortality. Sean emphasized that movement-integrated SDMs are a useful tool for deriving fishery independent projections of distributions throughout the year, and are developed by combining an SDM from survey data, and a movement model from BBRKC tagging data. The instantaneous movement matrix accounts for drift, taxis, and diffusion. Habitat preference functions are estimated from observed movement of tagged crab in relation to depth and bottom temperature.

Using movement data from 37 mature male RKC tagged in June 2023 and released in October 2023, the hybrid SDM approach was used to project summer 2023 crab densities into fall using a depth and bottom temperature interaction. Sean presented a spatial map of preferred fall habitat, and noted the directional southwest movement of mature males from summer to fall to deeper waters and preferred thermal habitats (~4°C). Results using projected fall densities indicate a net movement of mature males into the RKCSA in Fall 2023, and display high agreement between model projections and observed catches during the October BBRKC directed fishery. Overall, movement-integrated SDMs gave reasonable projections of mature male BBRKC densities in the fall, and highlight the value in continued BBRKC tagging efforts. Future directions include applying the approach to a more extensive mature female tagging dataset, and evaluating overlap with BBRKC and fishing gear.

The CPT appreciates the important and timely research projects being pursued by Jared and Sean, and looks forward to continued updates on both projects.

Disaster relief research funding update

Chris Siddon (ADF&G-Juneau) presented the CPT with a brief overview of the upcoming request for research proposals as part of the crab disaster relief funds. The request for proposals will be live soon on the ADF&G website with a proposal deadline of January 21, 4:00pm AKST. Funding is anticipated to be available starting June 1, 2025, and run through October 31, 2028.

The request for proposals (RFP) is not yet active. When available, it can be found on the ADF&G website under Federal Fishery Disasters. NPRB is contracted to administer proposal review and therefore the proposal format and process will be very similar to that of the regular NPRB RFP. The disaster relief RFP will identify a total of $6 million in research funding, with a maximum budget for any one project of $1.5 million. In addition to the $6 million RFP, an additional ~$10 million of funding for vessel expenses has already been allocated through the disaster relief spend plan. Coordination with BSFRF, which is organizing the vessel time, is essential for those proposals seeking to conduct at-sea sampling. For that reason, proposals will be required to have a letter of acknowledgement from BSFRF that they have contacted them to coordinate vessel usage.

Research priorities for these proposals are listed as part of the RFP, and priorities that have been identified by the CPT and the Council research prioritization process. Additionally, this funding is designed to go towards research that improves management of the snow crab and BBRKC stocks in the Bering Sea, and assists in preventing future disasters. Projects that fund graduate students and postdocs are highly encouraged to help build capacity in the Alaska crab research community.

Draft risk table overview

At this meeting the CPT reviewed draft risk tables for the three main Bering Sea stocks - snow, Tanner, and BBRKC. During this review several key questions and decision points came up that the CPT felt would be better addressed through a separate agenda item in May 2025. At the May meeting the CPT can work to develop a set of SOPs for crab risk tables.

Some of discussion on the draft risk tables centered around: 1) what information sources should be used for the risk tables (specifically including information from ESRs and ESPs) and which groups should be part of that discussion; 2) how to standardize scoring among crab assessments; and 3) if the scoring should be directly related to the buffer level in a systematic way. Instead of rushing through this discussion at this meeting, CPT plans to have a thorough discussion of this process in May with the goal of recommending general guidelines for all crab assessments.

January modeling workshop

The CPT plans to once again hold a modeling workshop in 2025, tentatively scheduled for the week of January 13 at the NPFMC offices in Anchorage. The following topics were identified for that workshop:

- A comparison of sdmTMB and VAST for constructing model-based indices of survey data. This comparison is expected to be conducted for NSRKC, SMBKC, and Tanner crab, and will be a collaborative effort between ADF&G-Juneau and NOAA-Kodiak biologists. The CPT discussed previous comparisons for groundfish surveys that will likely serve as a template for model evaluation approaches.
- GMACS coding updates and model developments
- NSRKC OFL calculations
- Simulations using GMACS (Tyler, Buck)
- Review versions of GMACS and confirm version control guidance
- GMACS updates task list
- Guidelines for diagnostics and plotting for jitter run results and MCMC
- BSFRF SBS selectivity (Buck)

New Business

Upcoming CPT meeting dates and locations:

- Nov 5th, 2024: virtual meeting to approve NSRKC final specs (morning)
- Jan 14th - 16th, 2025: modeling workshop, no CPT meeting, Anchorage, AK (NPFMC office)
- May 12th - 16th, 2025: Kodiak
- Sept 8th-12th, 2025: Seattle, WA (AFSC)

CPT members were informed that there will be an Interagency crab meeting hosted by ADF&G and NMFS staff on **Nov. 20th, held virtually**. Information on the meeting and sign up can be found below.
Interagency crab meeting info:
This is an informal opportunity for crab researchers and managers throughout the State to share ideas. We invite presentations on research updates, survey plans or methods, management practices or tools, or just general sharing of knowledge on Alaska crab stocks.

The objective of this meeting is to bring together crab biologists, researchers, and managers to share ideas and build collaborations throughout the State. At this time of changing ecosystem conditions and crisis for many of our crab stocks, building collaborations and sharing ideas is vital to the future of our crab fisheries throughout the State.

The meeting will be Wednesday, November 20; interest in the meeting will drive the agenda, and depending on interest this is expected to be a full-day meeting. We are hoping to have presentations followed by a pointed discussion at the end of the day to encourage future collaboration. Each presentation will be 10-12 minutes with 3-5 minutes for questions.

Please sign up for the meeting with this spreadsheet on Google docs (name, agency, presentation topic-if you want to do one). The deadline to sign up to present is October 21 COB:

Register to attend or present here: https://forms.gle/hxxNMeU883uQMYBTA

May CPT agenda topics:

- Survey modernization update
- Update on sdTMB/ integrated index from Jan modeling (T)
- Tanner crab ESP (T)
- Second stage indicator analysis ESP
- Risk table SOP discussion
- BSFRF update
- Research updates
- AIGKC Final SAFE
- Proposed models:
    - Tanner
    - Snow
    - BBRKC
    - PIRKC
    - PIBKC

Others in attendance: *(alphabetical order)*

Grant Adams
Rachel Alinsunurin
Kerim Aydin
Asia Beder
Jennifer Bell
Scott Campbell
Louise Copeman
Maria Davis
Sherri Dressel
Darcy Dugan
Austin Estabrooks
Diana Evans
Lance Farr
Bridget Ferriss
John Gauvin
Jamie Goen
Scott Goodman*
Jeffery Groenke
Gretar Gudmundsson
George Hall
Melissa Haltuch
Toshihide Hamazaki*
Dana Hanselman
Sean Hardison*
Abigail Harley
Madi Heller-Shipley
Mark Henkel
Shannon Hennessey
Kendall Henry
Charlie Hensel
Lenny Herzog
John Hilsinger
AM Hopkins
Tom Hurst
Jim Ianelli
Wes Jones
Kevin Kaldestad
Frank Kelty
Nicole Kimball
Linda Kozak
Anita Kroska
Gordon Kruse
Lynn Langford Walton
Tim Loher
Oystein Lone
Stephanie Madsen
Heather Mann
Emily Markowitz
Connie Melovidov
Danielle Merculief
Sarah Mincks
Steven Minor
Harrison Moore
Franz Mueter
Andy Nault
Nat Nicols
Ivonne Ortiz*
Mateo Paz-Soldan
Edward Poulsen
Landry Price
Fabio Prior Caltabellotta
Jeff Regnart
Jacob Resneck
Steve Ricci
John Richar
Jon Richew
Jan Rumble
Emily Ryznar
Nick Sagalkin
Rachel Sapin
Mike Shelford
Madison Shipley
Kalei Shotwell
Chris Siddon*
Elizabeth Siddon*
Joletta Silva
Nickolai Sivertstol
Joshua Songstad
Gary Stauffer
George Steers
Rachel Stein
Kirsten Steinke
Caitlin Stern*
Mark Stichert
Erin Strand
Diana Stram
Anne Vanek
Vicki Vanek
Sophia Wasserman
Sarah Webster
Jared Weems*
Ernie Weiss
Doug Wells
Bo Whiteside
Clair Widing
Paul Wilkins
Chris Woodley
Noelle Yochum
Stephani Zador
Intrafish media
KING 5 TV

*** Denotes a presenter at CPT**