

Stock Assessment and Fishery Evaluation Report for the
KING AND TANNER CRAB FISHERIES
of the
Bering Sea and Aleutian Islands Regions

2024 Final Crab SAFE

Compiled by

The Plan Team for the King and Tanner Crab Fisheries of
the Bering Sea and Aleutian Islands

With Contributions by

W. Bechtol, B. Daly, G. Eckert, E. Fedewa, B. Garber-Yonts, T. Hamazaki, T.
Jackson, A. Kroska, M. Litzow, K. Milani, E. Nichols, A. Olson, K. Palof, A.E.
Punt, S. Siddeek, W. Stockhausen, D. Stram, and C. Szuwalski

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North Pacific Fishery Management Council

1007 West Third, Suite 400
Anchorage, AK 99501-2252

For definition of acronyms and abbreviations, see online list: <https://www.npfmc.org/library/acronyms>

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Introduction

The annual stock assessment and fishery evaluation (SAFE) report is a requirement of the North Pacific Fishery Management Council's *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs* (FMP), and a federal requirement [50 CFR Section 602.12(e)]. The SAFE report summarizes the current biological and economic status of fisheries, total allowable catch (TAC) or Guideline Harvest Level (GHL), and analytical information used for management decisions. Additional information on Bering Sea/Aleutian Islands (BSAI) king and Tanner crab is available on the National Marine Fisheries Service (NMFS) web page at <https://www.fisheries.noaa.gov/about/alaska-regional-office> and the Alaska Department of Fish and Game (ADF&G) Shellfish web page at: <http://www.adfg.alaska.gov/index.cfm?adfg=CommercialByFisheryShellfish.main>.

Paralithodes camtschaticus, stocks (Bristol Bay, Pribilof Islands, Norton Sound and Adak), 2 blue king crab, *Paralithodes platypus*, stocks (Pribilof Islands and St Matthew Island), 2 golden (or brown) king crab, *Lithodes aequispinus*, stocks (Aleutian Islands and Pribilof Islands), southern Tanner crab *Chionoecetes bairdi* hereafter referred to as Tanner crab, and snow crab *Chionoecetes opilio*. All other crab stocks in the BSAI are exclusively managed by the State of Alaska (SOA).

The Crab Plan Team (CPT) annually assembles the SAFE report with contributions from ADF&G and the NMFS. This SAFE report is presented to the North Pacific Fishery Management Council (NPFMC) and is available to the public on the NPFMC web page at: <https://www.npfmc.org/fisheries/bsai-crab/>. Due to a process to accommodate specific fishery and data availability needs to determine overfishing level (OFL) determinations, and annual catch limit (ACL) requirements, the CPT reviews assessments in a staggered time frame. Additionally, based upon consideration of stock prioritization including assessment methods and data availability, some stocks are assessed on an annual basis while others are assessed less frequently. The CPT reviews one assessment in January (Norton Sound red king crab), three assessments in May (Aleutian Islands golden king crab, Western Aleutian Islands (WAI) red king crab and Pribilof Islands golden king crab) and the remaining assessments (Bristol Bay red king crab, EBS snow crab, EBS Tanner crab, Saint Matthew Island blue king crab, Pribilof Islands red king crab and Pribilof Islands blue king crab) in September (Table 1). Pribilof Islands red king crab, WAI red king crab and Pribilof Islands golden king crab are assessed triennially, while Pribilof Islands blue king crab and Saint Matthew Island blue king crab are assessed biennially. Stocks can be assessed more frequently on a case-by-case basis should data indicate that it is necessary.

Table 1: Ten BSAI crab stocks: Schedule for review by the CPT and SSC and Assessment frequency

| Stock | CPT review and recommendations to SSC | SSC review and recommendations to Council | Assessment frequency | Year of next Assessment |
|---|---------------------------------------|---|----------------------|-------------------------|
| Norton Sound red king crab (NSRKC) | January | February | Annual | 2025 |
| Aleutian Is. golden king crab (AIGKC) | May | June | Annual | 2025 |
| Pribilof Is. golden king crab (PIGKC) | May | June | Triennial | 2026 |
| Western Aleutian Is. red king crab (WAIRKC) | May | June | Triennial | 2026 |
| EBS snow crab | September | October | Annual | 2025 |
| Bristol Bay red king crab (BBRKC) | September | October | Annual | 2025 |
| EBS Tanner crab | September | October | Annual | 2025 |
| Pribilof Is. red king crab (PIRKC) | September | October | Triennial | 2025 |
| Pribilof Is. blue king crab (PIBKC) | September | October | Biennial | 2025 |
| Saint Matthew blue king crab (SMBKC) | September | October | Biennial | 2026 |

Based upon the assessment frequency described in Table 1, the CPT provides recommendations on OFL, acceptable biological catch (ABC) and stock status specifications for review by the NPFMC Science and Statistical Committee (SSC) in February (NSRKC) and June (WAIRKC, PIGKC, AIGKC) and October (BBRKC, EBS Snow crab, EBS Tanner crab, SMBKC, PIRKC, PIBKC). The rationale for this staggered review process is the following: The stocks with summer fisheries as well as those established on catch data only have specifications set in June. The stocks that employ data from the EBS NMFS trawl survey thus cannot be assessed until survey data are available in early September. Summer catch data for NSRKC however are not available in time for fall specifications, nor is assessing this stock with the June timing feasible as the CDQ fishery can open as early as May thus this stock is assessed in the winter. Additional information on the OFL and ABC determination process is contained in this report.

The CPT met from September 9-12, 2024, to review the final stock assessments as well as additional related issues, in order to provide the recommendations and status determinations contained in this SAFE report. This final 2024 Crab SAFE report contains recommendations for all 10 stocks including those whose OFL and ABC were previously determined in February and June 2024. This SAFE report will be presented to the NPFMC in October 2024 for their annual review of the status of BSAI Crab stocks.

These reviews were attended by almost the entire membership of the CPT: Mike Litzow (Co-Chair), Katie Palof (Co-Chair), Anita Kroska (Coordinator), William Bechtol, Ben Daly, Ginny Eckert, Erin Fedewa, Brian Garber-Yonts, Tyler Jackson, Krista Milani, Ethan Nicols, A. Olson, William Stockhausen, and Cody Szuwalski.

Stock Status Definitions

The FMP (incorporating all changes made following adoption of Amendment 24) contains the following stock status definitions:

Acceptable biological catch (ABC) is a level of annual catch of a stock that accounts for the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty and is set to prevent, with a greater than 50 percent probability, the OFL from being exceeded. The ABC is set below the OFL.

ABC Control Rule is the specified approach in the five-tier system for setting the maximum permissible ABC for each stock as a function of the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty.

Annual catch limit (ACL) is the level of annual catch of a stock that serves as the basis for invoking accountability measures. For EBS crab stocks, the ACL will be set at the ABC.

Total allowable catch (TAC) is the annual catch target for the directed fishery for a stock, set to prevent exceeding the ACL for that stock and in accordance with section 8.2.2 of the FMP.

Guideline harvest level (GHL) means the preseason estimated level of allowable fish harvest which will not jeopardize the sustained yield of the fish stocks. A GHL may be expressed as a range of allowable harvests for a species or species group of crab for each registration area, district, subdistrict, or section.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available.

F_{MSY} control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.

B_{MSY} stock size is the biomass that results from fishing at constant F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Maximum fishing mortality threshold (MFMT) is defined by the F_{OFL} control rule and is expressed as the fishing mortality rate.

Minimum stock size threshold (MSST) is one half the B_{MSY} stock size.

Overfished is determined by comparing annual biomass estimates to the established MSST. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. For crab stocks, biomass for determining overfished status is estimated on February 15 of the completed fishing year and compared to the MSST from the most recent accepted assessment.

Overfishing is defined as any amount of catch in excess of the overfishing level (OFL). The OFL is calculated by applying abundance estimates to the F_{OFL} control rule which is annually estimated according to the tier system (see Chapter 6.0 in the FMP).

Status Determination Criteria

The FMP defines the following status determination criteria and the process by which these are defined following adoption of amendment 24 and 38.

Status determination criteria for crab stocks are calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criteria and ABC levels for most stocks are annually formulated. The ACL for each stock equals the ABC for that stock. Each crab stock is annually assessed to determine its status and whether (1) overfishing is occurring or the rate or level of fishing mortality for the stock is approaching overfishing, (2) the stock is overfished, or the stock is approaching an overfished condition, and (3) the catch has exceeded the ACL.

For crab stocks, the OFL equals the maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Overfishing is determined by comparing the OFL with the estimated total catch mortality for the most recently completed crab fishing year. Catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL will be set for and compared to the retained catch.

Overfished status is determined using the MMB estimate at the time of mating in the previous fishing year and the Minimum Stock Size Threshold (MSST). These quantities are estimated from the current stock assessment. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. MSSTs or proxies are set for stocks in Tiers 1-4. For Tier 5 stocks, it is not possible to set an MSST because there are no reliable estimates of biomass.

If overfishing occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the NPFMC to immediately end overfishing and rebuild affected stocks.

The Magnuson-Stevens Act requires that FMPs include accountability measures to prevent ACLs from being exceeded and to correct overages of the ACL if they do occur. Accountability measures to prevent TACs and GHs from being exceeded have been used under this FMP for the management of the BSAI crab fisheries and will continue to be used to prevent ACLs from being exceeded. These include: individual fishing quotas and the measures to ensure that individual fishing quotas are not exceeded, measures to minimize crab bycatch in directed crab fisheries, and monitoring and catch accounting measures. Accountability measures in the harvest specification process include downward adjustments to the ACL and TAC in the fishing year after an ACL has been exceeded.

Annually, the NPFMC, SSC, and CPT will review (1) the stock assessment documents, (2) the OFLs and ABCs, and TACs or GHs, (3) NMFS's determination of whether overfishing occurred in the previous crab fishing year, (4) NMFS's determination of whether any stocks are overfished and (5) NMFS's determination of whether catch exceeded the ACL in the previous crab fishing year.

Optimum yield is defined in Chapter 4 of the FMP. Information pertaining to economic, social and ecological factors relevant to the determination of optimum yield is provided in several sections of the FMP, including sections 7.2 (Management Objectives), Chapter 11, Appendix D (Biological and Environmental Characteristics of the Resource), and Appendix H (Community Profiles).

For each crab fishery, the optimum yield range is 0 to $<$ OFL catch. For crab stocks, the OFL is the annualized MSY and is derived through the annual assessment process, under the framework of the tier system. Recognizing the relatively volatile reproductive potential of crab stocks, the cooperative management structure of the FMP, and the past practice of restricting or even prohibiting directed harvests of some stocks out of ecological considerations, this optimum yield range is intended to facilitate the achievement of the biological objectives and economic and social objectives of the FMP (see sections 7.2.1 and 7.2.2) under a variety of future biological and ecological conditions. It enables the SOA to determine the appropriate TAC levels below the OFL to prevent overfishing or address other biological concerns that may affect the reproductive potential of a stock but that are not reflected in the OFL itself. Under FMP section 8.2.2, the SOA establishes TACs at levels that maximize harvests, and associated economic and social benefits, when biological and ecological conditions warrant doing so.

Five-Tier System

Fisheries specifications, OFL and ABC, are set using the fishing mortality rate associated with the OFL (F_{OFL}) as estimated from the current assessment, compared with MMB projected forward to the time of mating in the next fishing season. This approach was established in 2007 and was modeled after the groundfish assessment process. The OFL and ABC for each stock are estimated for the upcoming crab fishing year using the five-tier system, detailed in Table 2 and Table 3. First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the CPT process to the SSC. The SSC recommends tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the proposed OFLs and ABCs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the determination of stock status level is based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the F_{OFL} . Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 2). The F_{MSY} control rule reduces the F_{OFL} as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the B_{MSY} . For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β).

In stock status level "c," the ratio of current biomass to B_{MSY} (or a proxy for B_{MSY}) is below β . At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the MSST.

For Tiers 1 through 3, the coefficient α is set at a default value of 0.1, and β set at a default value of 0.25, with the understanding that the SSC may recommend different values for a specific stock or stock complex as merited by the best available scientific information.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ , are used in the calculation of the F_{OFL} .

In Tier 5, the OFL is specified in terms of an average catch value over an historical time period, unless the SSC recommends an alternative value based on the best available scientific information.

First, the assessment author prepares the stock assessment and calculates the proposed OFLs by applying the F_{OFL} and using the most recent abundance estimates. The assessment authors calculate the proposed ABCs by applying the ABC control rule to the proposed OFL.

Stock assessment documents shall:

- use risk-neutral assumptions;
- specify how the probability distribution of the OFL used in the ABC control rule is calculated for each stock; and
- specify the factors influencing scientific uncertainty that are accounted for in calculation of the probability distribution of the OFL.

Second, the CPT annually reviews stock assessment documents, the most recent abundance estimates, the proposed OFLs and ABCs, and compiles the SAFE. The CPT then makes recommendations to the SSC on the OFLs, ABCs, and any other issues related to the crab stocks.

Third, the SSC annually reviews the SAFE report, including the stock assessment documents, recommendations from the CPT, and the methods to address scientific uncertainty.

In reviewing the SAFE, the CPT and the SSC shall evaluate and make recommendations, as necessary, on:

- the assumptions made for stock assessment models and estimation of OFLs;
- the specifications of the probability distribution of the OFL;
- the methods to appropriately quantify uncertainty in the ABC control rule; and
- the factors influencing scientific uncertainty that the SOA has accounted for and will account for on an annual basis in TAC setting.

The SSC will then set the final OFLs and ABCs for the upcoming crab fishing year. The SSC may set an ABC lower than the result of the ABC control rule, but it must provide an explanation for setting the ABC less than the maximum ABC.

As an accountability measure, the total catch estimate used in the stock assessment will include any amount of harvest that may have exceeded the ACL in the previous fishing season. For stocks managed under Tiers 1 through 4, this would result in a lower maximum ABC in the subsequent year, all else being equal, because maximum ABC varies directly with biomass. For Tier 5 stocks, the information used to establish the ABC is insufficient to reliably estimate abundance or discern the existence or extent of biological consequences caused by an overage in the preceding year. Consequently, the subsequent year's maximum ABC will not automatically decrease. However, when the ACL for a Tier 5 stock has been exceeded, the SSC may decrease the ABC for the subsequent fishing season as an accountability measure.

Tiers 1 through 3

For Tiers 1 through 3, reliable estimates of B , B_{MSY} , and F_{MSY} , or their respective proxy values, are available. Tiers 1 and 2 are for stocks with a reliable estimate of the spawner/recruit relationship, thereby enabling the estimation of the limit reference points B_{MSY} and F_{MSY} .

- Tier 1 is for stocks with assessment models in which the probability density function (pdf) of F_{MSY} is estimated.
- Tier 2 is for stocks with assessment models in which a reliable point estimate, but not the pdf, of F_{MSY} is made.
- Tier 3 is for stocks where reliable estimates of the spawner/recruit relationship are not available, but proxies for F_{MSY} and B_{MSY} can be estimated.

For Tier 3 stocks, maturity and other essential life-history information are available to estimate proxy limit reference points. For Tier 3, a designation of the form “ F_X ” refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or its proxy such as mature male biomass at mating) per recruit equal to $X\%$ of the equilibrium level in the absence of any fishing.

The OFL and ABC calculation accounts for all losses to the stock not attributable to natural mortality. The OFL and ACL are total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, the handling mortality rate is multiplied by bycatch discards in each fishery. Overfishing would occur if, in any year, the sum of all three catch components exceeds the OFL.

Tier 4

Tier 4 is for stocks where essential life-history, recruitment information, and understanding are insufficient to achieve Tier 3. Therefore, it is not possible to estimate the spawner-recruit relationship. However, there is sufficient information for simulation modeling that captures the essential population dynamics of the stock as well as the performance of the fisheries. The simulation modeling approach employed in the derivation of the annual OFLs captures the historical performance of the fisheries as seen in observer data from the early 1990s to present and thus borrows information from other stocks as necessary to estimate biological parameters such as γ .

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ , are used in the calculation of the F_{OFL} . Explicit to Tier 4 are reliable estimates of current survey biomass and the instantaneous M . The proxy B_{MSY} is the average biomass over a specified time period, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information. A scalar, γ , is multiplied by M to estimate the F_{OFL} for stocks at status levels "a" and "b," and γ is allowed to be less than or greater than unity. Use of the scalar γ is intended to allow adjustments in the overfishing definitions to account for differences in biomass measures. A default value of γ is set at 1.0, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information.

If the information necessary to determine total catch OFLs and ACLs is available for a Tier 4 stock, then the OFL and ACL will be total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. If the information necessary to determine total catch OFLs and ACLs is not available for a Tier 4 stock, then the OFL and ACL are determined for retained catch. In the future, as information improves, data would be available for some stocks to allow the formulation and use of selectivity curves for the discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models. The resulting OFL and ACL from this approach, therefore, would be the total catch OFL and ACL.

Tier 5

Tier 5 stocks have no reliable estimates of biomass and only historical catch data are available. For Tier 5 stocks, the OFL is set equal to the average catch from a time period determined to be representative of the production potential of the stock, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information. The ABC control rule sets the maximum ABC at less than or equal to 90 percent of the OFL and the ACL equals the ABC.

For Tier 5 stocks where only retained catch information is available, the OFL and ACL will be set for the retained catch portion only, with the corresponding limits applying to the retained catch only. For Tier 5 stocks where information on bycatch mortality is available, the OFL and ACL calculations could include discard losses, at which point the OFL and ACL would be applied to the retained catch plus the discard losses from directed and non-directed fisheries.

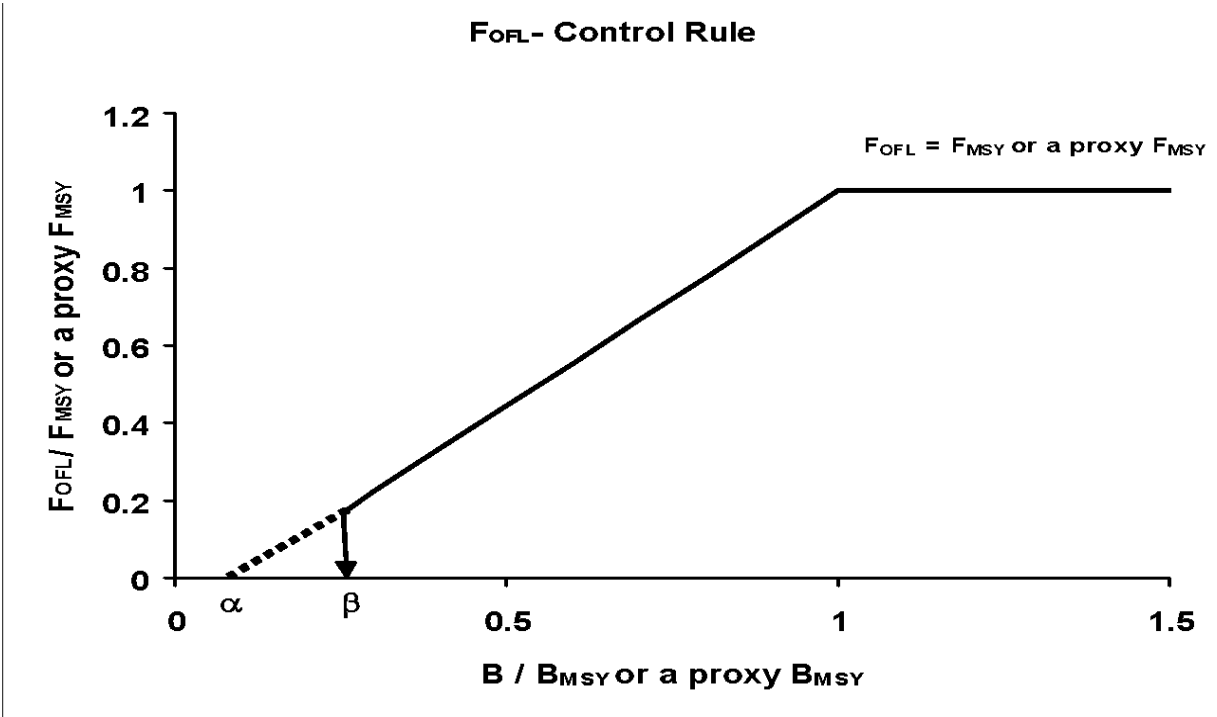


Figure 1: Overfishing control rule for Tiers 1 through 4. Directed fishing mortality is 0 below β.

Table 2: Five-Tier System for setting overfishing limits (OFLs) and Acceptable Biological Catches (ABCs) for crab stocks. The tiers are listed in descending order of information availability. Table 3 contains a guide for understanding the five-tier system.

| Information available | Tier | Stock status level | F_{OFL} | ABC control rule |
|--|------|--|---|--------------------------|
| B, B_{MSY}, F_{MSY} , and pdf of F_{MSY} | 1 | a. $\frac{B}{B_{msy}} > 1$ | $F_{OFL} = \mu_A = \text{arithmetic mean of the pdf}$ | ABC $\leq (1-b_y) * OFL$ |
| | | b. $\beta < \frac{B}{B_{msy}} \leq 1$ | $F_{OFL} = \mu_A \frac{\frac{B}{B_{msy}} - \alpha}{1 - \alpha}$ | |
| | | c. $\frac{B}{B_{msy}} \leq \beta$ | Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$ | |
| B, B_{MSY}, F_{MSY} | 2 | a. $\frac{B}{B_{msy}} > 1$ | $F_{OFL} = F_{msy}$ | ABC $\leq (1-b_y) * OFL$ |
| | | b. $\beta < \frac{B}{B_{msy}} \leq 1$ | $F_{OFL} = F_{msy} \frac{\frac{B}{B_{msy}} - \alpha}{1 - \alpha}$ | |
| | | c. $\frac{B}{B_{msy}} \leq \beta$ | Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$ | |
| $B, F_{35\%}^*, B_{35\%}^*$ | 3 | a. $\frac{B}{B_{35\%}^*} > 1$ | $F_{OFL} = F_{35\%}^*$ | ABC $\leq (1-b_y) * OFL$ |
| | | b. $\beta < \frac{B}{B_{35\%}^*} \leq 1$ | $F_{OFL} = F_{35\%}^* \frac{\frac{B}{B_{35\%}^*} - \alpha}{1 - \alpha}$ | |
| | | c. $\frac{B}{B_{35\%}^*} \leq \beta$ | Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$ | |
| B, M, B_{msy}^{prox} | 4 | a. $\frac{B}{B_{msy}^{prox}} > 1$ | $F_{OFL} = \gamma M$ | ABC $\leq (1-b_y) * OFL$ |
| | | b. $\beta < \frac{B}{B_{msy}^{prox}} \leq 1$ | $F_{OFL} = \gamma M \frac{\frac{B}{B_{msy}^{prox}} - \alpha}{1 - \alpha}$ | |
| | | c. $\frac{B}{B_{msy}^{prox}} \leq \beta$ | Directed fishery $F = 0$ $F_{OFL} \leq F_{MSY}^\dagger$ | |
| Stocks with no reliable estimates of biomass or M. | 5 | | OFL = average catch from a time period to be determined, unless the SSC recommends an alternative value based on the best available scientific information. | ABC $\leq 0.90 * OFL$ |

*35% is the default value unless the SSC recommends a different value based on the best available scientific information.

† An $F_{OFL} \leq F_{MSY}$ will be determined in the development of the rebuilding plan for an overfished stock.

Table 3: A guide for understanding the five-tier system.

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| <ul style="list-style-type: none"> ● F_{OFL} — the instantaneous fishing mortality (F) from the directed fishery that is used in the calculation of the overfishing limit (OFL). F_{OFL} is determined as a function of: <ul style="list-style-type: none"> ○ F_{MSY} — the instantaneous F that will produce MSY at the MSY-producing biomass <ul style="list-style-type: none"> ▪ A proxy of F_{MSY} may be used; e.g., $F_{x\%}$, the instantaneous F that results in x% of the equilibrium spawning per recruit relative to the unfished value ○ B — a measure of the productive capacity of the stock, such as spawning biomass or fertilized egg production. <ul style="list-style-type: none"> ▪ A proxy of B may be used; e.g., mature male biomass ○ B_{MSY} — the value of B at the MSY-producing level <ul style="list-style-type: none"> ▪ A proxy of B_{MSY} may be used; e.g., mature male biomass at the MSY-producing level ○ β — a parameter with restriction that $0 \leq \beta < 1$. ○ α — a parameter with restriction that $0 \leq \alpha \leq \beta$. ● The maximum value of F_{OFL} is F_{MSY}. $F_{OFL} = F_{MSY}$ when $B > B_{MSY}$. ● F_{OFL} decreases linearly from F_{MSY} to $F_{MSY} \cdot (\beta - \alpha) / (1 - \alpha)$ as B decreases from B_{MSY} to $\beta \cdot B_{MSY}$ ● When $B \leq \beta \cdot B_{MSY}$, $F = 0$ for the directed fishery and $F_{OFL} \leq F_{MSY}$ for the non-directed fisheries, which will be determined in the development of the rebuilding plan. ● The parameter, β, determines the threshold level of B at or below which directed fishing is prohibited. ● The parameter, α, determines the value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$ and the rate at which F_{OFL} decreases with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$. <ul style="list-style-type: none"> ○ Larger values of α result in a smaller value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$. ○ Larger values of α result in F_{OFL} decreasing at a higher rate with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$. ● The parameter, b_y, is the value for the annual buffer calculated from a P* of 0.49 and a probability distribution for the OFL that accounts for scientific uncertainty in the estimate of OFL and provides the maximum permissible ABC. ● P* is the probability that the estimate of ABC, which is calculated from the estimate of OFL, exceeds the “true” OFL (noted as OFL’) ($P(ABC > OFL')$). |
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Crab Plan Team Recommendations

Table 4 contains status determination for the 2023/24 season. Status of stocks in relation to status determination criteria for stocks in Tiers 3 and 4 are shown in Figure 2. Table 5 contains the team’s recommendations for 2024/2025 on tier assignments, model parameterizations, time periods for reference biomass estimation or appropriate catch averages, OFLs and ABCs. The team recommends four stocks be placed in Tier 3 (EBS snow crab, Bristol Bay red king crab, EBS Tanner crab, and Aleutian Islands golden king crab), four stocks in Tier 4 (St. Matthew Island blue king crab, Pribilof Islands blue king crab, Pribilof Islands red king crab, and Norton Sound red king crab) and two stocks in Tier 5 (Pribilof Islands golden king crab, and Western Aleutian Islands red king crab). Table 5 lists those stocks for which the team recommends an ABC less than the maximum permissible ABC for 2024/25.

The CPT has general recommendations for all assessments and specific comments related to individual assessments. All recommendations are for consideration for the next scheduled assessment. The general comments are listed below while the comments related to individual assessments are contained within the summary of CPT deliberations and recommendations contained in the stock specific summary section.

Additional details regarding recommendations are contained in the Crab Plan Team Report (September 2023 CPT Report).

General Recommendations for all Assessments

1. The CPT recommends that all assessment authors document assumptions and simulate data under those assumptions to test the ability of the model to estimate key parameters in an unbiased manner. These simulations would be used to demonstrate precision and bias in estimated model parameters.
2. The CPT recommends that weighting factors be expressed as sigmas or CVs or effective sample sizes. The team requests all authors to follow the Guidelines for SAFE preparation and to follow the Terms of Reference as listed therein as applicable by individual assessment for both content and diagnostics.
3. Authors should focus on displaying information on revised models as compared to last year's model rather than focusing on aspects of the assessment that have not changed from the previous year.
4. The current approach for fitting length-composition data accounts for sampling error but ignores the fact that selectivity among size classes is not constant within years; a small change in the selectivity on small animals could lead to a very large change in the catch of such animals. Authors are encouraged to develop approaches for accounting for this source of process error. This issue is generic to assessments of crab and groundfish stocks.
5. Authors are reminded that assessments should include the time series of stock estimates at the time of survey for at least the author's recommended model in that year.
6. Consider stepwise changes to data as individual model runs instead of changing multiple parameters at once so that changes in model performance may be attributed to specific data.

By convention the CPT used the following conversions to include tables in both pounds (lb) and metric tons (t) in the status summary sections:

- million lb to 1000 t [$/2.204624$]
- 1000 t to million lb [$/0.453592$]

Stock Status Summaries

1 *Eastern Bering Sea Snow crab*

Fishery information relative to OFL setting

The 2023/24 directed fishery was closed. Bycatch in the non-directed crab and groundfish fisheries resulted in a total catch mortality of 0.07 kt (with handling mortality rates applied). Because the total catch mortality for this stock was below the 2023/24 OFL of 15.44kt, overfishing did not occur.

Data and assessment methodology

The stock assessment uses a size- and sex-structured model in which crabs are categorized as immature or mature, and growth ends with terminal molt. The model is fit to biomass and size frequency data from the NMFS trawl survey, total catch data from the directed fishery, and bycatch data from the non-directed crab and groundfish fisheries. Updated data in the 2024 assessment include 2024 eastern Bering Sea survey biomass and length composition data and non-directed discard length frequency and discard biomass from 2023. Results from the 2024 NMFS bottom trawl survey indicated an increase in male abundance relative to the 2023 survey, although the majority of these crab will not enter the fishery for several years. The estimated abundance in 2024 of commercially-preferred male crab (>101 mm carapace width) was the fourth lowest in the time series.

GMACS was approved for use in this assessment by the SSC in June 2022. The assessment author compared last year's accepted model (model 23.1) with five alternatives. Model 24.1 was last year's model fit to updated data. Model 24.1a corrected an issue with indexing of molting probabilities, retained morphometric maturity as the definition for the currency of management (i.e., the part of the population used to estimate mature male biomass), but retained $B_{35\%}$ as the B_{MSY} proxy. Model 24.1b was based on 24.1a but used an estimate of size at functional maturity (>95mm carapace width, CW) as the currency of management. Model 24.1c was based on 24.1b but used $B_{45\%}$ as the B_{MSY} proxy. The author also brought forward a Tier 4 "fallback" option based on survey estimates of the biomass of males >95mm CW.

The CPT recommended model 24.1b. This recommendation was based on information indicating that a >95 mm CW definition of maturity is more appropriate for this stock than morphometric maturity. This decision was based on three considerations: 1) a single study from Canada indicating that mating males in the wild were almost exclusively >95 mm CW; 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; and 3) long-term declines in the biomass of large males in the population. The CPT considered changing the B_{MSY} proxy to $B_{45\%}$ based on a yield curve analysis presented by the assessment author that accounted for uncertainty in the size at functional maturity but recommended retaining $B_{35\%}$ out of concern over making multiple changes in the assessment approach in a single year. The CPT recommends continued evaluation of the information that would be required to change the B_{MSY} proxy.

Stock biomass and recruitment trends

Observed mature male biomass (MMB, ≥ 95 mm CW) at the time of the survey was at a historical high in the 1990s (observed MMB during 1990, 1991, and 1997 were 347.75, 347.98, and 232.39 kt, respectively). The stock was declared overfished in 1999 in response to the total mature biomass dropping below the 1999 minimum stock size threshold. Observed MMB slowly increased after 1999, and the stock was declared rebuilt in 2011. However, after 2011, the stock declined and the observed MMB at the time of survey dropped to a low in 2016 of 29.96 kt. Recently, MMB was increasing as a large recruitment event moved through the size classes, but that recruitment has since disappeared, and the observed MMB

reached an all-time low (15.49 kt) in the 2023 survey. The 2024 survey estimate of MMB increased to 23.19 kt, the second-lowest value in the time series.

Estimated recruitment shifted from a period of high recruitment to a period of low recruitment in the mid-1990s (late 1980s when lagged to fertilization). A large year class recruited to the survey gear in 2015 and was tracked until 2019, but was not present in subsequent surveys, and appears to have disappeared from the eastern Bering Sea shelf before reaching commercial size.

Tier determination/Plan Team discussion and resulting OFL/ABC determination, status, and catch specifications

Snow crab was declared overfished in 2021 on the basis that the 2021 assessment indicated MMB was below the MSST. EBS snow crab is a Tier 3 stock, with the OFL determined by the F_{OFL} control rule using $F_{35\%}$ as the proxy for F_{MSY} . The Tier 3 proxy for B_{MSY} ($B_{35\%}$) is the MMB at mating based on average recruitment from 1982 to present. The CPT recommends that the ABC buffer be 20%, the same value recommended by the CPT in 2023.

Status and catch specifications (1000 t) for snow crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|--------|---------------|--------|----------------|-------------|-------|-------|
| 2020/21 | 76.7 | 26.7 | 20.4 | 20.4 | 26.2 | 95.4 | 71.6 |
| 2021/22 | 91.6 | 41.3 | 2.5 | 2.5 | 3.6 | 7.5 | 5.6 |
| 2022/23 | 136.9 | 92.4 | Closed | 0 | 0.05 | 10.3 | 7.7 |
| 2023/24 | 47.41* | 13.4* | Closed | 0 | 0.07 | 15.4 | 7.7 |
| 2024/25 | | 11.3* | | | | 0.05* | 0.04* |

Status and catch specifications (million lb) for snow crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|--------|---------------|--------|----------------|-------------|-------|-------|
| 2020/21 | 169.1 | 59.0 | 45.0 | 45.0 | 57.8 | 210.3 | 157.7 |
| 2021/22 | 201.9 | 91.1 | 5.5 | 5.5 | 7.9 | 16.5 | 12.4 |
| 2022/23 | 301.8 | 203.7 | Closed | 0 | 0.11 | 22.7 | 17.0 |
| 2023/24 | 104.5* | 29.5* | Closed | 0 | 0.15 | 34.0 | 17.0 |
| 2024/25 | | 24.9* | | | | 0.11* | 0.09* |

*Values reflect >95mm carapace width definition of male maturity

2 Bristol Bay Red King Crab

Fishery information relative to OFL setting

The 2023/24 directed fishery was open after two years of closures, with a retained catch of 0.96 kt. Bycatch in the non-directed crab and groundfish fisheries resulted in a total catch mortality of 1.34 kt (with handling mortality rates applied). Because the total catch mortality for this stock was below the 2023/24 OFL of 4.42 kt, overfishing did not occur.

Data and assessment methodology

The stock assessment uses a sex- and size-structured population dynamics model incorporating data from the NMFS eastern Bering Sea trawl survey, the Bering Sea Fisheries Research Foundation (BSFRF) trawl survey, landings of commercial catch, bycatch in the non-directed crab and groundfish fisheries, and dockside retained catch sampling. Annual stock abundance was estimated for male and female crab ≥ 65 mm CL from 1975 to 2024, and mature male (males ≥ 120 mm CL) biomass was projected to 15 February 2025. The assessment was updated with 2023/24 fishery data on bycatch in the non-directed crab and groundfish fisheries, as well as data from the 2024 NMFS trawl survey.

Two model scenarios were evaluated using GMACS (version 2.20.14, 2024-05-20) for the 2024 assessment: model 23.0a and model 24.0c. Model 24.0c is identical to model 23.0a, except it combines the block of molting probability in 1975-1979 with the block of molting probability from 1980-present. This action resulted in almost no change to model fits and estimated management quantities. The CPT endorsed adoption of model 24.0c based on these small changes to model fit and the removal of two parameters from the model.

Stock biomass and recruitment trends

Based on model 24.0c, the MMB at the time of mating is estimated to have been highest in the late 1970s, with secondary peaks in 1989 and 2002-2003, followed by a gradual decline. The estimated MMB at time of mating in 2023/24 was 18.65 kt. The projection for MMB at the 2024/25 time of mating, which assumes the fishing mortality in 2023/24 matches that corresponding to the OFL, is 15.43 kt. Estimates of recruitment since 1985 have been generally low relative to those estimated for the period prior to 1985 and with intermittent peaks in 1995, 2002, and 2005. The estimate for 2024 was one of the smallest on record, but it is highly uncertain because it is based only on 2024 NMFS EBS survey data.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

Based on the information available, BBRKC is categorized as a Tier 3 stock. The CPT recommends computing average recruitment as in recent assessments (i.e., based on model recruitment using the time period from 1984 (corresponding to fertilization in 1977) to the penultimate year of the assessment. The estimated $B_{35\%}$ is 18.69 kt. MMB projected for 2024/25 is 15.43 kt, 83% of $B_{35\%}$. Consequently, the BBRKC stock is in Tier 3b for 2024/25. The corresponding OFL is 5.02 kt.

The CPT recommends continuing to use a 20% buffer because the level of uncertainty expressed in previous years remains, although the basis for those concerns has changed slightly. These include:

- Continued lack of recent recruitment
- Poor and variable environmental conditions (e.g., cold pool distributional shifts)
- The lack of fit to 2018-2024 NMFS female survey biomass
- The retrospective patterns exhibited by the recommended model

MMB for 2023/24 was estimated to be 18.65 kt and above MSST (9.35 kt), hence the stock was not overfished in 2023/24. The total catch mortality in 2023/24 (1.34 kt) was less than the 2023/24 OFL (4.42 kt); hence overfishing did not occur in 2023/24. Based on MCMC projections, the probability of MMB in 2024/25 dropping below the MSST when fishing at F_{OFL} was less than 0.5, so the stock is not approaching an overfished condition.

Status and catch specifications (1000 t) for Bristol Bay red king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|-------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2020/21 | 12.12 | 13.96 | 1.20 | 1.26 | 1.57 | 2.14 | 1.61 |
| 2021/22 | 12.01 | 16.64 | 0 | 0.02 | 0.10 | 2.23 | 1.78 |
| 2022/23 | 9.68 | 18.34 | 0 | 0.02 | 0.07 | 3.04 | 2.43 |
| 2023/24 | 9.35 | 18.65 | 0.975 | 0.96 | 1.34 | 4.42 | 3.54 |
| 2024/25 | | 15.43 | | | | 5.02 | 4.02 |

Status and catch specifications (million lb) for Bristol Bay red king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|-------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2020/21 | 26.7 | 30.8 | 2.77 | 2.65 | 3.47 | 4.72 | 3.54 |
| 2021/22 | 26.5 | 36.7 | 0 | 2.65 | 3.47 | 4.91 | 3.92 |
| 2022/23 | 21.3 | 40.4 | 0 | 0.05 | 0.16 | 6.70 | 5.35 |
| 2023/24 | 20.6 | 41.1 | 2.15 | 2.12 | 2.96 | 9.75 | 7.8 |
| 2024/25 | | 34.0 | | | | 11.07 | 8.87 |

3 Eastern Bering Sea Tanner crab

Fishery information relative to OFL setting

The State of Alaska sets separate TACs for directed fisheries east and west of 166°W longitude. A single OFL is set for Tanner crab in the EBS. Retained catch was 597t west of 166°W longitude, and 344 t east of 166°W longitude. Bycatch in the non-directed crab and groundfish fisheries resulted in a total catch mortality of 1.09 kt (with handling mortality rates applied). Because the total catch mortality for this stock was below the 2023/24 OFL of 36.20 kt, overfishing did not occur.

Data and assessment methodology

The stock assessment uses a size- and sex-structured model in which crabs are categorized as immature or mature, and growth ends with terminal molt. The model is fit to biomass and size frequency data from the NMFS trawl survey, total catch data from the directed fishery, and bycatch data from the non-directed crab and groundfish fisheries. Updated data in the 2024 assessment include 2024 eastern Bering Sea survey biomass and length composition data, retained and total catch data from the directed fishery, and bycatch data from the Bristol Bay red king crab fishery and the groundfish fisheries.

The CPT-recommended model 22.03d5 is a revised version of model 22.03b that was updated to include the addition of the 2018 BSFRF SBS (side-by-side selectivity study) data and updates to previous years of this data, updated availability curves from the revised SBS data, and fixed effective sample size parameters that would otherwise have hit a bound.

Stock biomass and recruitment trends

The MMB at the time of mating was estimated to have been highest in the early 1970s (close to 400 kt), with secondary peaks in 1989 (108 kt), 2008 (122 kt), and 2014 (117 kt). The estimated MMB on 15 February 2024 was 88.21 kt and the projection for 15 February 2025 was 56.06 kt under the assumption that the OFL was taken. Estimates of recruitment since 1999 have been generally low relative to the peaks estimated for the period prior to 1990. This is the first year that estimates of strong recruitment in recent years show signs of propagating into larger size classes in subsequent years. The lack of subsequent cohort progression continues to be a concerning source of uncertainty but is lessened somewhat in the most recent assessment.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends the OFL for this stock be based on the Tier 3 control rule. Application of the Tier 3 control rule requires a set of years for defining average recruitment corresponding to B_{MSY} under prevailing environmental conditions. This recommended time period is 1982 – 2023, based on the approach used to select the time period from the last few assessments, which excludes the most recent estimate of recruitment given its uncertainty.

Based on the estimated biomass on 15 February 2024, the stock is at 134% of B_{MSY} , and therefore is in Tier 3a. The F_{MSY} proxy ($F_{35\%}$) is 1.23 yr⁻¹, and the 2024/25 F_{OFL} is 1.23 yr⁻¹ under the Tier 3a OFL control rule, which results in a total OFL of 41.29 kt. The CPT recommended a 20% buffer to account for model uncertainty and stock productivity uncertainty be applied to the OFL to set $ABC = 33.03$ kt. The 20% buffer is consistent with previous years' concerns, but the CPT wishes to highlight its increasing concerns regarding the appropriateness of $B_{35\%}$ and $F_{35\%}$ as proxies for MSY-related management quantities due to uncertainty related to MMB as the appropriate currency of management, similar to concerns expressed for snow crab.

Total catch mortality in 2023/24 (1.09 kt) was below the OFL, therefore overfishing did not occur.

Status and catch specifications (1000 t) for Tanner crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|-------|---------------|------|----------------|-------------|-------|-------|
| 2020/21 | 17.97 | 56.34 | 1.07 | 0.66 | 0.96 | 21.13 | 16.90 |
| 2021/22 | 17.37 | 62.05 | 0.50 | 0.49 | 0.78 | 27.17 | 21.74 |
| 2022/23 | 18.19 | 74.17 | 0.91 | 0.91 | 1.19 | 32.81 | 26.25 |
| 2023/24 | 20.00 | 88.21 | 0.94 | 0.94 | 1.09 | 36.20 | 28.96 |
| 2024/25 | | 56.05 | | | | 41.29 | 33.03 |

Status and catch specifications (million lb) for Tanner crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|-------|---------------|------|----------------|-------------|-------|-------|
| 2020/21 | 39.61 | 124.19 | 2.35 | 1.44 | 2.11 | 46.58 | 37.26 |
| 2021/22 | 38.29 | 136.79 | 1.10 | 1.09 | 1.73 | 59.89 | 47.91 |
| 2022/23 | 40.11 | 163.52 | 2.02 | 2.01 | 2.62 | 72.34 | 54.25 |
| 2023/24 | 44.10 | 194.46 | 2.08 | 2.07 | 2.39 | 79.82 | 63.85 |
| 2024/25 | | 123.59 | | | | 91.03 | 72.82 |

4 Pribilof Islands red king crab

The Pribilof Islands red king crab (PIRKC) assessment is on a triennial cycle. A full assessment was conducted in 2022. The next full assessment will occur in 2025.

Fishery information relative to OFL setting

The Pribilof Islands red king crab fishery began in 1973 as bycatch during the blue king crab fishery. In 1993 and 1994 the red king crab fishery was open to directed fishing. From 1995 through 1998, combined guideline harvest levels (GHLs) were used for the Pribilof Islands red and blue king crab fishery. Declines in crab abundance of both red and blue king crab stocks from 1996 to 1998 resulted in poor fishery performance with annual harvests below the GHLs. The Pribilof red king crab fishery has been closed since 1999 due to uncertainty in estimated red king crab abundance and concerns for bycatch mortality of blue king crab, which is overfished and severely depressed. Fishery closures near the Pribilof Islands have resulted in low bycatch, and recent bycatch has been well below the OFL, ranging from 1.0 to 17.0 t from 2012/13 to 2020/21.

Data and assessment methodology

In 2019 a GMACS model was accepted for this stock. The 2022 assessment is based on trends in male mature biomass (MMB) from NMFS bottom trawl survey and commercial catch and trawl bycatch data through 2022. The GMACS integrated model was presented with three variations: 1) model 22.1: 2019 accepted model with updated data and .tpl file to fix small bugs in the model parameterization, 2) model 22.1a: 22.1 adding in the bycatch size composition data into the assessment, which allows for estimation of bycatch selectivity, and 3) 22.1b: 22.1a with the slope of the growth increments model fixed to zero and the intercept estimated in order to more closely match the observed biology from tagging data used in the BBRKC assessment.

Stock biomass and recruitment trends

The GMACS model fit to mature male biomass identified three peaks in the timeseries. In recent years, observed mature male biomass (>120 mm CL) peaked in 2015, then declined until 2019 when it began to increase. The mature male biomass varied widely over the history of the survey time series and uncertainty around area-swept estimates of biomass were largely due to relatively low sample sizes. Recruitment estimated by the GMACS integrated model appeared to be episodic. Survey length composition data suggest a new cohort has been established recently, but its size is unclear. Numbers at length vary dramatically among years; however, three cohorts can be seen moving through the length frequencies over time. The estimated MMB peaked during 1999 to 2003 and systematically declined until 2018, had a short increase until 2020 when it began to decline again.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT continues to recommend Tier 4 stock status determination and selected the GMACS model 22.1b. This model was selected because it incorporates all available information for the stock, including adding in the size composition data from bycatch fisheries and uses a more consistent approach to molt increment estimation relative to other red king crab stocks. In 2019 the CPT recommended use of a modified method of B_{MSY} estimation, which is equal to $0.35 \times \text{average MMB}$ for 2000 to present, during which no directed fishery occurred. For 2022/23 the $B_{MSY} = 1,709$ t derived as the $0.35 \times \text{mean MMB}$ from 2000/01 to 2021/22 from the GMACS model 22.1b. Male mature biomass at the time of mating for 2021/22 was estimated at 3,879 t. The $B/B_{MSY} = 2.27$ and $F_{OFL} = 0.21$. B/B_{MSY} is > 1 , therefore the stock status level is Tier 4a. For the 2022/23 fishery, the OFL is 685 t. The CPT recommended a 25% buffer for an ABC from the OFL as in previous years.

No directed fishery occurred for PIRKC in 2023/2024. Bycatch mortality in non-directed fisheries was 3.95 t. Given that observed catches were lower than the OFL, overfishing did not occur in 2023/2024. The stock was above MSST in 2022/23 and is not overfished.

Status and catch specifications (t) for Pribilof Islands red king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|-------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2018/19 | 866 | 5,368 | 0 | 0 | 7.22 | 404 | 303 |
| 2019/20 | 866 | 6,431 | 0 | 0 | 3.84 | 864 | 648 |
| 2020/21 | 866 | 6,431 | 0 | 0 | 5.09 | 864 | 648 |
| 2021/22 | 854 | 3,879 | 0 | 0 | 1.47 | 864 | 648 |
| 2022/23 | 854 | 3,879 | 0 | 0 | 4.03 | 685 | 514 |
| 2023/24 | 854 | 3,879 | 0 | 0 | 3.95 | 685 | 514 |
| 2024/25 | | 3,879 | 0 | | | 685 | 514 |

Status and catch specifications (million lb) for Pribilof Islands red king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|-------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2018/19 | 1.91 | 11.83 | 0 | 0 | 0.02 | 0.89 | 0.67 |
| 2019/20 | 1.91 | 14.18 | 0 | 0 | 0.01 | 1.9 | 1.43 |
| 2020/21 | 1.91 | 14.18 | 0 | 0 | 0.11 | 1.9 | 1.43 |
| 2021/22 | 1.88 | 8.55 | 0 | 0 | 0.00 | 1.9 | 1.43 |
| 2022/23 | 1.88 | 8.55 | 0 | 0 | 0.01 | 1.51 | 1.13 |
| 2023/24 | 1.88 | 8.55 | 0 | 0 | 0.01 | 1.51 | 1.13 |
| 2024/25 | | 8.55 | 0 | | | 1.51 | 1.13 |

5 ***Pribilof Islands blue king crab***

The Pribilof Islands blue king crab assessment is biennial, the next assessment will occur in 2025.

Fishery information relative to OFL setting.

The 2022/23 directed fishery was closed. Bycatch in the non-directed crab and groundfish fisheries resulted in a total catch mortality of 0.25 t (with handling mortality rates applied). Because the total catch mortality for this stock was below the 2022/23 OFL of 1.16 t, overfishing did not occur. The stock was declared overfished in 2002, and a rebuilding plan was implemented in 2004. The rebuilding plan closed directed fishing for Pribilof blue king crab until the stock is rebuilt. In 2009, NMFS determined the stock would not meet its 10-year rebuilding horizon. The stock remains under a rebuilding plan, with no time specified to rebuild.

Data and assessment methodology

The 2021 assessment was conducted in May, prior to the 2021 NMFS EBS shelf survey and the completion of the crab year (July 1-June 30). The timing of the assessment was subsequently changed to September beginning in 2023, to be able to incorporate the current year's EBS shelf survey and bycatch data for the complete crab year.

The current methodology is the same as in the 2021 assessment. This approach uses a state space/random effects random walk model to smooth survey MMB prior to estimating MMB at mating (February 15), accounting for natural and fishing mortality in the period between the survey and the time of mating.

The 2023 assessment evaluated three scenarios addressing the observation of zero mature males in the 2023 NMFS EBS shelf survey: 1) to treat 2023 as missing data (i.e., 'NA'), 2) to set 2023 to a small constant, or 3) assume a Tweedie error distribution as opposed to lognormal. Following Groundfish Plan Team recommendations, the CPT recommends treating 2023 as missing data, since model predictions were sensitive to the small constant used and MCMC results could not be produced for the Tweedie model.

Stock biomass and recruitment trends

The 2023/24 MMB at mating is projected to be 181 t, which is approximately 4% of the proxy for B_{MSY} . The Pribilof Islands blue king crab stock biomass continues to be low with no indication of recruitment.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that stock status be evaluated using Tier 4 methods. B_{MSY} was estimated using the time periods 1980/81 -1984/85 and 1990/91-1997/98. This range was chosen as representative of the productive potential of the stock. B_{MSY} is estimated at 4,196 t for 2023/24. Because the projected 2023/24 estimate of MMB is less than 25% B_{MSY} , the stock is in stock status c and the directed fishery F is 0.

The OFL specified as part of the rebuilding plan is based on average groundfish bycatch between 1999/2000 and 2005/06. The recommended OFL for 2023/24 and 2024/25 is 1.16 t.

The CPT continues to recommend setting the ABC less than the maximum permissible by employing a 25% buffer on the OFL. This recommendation is based upon continuing concerns with stock status and consistency with buffer levels for other stocks for which the OFL is based upon average catch.

Total catch mortality was below the OFL for 2023/24; therefore, overfishing did not occur.

Historical status and catch specifications for Pribilof Islands blue king crab (t). Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|-------|---------------|--------|----------------|-------------|------|------|
| 2020/21 | 2,049 | 181 | Closed | 0 | 0.00 | 1.16 | 0.87 |
| 2021/22 | 2,098 | 235 | Closed | 0 | 0.102 | 1.16 | 0.87 |
| 2022/23 | 2,098 | 180 | Closed | 0 | 0.25 | 1.16 | 0.87 |
| 2023/24 | | 181 | Closed | | 0.0906 | 1.16 | 0.87 |
| 2024/25 | | 181 | | | | 1.16 | 0.87 |

Historical status and catch specifications for Pribilof Islands blue king crab (million lb). Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|-------|---------------|--------|----------------|-------------|--------|--------|
| 2020/21 | 4.517 | 0.399 | Closed | 0 | 0.0000 | 0.0026 | 0.0019 |
| 2021/22 | 4.625 | 0.518 | Closed | 0 | 0.0002 | 0.0026 | 0.0019 |
| 2022/23 | 4.625 | 0.397 | Closed | 0 | 0.0006 | 0.0026 | 0.0019 |
| 2023/24 | | 0.398 | Closed | | 0.0002 | 0.0026 | 0.0019 |
| 2024/25 | | 0.398 | | | | 0.0026 | 0.0019 |

6 St. Matthew Island blue king crab

Fishery information relative to OFL setting

The fishery was prosecuted as a directed fishery from 1977 to 1998. Harvests peaked in 1983/84 when 4,288 t were landed by 164 vessels. Harvest was fairly stable from 1986/87 to 1990/91, averaging 568 t annually. Harvest increased to a mean catch of 1,496 t during the 1991/92 to 1998/99 seasons until the fishery was declared overfished and closed in 1999 when the stock size estimate was below the MSST. In November 2000, Amendment 15 to the FMP was approved to implement a rebuilding plan for the St. Matthew Island blue king crab stock. The rebuilding plan included a harvest strategy identified in regulation by the Alaska Board of Fisheries, an area closure to control bycatch, and gear modifications. In 2008/09 and 2009/10, the MMB was estimated to be above B_{MSY} for two years and the stock declared rebuilt in 2009.

The fishery re-opened in 2009/10 after a 10-year closure, closed in 2013/14 due to declining trawl survey biomass, and opened from 2014/15 to 2015/16 with a TAC of 300 t. Fishery performance was relatively poor with retained catches of 140 t in 2014/15 and 48 t in 2015/16; the fishery has been closed since 2016/17. Bycatch of non-retained blue king crab has occurred in the St. Matthew blue king crab fishery, the eastern Bering Sea snow crab fishery, and trawl and fixed-gear groundfish fisheries. The stock declined below the minimum stock size threshold in 2018 and was declared overfished. A rebuilding plan was implemented in October 2020.

Data and assessment methodology

This assessment uses a GMACS model, which was first accepted for use by the SSC in June 2016. The model incorporates the following data: (1) commercial catch; (2) NMFS annual trawl survey; (3) ADF&G

triennial pot survey; (4) bycatch in the groundfish trawl and groundfish fixed-gear fisheries; and (5) ADF&G observer size compositions.

Stock biomass and recruitment trends

The 2024 NMFS trawl survey biomass estimate is not comparable to the time series typically used for this assessment because the 2024 survey excluded the corner stations that have been sampled since 1983, and thus some decrease in biomass is expected: mean biomass for 1983-2023 with corner stations excluded is only 79% of the mean biomass for the same time period with corner stations included. Standardization using a spatiotemporal model is needed to produce a biomass index that is robust to changes in the set of stations surveyed over time, but this index is still under development. For that reason, the following comparisons use the 1978-2024 NMFS trawl survey time series with corner stations excluded from biomass estimates for all years. Using this time series without corner stations, the 2024 NMFS trawl survey biomass of ≥ 90 mm carapace length (CL) male crab is 1,833 t (47% CV), the 15th lowest in the 47 years of the survey and the 11th lowest since 2000. The 2024 biomass is 41% of the 1978-2024 NMFS trawl survey mean biomass with corner stations excluded (4,490 t), and a 3% increase from the 2023 biomass. The mean NMFS survey biomass over the most recent three years is 35% of the time series mean value, indicating a low biomass compared to historical survey estimates. The ADF&G pot survey last occurred in 2022, when the relative biomass index was the highest since 2013, and 70% of the mean from the 12 surveys conducted since 1995. The assessment model estimates do not fit either of the survey time series particularly well. For the NMFS trawl survey, estimates from model 16.1 suggest that the stock biomass is 48% of the mean model-predicted biomass, with a poor fit to the 2019 biomass observation; note that model 16.1 uses the NMFS trawl survey time series with corner stations included for those years in which they are available (1983-2023). For the ADF&G pot survey, estimates from model 16.1 suggest that the stock biomass in 2022 was 66% of the mean model-predicted biomass, with a poor fit to the 2016, 2017, and 2018 biomass observations. Model 24.1 is model 16.1 with natural mortality fixed at $M = 0.23$ for the entire time series (except for the 1998 natural mortality spike) based on the value estimated in the 2023 Bristol Bay Red King Crab model.

Recruitment is based on the estimated number of male crab in the 90-104 mm carapace length (CL) size class in each year. Using the NMFS trawl survey time series with corner stations excluded, the 2024 trawl survey area-swept estimate of 252,145 male crab in this size class is ranked 36th, near the lower end of the 47 years of the survey. Mean recruitment over the most recent six years (2018-2024) is 46% of the long-term mean. In the ADF&G pot survey, the abundance of male crab in the 90-104 mm CL size class in 2022 ranked 7th in the time series (56% of the mean for the 12 available years of pot survey data) and was the highest abundance observed for this size class since 2013.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The stock assessment is based on Model 24.1, which uses a more recent version of GMACS (2.20.14), updated groundfish bycatch data for the 2023/24 crab season, updated survey data from the 2024 NMFS trawl survey and 2022 ADF&G pot survey, and a natural mortality value of 0.23 consistent with the most recent BBRKC assessment.

The CPT concurs with the author's recommendation to use Model 24.1 for the 2024/25 crab year. The stock is in Tier 4. The CPT recommends that the period 1978-2023 be used to define the proxy B_{MSY} in terms of average estimated MMB at mating. The projected MMB estimated for 2024/25 is 1,530 t, the F_{MSY} proxy is the natural mortality rate (0.23 year^{-1}), and the F_{OFL} is 0.108, resulting in a mature male biomass OFL of 129 t. The MMB/B_{MSY} ratio is 0.52. The author recommended and the CPT concurred with a 25% buffer on the OFL for the ABC. The ABC based on this buffer is 97 t.

Given that this is a biennial assessment, the CPT recommends the same OFL and ABC for 2025/2026. This stock will next be assessed in 2026.

The stock was found to be below the MSST in 2023/24 and thus remains in an overfished condition. However, the stock is projected to be above the MSST in 2024/25. Total catch was less than the OFL in 2023/24 and as such, overfishing did not occur.

Historical status and catch specifications for St. Matthew Island blue king crab (kt). Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|------|---------------|------|----------------|-------------|-------|-------|
| 2020/21 | 1.65 | 1.14 | 0.00 | 0.00 | 0.001 | 0.05 | 0.04 |
| 2021/22 | 1.63 | 1.18 | 0.00 | 0.00 | 0.001 | 0.05 | 0.04 |
| 2022/23 | 1.50 | 1.31 | 0.00 | 0.00 | 0.001 | 0.066 | 0.050 |
| 2023/24 | 1.48 | 1.41 | 0.00 | 0.00 | 0.005 | 0.066 | 0.050 |
| 2024/25 | | 1.53 | | | | 0.129 | 0.097 |
| 2025/26 | | 1.53 | | | | 0.129 | 0.097 |

Historical status and catch specifications for St. Matthew Island blue king crab (million lb). Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|------|---------------|------|----------------|-------------|-------|-------|
| 2020/21 | 3.64 | 2.52 | 0.00 | 0.00 | 0.002 | 0.112 | 0.08 |
| 2021/22 | 3.59 | 2.59 | 0.00 | 0.00 | 0.002 | 0.112 | 0.08 |
| 2022/23 | 3.32 | 2.89 | 0.00 | 0.00 | 0.002 | 0.146 | 0.11 |
| 2023/24 | 3.27 | 3.10 | 0.00 | 0.00 | 0.011 | 0.146 | 0.11 |
| 2024/25 | | 3.37 | | | | 0.285 | 0.214 |
| 2025/26 | | 3.37 | | | | 0.285 | 0.214 |

7 Norton Sound red king crab

Fishery information relative to OFL setting

During the 2023 fishery, 3,580 crab (4.54 t) were harvested in the winter commercial fishery and 146,087 crab (187 t) were harvested in the summer commercial fishery. In the winter subsistence fishery, 702 crab (0.89 t) were caught, while 573 crab (0.73 t) were retained. Because the total catch mortality for this stock was below the 2023 OFL of 310 t, overfishing did not occur.

Data and assessment methodology

Four types of surveys for NSRKC have occurred periodically during the last three decades: summer trawl, summer pot, winter pot, and preseason summer pot. These provide data on annual abundance and size/shell condition compositions. In addition, time series of standardized CPUE from the summer commercial fishery provide additional indices of abundance. Tag return data provide information on growth. Retained catch data are available from fish tickets for the winter and summer commercial fisheries, as well as from subsistence catch reports. Retained catch size-composition data are generally available for the summer commercial fishery, but only limited data are available for the winter commercial fishery. Limited data on discards are available from summer commercial fishery observer data and subsistence catch reports.

The assessment has been updated to include the following new data for 2023: retained catch for the winter and summer commercial fisheries, length-shell compositions for the summer commercial fishery, total and retained catch for the winter subsistence fishery, standardized CPUE time series, and survey abundance and shell condition/size composition data from the 2023 NOAA Northern Bering Sea and ADF&G summer trawl surveys.

The assessment is based on a length-based model of male crab abundance that combines these multiple sources of data. Logistic functions are used to describe fishery and survey selectivities, except that a dome-shaped function used for the winter pot fishery. The ADF&G trawl survey is assigned a catchability of 1, with catchabilities estimated for other surveys and the standardized CPUE indices. Molting and growth are combined into a size-transition matrix. The model allows for length-dependent natural mortality. A penalized maximum likelihood approach is used to estimate quantities relevant to management.

The assessment author presented results from three models (21.0, 23.0, and 23.1) for consideration by the CPT for status determination and OFL/ABC calculation. Model 21.0 was the accepted model from the 2023 assessment (updated with 2023 data). It assumed a constant M of 0.18 yr^{-1} for all length classes except the largest (i.e., $>123\text{mm CL}$), for which M was estimated at 0.61 yr^{-1} . Model 23.0 was identical in structure to 21.0 except that a single M was estimated and applied to all length classes. Model 23.1, addressing a request from the SSC in October 2023, was identical to model 23.0, except that a prior was placed on the estimate of M . Detailed results from 23.1 were not included in the SAFE document because they were similar to those from the other models. Overall, model 21.0 fit the data slightly better than 23.0. And while the CPT found little rationale to support the estimated M (0.61 yr^{-1}) for the largest size class in model 21.0, the estimated M (0.41 yr^{-1}) across all size bins in model 23.0 was considered more biologically unrealistic. To maintain consistency in the absence of any evidence or rationale that model 23.0 represented an improvement on model 21.0, the CPT recommended that model 21.0 again be adopted to determine stock status and calculate the OFL and ABC.

Stock biomass and recruitment trends

Estimated mature male biomass was low in 1982 following a sharp decline from the peak biomass in 1977. MMB increased from a historic low in 1996 to a peak in 2010, after which it fluctuated about the B_{MSY} proxy. Estimated MMB increased to its highest level since the late 1980s in 2022 (2,880 t) after its lowest estimated level in 2019 (1,139 t). Estimated MMB has decreased over the past two years to 2,504 t for 2024. Estimated recruitment has generally been variable, but recruitment in 2021 was the highest since the late 1970s; it decreased in 2022 and 2023, but the estimate for 2024 is somewhat larger than that for 2023. The 2023 NMFS survey estimate of male abundance declined slightly from the 2022 estimate, from 2.1 to 1.7 million males larger than 64 mm CL. In contrast, the ADF&G trawl survey showed an increase in abundance from 2021 (2.4 million males) to 2023 (3.4 million males); the ADF&G survey was not conducted during 2022. Standardized CPUE from the 2023 summer commercial fishery, 2.13, was larger than that for 2022 (1.41).

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that this stock remain in Tier 4. Using model 21.0, the Tier 4 B_{MSY} proxy for model 21.0 was calculated as the average of mature male biomass on February 1 during 1980-2024 and equaled 2,019 t. The estimated 2024 mature male biomass on February 1 was 2,504 t, which is above the B_{MSY} proxy, placing Norton Sound red king crab in status category 4a. The corresponding F_{MSY} proxy for NSRKC is $M = 0.18 \text{ yr}^{-1}$ (using the default $\gamma = 1.0$), as is the associated F_{OFL} because the 2024 mature male biomass is greater than the B_{MSY} proxy. In 2023, the CPT recommended adopting a retained catch OFL due to the lack of new information on discard mortality; the SSC rejected this recommendation and based the OFL on total catch mortality as in 2022. To maintain consistency with recent practice, the CPT recommends a total catch OFL for 2024. Consequently, the 2024 Tier 4a total catch OFL is 332 t (0.733 million lb).

The CPT recommends that the ABC for 2024 be set below the maximum permissible ABC. In 2023, the SSC endorsed using a buffer of 30% for the ABC given concerns regarding assessment. Although retrospective patterns showed improvement in 2024, the majority of concerns identified in 2023 are still relevant. These concerns include:

- uncertainty regarding biological characteristics:
 - M and size-at-maturity are borrowed from other stocks;
 - impact of seasonal movement on survey estimates;
 - uncertainty in stock vs. survey areas;
- shortage of discard data on which to base estimates of total catch mortality;
- estimates of total catch mortality rely on *ad hoc* methods to estimate discards;
- discrepancies between the ADF&G and NOAA NBS survey estimates remain unresolved;
- some parameters are at bounds, indicating potential problems with convergence;
- the model consistently overestimates the proportion of large crab; and
- whether the high estimate for M in the largest size class is reasonable remains unresolved

The SSC requested the author provide an alternative ABC buffer based on using the long-term average fishing mortality rate as F_{OFL} in place of M in the OFL calculation. Using this approach, the buffer would be 41%. However, the CPT considered this approach to be more appropriate for setting TAC than ABC because the latter is supposed to account for scientific uncertainty not included in the assessment model. Thus, the CPT does not recommend adopting the alternative approach and recommends using the same ABC buffer as was endorsed by the SSC in 2023: 30%. The resulting ABC is 233 t (0.513 million lb).

Status and catch specifications (million lb.) Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | GHL | Retained Catch Mortality ¹ | Total Catch Mortality ² | OFL ³ | ABC ³ |
|------|------|---------------|------|---------------------------------------|------------------------------------|------------------|------------------|
| 2019 | 2.24 | 3.12 | 0.15 | 0.08 | 0.08 | 0.24 | 0.19 |
| 2020 | 2.28 | 3.67 | 0.17 | Conf. | Conf. | 0.29 | 0.20 |
| 2021 | 2.26 | 5.00 | 0.38 | 0.007 | 0.007 | 0.63 | 0.35 |
| 2022 | 2.08 | 5.33 | 0.34 | 0.34 | 0.36 | 0.67 | 0.40 |
| 2023 | 2.65 | 5.29 | 0.39 | 0.43 | 0.44 | 0.680 | 0.480 |
| 2024 | 2.20 | 5.52 | | | | 0.733 | 0.513 |

Status and catch specifications (1000 t)

| Year | MSST | Biomass (MMB) | GHL | Retained Catch Mortality ¹ | Total Catch Mortality ² | OFL ³ | ABC ³ |
|------|------|---------------|------|---------------------------------------|------------------------------------|------------------|------------------|
| 2019 | 1.03 | 1.41 | 0.07 | 0.04 | 0.04 | 0.11 | 0.09 |
| 2020 | 1.04 | 1.66 | 0.08 | Conf. | Conf. | 0.13 | 0.09 |
| 2021 | 1.03 | 2.27 | 0.17 | 0.003 | 0.003 | 0.29 | 0.16 |
| 2022 | 0.95 | 2.42 | 0.15 | 0.15 | 0.16 | 0.30 | 0.18 |
| 2023 | 1.20 | 2.40 | 0.18 | 0.19 | 0.20 | 0.310 | 0.220 |
| 2024 | 1.00 | 2.50 | | | | 0.332 | 0.233 |

Notes:

¹2019:2020: Refers to commercial fisheries only; 2021-2023: refers to all (commercial + subsistence) retained catch

²2019:2020: Do not include discard mortality (total retained catch only); 2021-2023 include estimated discard mortality

³OFL/ABC are total catch values in 2021-2024

Discard catch mortality was estimated within the model to be 0.01 thousand t and was added to observed retained catch to produce a total catch mortality. Total catch mortality in 2023 (0.2 thousand t) was less than the OFL (0.31 thousand t); therefore, overfishing did not occur.

8. Aleutian Islands Golden King Crab

Fishery information relative to OFL setting

During the 2023/24 fishery, the estimated retained catch was 2.578 kt (5.7 million lb), while the estimated total catch mortality was 2.755 kt (6.1 million lb). At the time of the 2023/24 assessment, the groundfish fisheries had not been completed, so total catch mortality is an estimate, and the total fishery mortality will be updated in September 2024.

Data and assessment methodology

The assessment for AI golden king crab establishes a single OFL and ABC for the whole stock. However, separate models are evaluated for the EAG and the WAG owing to, *inter alia*, different abundance trends in each area. A Tier 3 modeling framework for AI golden king crab based on fisheries-only data was developed over several years starting in 2011 with model assumptions and data inputs refined by reviews by the SSC and CPT. This modeling framework was recommended for the assessment by the CPT in September 2016 and approved by the SSC in October 2016. The CPT endorsed, and the SSC subsequently

approved, the GMACS model for this stock in January 2023, and GMACS formed the basis for the 2023 and the current assessment.

The model-based stock assessment involves fitting a male-only population dynamics model to data on catches and discards in the directed fishery, discards in the groundfish fishery, standardized indices of abundance based on observer and fish ticket data, length-frequency data for the directed fishery (landings and total catch), and mark-recapture data. The groundfish fisheries in both areas were still operating when the assessment was conducted, but the difference in total catch mortality from that in the assessment is likely to be low. A cooperative survey was conducted by the Aleutian King Crab Research Foundation (an industry group) and ADF&G during the fishery in the EAG since 2016, and in the WAG during 2018 only. Indices based on the cooperative survey are not included in the current assessment.

The assessment author examined three models for the EAG and WAG this assessment cycle. Model 23.0a was the 2023 assessment model with updated catch and size-composition time series, and a CPUE index based on fitting GAMs. This model included three catchability periods, knife-edge male maturity size at 116 mm CL, M set to 0.22 yr^{-1} , a fixed period (1987–2020; updated from 1987–2017 for the 2023 assessment) for reference points calculation. Model 23.1 was model 23.0a with truncated size-composition data, i.e. excluding data for crab ≤ 100 mm carapace length, and Model 23.1b was the same as Model 23.1, except there are two selectivity periods during the pre-rationalized period (1985–1996; 1997–2004).

For the EAG, the three models provided very similar results. All three fit the retained catch, total catch, and groundfish bycatch data well. Otherwise, the three models fit the catch data almost identically. All three models also fit the standardized CPUE indices similarly, but the overall fits were poor. The fits to the retained catch and total catch size compositions were good, except that model 23.0a did not fit the data for the smallest size bin for total catch prior to 2005/06, where the model substantially underestimated the relative abundance. This was the reason for the development of model 23.1 which excludes the data for crab smaller than the lower limit of the smallest size bin in the model.

For the WAG, all three models fit the respective catch data and standardized CPUE indices equally well and produced similar estimates for the recruitment and MMB time series. The models followed the trends in standardized CPUE much better than the EAG models. However, the issue with the high relative abundances of small crab in the total catch size compositions was also evident in the data for model 23.0a.

The author-preferred models were 23.1 for both areas.

Stock biomass and recruitment trends

Estimated mature male biomass (MMB) for the EAG decreased from the 1980s to the 1990s, then increased during the 2000s, decreased marginally during the early 2010s, increased from 2014 to 2022 and declined slightly in 2023. Estimated MMB for the WAG decreased substantially during the late 1980s and 1990s, increased somewhat during the 2000s, decreased for several years after 2008 and has since declined steadily to a low in 2021 followed by slight increase since 2022. Recruitment to the EAG has declined from a high in 2017 to low but stable recruitment since 2021. Recruitment to the WAG has declined slowly since 1985, although 2023 recruitment is the highest since 2013.

Summary of major changes

The assessment model recommended by the CPT, Model 23.1, is identical to the model used in the previous assessment, except that it is based on revised (and new) catch and CPUE time-series and excludes the size-composition data for crab smaller than the lower limit of the first size bin the model. Model 23.1b fits the data better than Model 23.1, but the CPT agreed that the same model should be used for both the EAG and

WAG; the differences in results between models 23.1 and 23.1b are minimal and ongoing work may lead to a changed model structure.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that this stock be managed as a Tier 3 stock in 2024/25. A single OFL and ABC is defined for AIGKC. However, separate models are available by area. During its May 2017 meeting, the CPT recommended that stock status be determined by adding the area-specific estimates of current MMB and B_{MSY} to ensure that there would only be one stock status for the AIGKC stock. However, area-specific stock status is used to determine the ratio of F_{OFL} to $F_{35\%}$ by area, which is then used to calculate the OFLs by area, which are then summed to calculate an OFL for the entire stock. The SSC has concurred with this approach. The CPT recommends that the B_{MSY} proxy for the Tier 3 harvest control rule be based on the average recruitment from 1987-2020, years for which recruitment estimates are relatively precise.

This is the only crab assessment that relies solely on fishery CPUE as an index of abundance. The CPUE index standardization process, subject to past CPT and SSC review, is a key reason for the 25% buffer between the OFL and the ABC used in past years. Concerns raised in recent assessments are summarized in the following table:

| Concern | year expressed | CPT 2024 concern? | Reason |
|---|----------------|-------------------|--|
| Only crab assessment that relies entirely on fishery CPUE as an index of abundance | 2020 | Yes | No change. |
| Uncertainty in natural mortality | 2020 | Yes | No change. |
| The limited spatial coverage of the fishery with respect to the total stock distribution | 2020 | Yes | No change. |
| The small number of vessels on which CPUE is based | 2020 | Yes | No change. |
| Retrospective pattern for the EAG | 2020 | Yes | No change |
| CPUE standardization is still subject to some methodological concerns | 2020 | Less | The data on which the standardization is based have been checked and improved diagnostics are now available. |
| Catches from the WAG that were not included in the assessment | 2021 | Less | Only the total catch was not final at the time of the assessment |
| Model convergence concerns reflecting potential parameter confounding (jitter analysis resulted in multiple solutions for MMB and $B_{35\%}$ at same likelihood values) | 2024 | Yes | Some of the models converged to implausible but better fits to the data, which should be explored in future work. |
| Model does not fit the trend in the index for the EAG. | 2024 | Yes | The fit to the standardized CPUE index for the EAG remains poor – the retrospective pattern observed for the EAG is likely related to this poor fit. |

The SSC adopted a 30% buffer for the ABC in 2021/22 based primarily on concerns raised by a jitter analysis that suggested the model may be converging to local minima, exhibiting multiple values for reference points associated with a single value for the likelihood. In 2022/23, the CPT recommended, and the SSC concurred with, reducing the buffer for the ABC back to 25%, its value before 2021/22, principally because no problems of this sort occurred for the 2022 recommended models and the CPT found reasons to reduce or eliminate several other concerns. For 2023/24 and 2024/25, the CPT found that several previously expressed concerns continued to exist, the principal one being the retrospective patterns for the recommended EAG model. Thus, the CPT recommends continuing to use a 25% buffer, its value last year, on the OFL for the ABC.

Status and catch specifications (1000 t) for Aleutian Islands golden king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|-------|---------------|-------|----------------|--------------------|-------|-------|
| 2020/21 | 6.026 | 16.207 | 2.999 | 3.000 | 3.444 | 4.798 | 3.599 |
| 2021/22 | 5.859 | 12.592 | 2.690 | 2.699 | 3.056 | 4.817 | 3.372 |
| 2022/23 | 5.832 | 13.600 | 2.291 | 2.369 | 2.612 | 3.761 | 2.821 |
| 2023/24 | 5.772 | 12.716 | 2,508 | 2,578 | 2.761 ^a | 4.182 | 3.137 |
| 2024/25 | | 11.388 | | | | 3,725 | 2,794 |

Status and catch specifications (million lb) for Aleutian Islands golden king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------|--------|---------------|-------|----------------|--------------------|--------|-------|
| 2020/21 | 13.284 | 35.730 | 6.610 | 6.614 | 7.593 | 10.579 | 7.934 |
| 2021/22 | 12.917 | 27.760 | 5.930 | 5.951 | 6.737 | 10.620 | 7.434 |
| 2022/23 | 12.857 | 29.984 | 5.051 | 5.223 | 5.758 | 8.291 | 6.219 |
| 2023/24 | 12.725 | 28.034 | 5.530 | 5,684 | 6.087 ^a | 9.220 | 6.916 |
| 2024/25 | | 25.107 | | | | 8.212 | 6.159 |

^a *The groundfish fisheries were still being prosecuted when the 2024 assessment was conducted.*

At the time the assessment was conducted, the total catch was 2,755 kt (6.1 million lb). The total fishery mortality in 2023/24 was below the OFL therefore overfishing is not occurring.

9 Pribilof District Golden King Crab

In accordance with the approved schedule, the Pribilof Islands golden king crab (PIGKC) assessment is conducted triennially with the previous assessment in 2020. Therefore, a full stock assessment was conducted in 2023 with results to be applied for the 2024–2026 specifications. The PIGKC stock is managed by calendar year, rather than a crab year, basis. Additional information listed below summarizes the 2023 assessment.

Fishery information relative to OFL setting

The PIGKC fishery began in the 1981/82 season. The directed fishery mainly occurs in Pribilof Canyon of the continental slope. Peak directed harvest was 388 t by 50 vessels during the 1983/84 season; fishery participation has since been sporadic and retained catches vary from 0 to 155 t. A guideline harvest level (GHL) was first established in 1999 at 91 t and the fishery was managed with a GHL of 68 t from 2000 to 2014, which was reduced to 59 t in 2015. Discarded (non-retained) catch has occurred in the directed golden king crab fishery, the eastern Bering Sea snow crab fishery, the Bering Sea grooved Tanner crab fishery, and in Bering Sea groundfish fisheries. Estimates of annual total fishery mortality during 2001–2021 due to crab fisheries range from 0 to 73 t. Estimates of annual fishery mortality during 1991/92–2022 due to groundfish fisheries range from negligible to 9 t.

Data and assessment methodology

There is no assessment model for this stock. Fish ticket and observer data are available, as are size-frequency data from samples of landed crabs, and pot lifts sampled during crab fisheries, and from the groundfish fisheries. Much of the directed fishery data are confidential due to low participation levels. A random effects model for moving toward a Tier 4 assessment was explored during the 2023 assessment; however, there is no indication that the slope survey will be conducted with any regularity in future years. The CPT recommends that the Tier 4 model not be adopted until updated survey data become available.

Stock biomass and recruitment trends

There are no stock biomass data used in this Tier 5 assessment.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends this stock be managed under Tier 5 in 2024-2026. The CPT concurs with the author's recommended status quo OFL of 94.7 t and an ABC of 71.1 t. The OFL and ABC differ from the previous SAFE due to updates to the estimates of historical bycatch in the groundfish fisheries. The ABC was derived by applying a 25% buffer of the OFL, $ABC = 0.75 * OFL$, the same buffer used for other Tier 5 stocks with similar levels of concern. The 2021-2023 OFL calculation is the same as recommended by the SSC for 2013–2020.

Two vessels participated in the 2023 fishery, thus retained and total fishing mortality are confidential. There was no effort in bycatch crab fisheries (snow and grooved Tanner crab) and total bycatch mortality in groundfish fisheries was 0.36 t (794 lb). Overfishing did not occur in 2023.

Status and catch specifications (t) for Pribilof Islands golden king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | GHL | Retained Catch | Total Catch | OFL | ABC |
|-------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2019 | | | 59 | Conf. | Conf. | 93 | 70 |
| 2020 | | | 59 | 49 | 52 | 93 | 70 |
| 2021 | | | 59 | 16 | 21 | 93 | 70 |
| 2022 | | | 59 | Conf. | Conf. | 93 | 70 |
| 2023 | | | 59 | Conf. | Conf. | 93 | 70 |
| 2024 | | | | | | 95 | 71 |
| 2025 | | | | | | 95 | 71 |
| 2026 | | | | | | 95 | 71 |

Status and catch specifications (million lb) for Pribilof Islands golden king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Year | MSST | Biomass (MMB) | GHL | Retained Catch | Total Catch | OFL | ABC |
|-------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2019 | | | 0.13 | Conf. | Conf. | 0.20 | 0.15 |
| 2020 | | | 0.13 | 0.11 | 0.12 | 0.20 | 0.15 |
| 2021 | | | 0.13 | 0.03 | 0.05 | 0.20 | 0.15 |
| 2022 | | | 0.13 | Conf. | Conf. | 0.20 | 0.15 |
| 2023 | | | 0.13 | Conf. | Conf. | 0.20 | 0.15 |
| 2024 | | | | | | 0.21 | 0.16 |
| 2025 | | | | | | 0.21 | 0.16 |
| 2026 | | | | | | 0.21 | 0.16 |

10 Western Aleutian Islands red king crab

In accordance with the approved schedule, the Western Aleutian Islands king crab assessment is conducted triennially with the previous assessment in 2020. Therefore, a full stock assessment was conducted in 2023 with results to be applied for the 2023/24, 2024/25, and 2025/26 specifications. Additional information listed below summarizes the 2023 assessment.

Fishery information relative to OFL and ABC setting

After 1995/96, the fishery was opened only occasionally. There was an exploratory fishery in 1998/99, three commissioner's permit fisheries in limited areas during 2000/01–2002/03 to allow for ADF&G-Industry surveys, and two commercial fisheries with a GHF of 227 t in 2002/03 and 2003/04 in the Petrel Bank area. The fishery has been closed since 2003/04.

Bycatch of red king crabs occurs in both the directed red king crab fishery, the Aleutian Islands golden king crab fishery, and in groundfish fisheries. Estimated annual total fishing mortality from 1995/96 to 2022/23 averaged 27 t. The average retained catch during that period was 20 t. This fishery is rationalized under the Crab Rationalization Program only for the area west of 179° W longitude.

Data and assessment methodology

The 1960/61 to 2022/23 time series of retained catch (number and pounds of crabs), effort (vessels, landings, and pot lifts), average weight and average carapace length of landed crabs, and catch-per-unit effort (number of crabs per pot lift) are available. Bycatch from crab fisheries from 1995/96 to 2022/23 and from groundfish fisheries from 1993/94 to 2022/23 are available. There is no assessment model for this stock. The standardized surveys of the Petrel Bank area conducted by ADF&G in 2006 and 2009, and the ADF&G-Industry Petrel Bank surveys conducted in 2001 were too limited in geographic scope and too infrequent for reliable estimation of abundance for the entire western Aleutian Islands area.

Stock biomass and recruitment trends

Estimates of stock biomass, recruitment trends, and current levels relative to virgin or historical levels are not available for this stock. The fishery has been closed since 2003/04 due to apparent poor recruitment. A 2009 survey conducted by ADF&G in the Petrel Bank area encountered an aging population of legal male crab occurring in a more limited area and at lower densities than were found in a 2006 survey and provided no expectations for recruitment. A test fishery conducted by a commercial vessel during October–December 2009 in the area west of Petrel Bank yielded only one legal male red king crab. A cooperative red king crab survey was performed by the Aleutian King Crab Research Foundation and ADF&G in the Adak area in 2015 and the Petrel Bank area in 2016, which averaged less than one crab per pot lift suggesting that the stock is in poor condition.

Tier determination/Plan Team discussion and resulting OFL and ABC determination

The CPT recommends that this stock be managed under Tier 5 for the 2023/24, 2024/25, and 2025/26 seasons. The CPT concurs with the assessment author's recommendation of an OFL based on the 1995/96–2007/08 average total catch following the recommendation of the SSC in June 2010 to set the time period for computing the OFL at 1995/96–2007/08. The CPT recommends an OFL for 2023/24, 2024/25, and 2025/26 of 56 t.

The CPT continues to have concerns regarding the depleted condition of this stock. Groundfish bycatch in recent years has accounted for the majority of the total catch. The CPT recommends an ABC of 14 t for 2023/24, 2024/25, and 2025/26 which is equivalent to a 75% buffer on OFL. The recommended ABC of 14 t is the same as that recommended by the CPT in 2017 and 2020. The ABC was lowered in 2017 because 1) the industry has not expressed interest in a small test fishery, and 2) because the stock is severely depressed as indicated by the most recent industry-cooperative surveys. This logic still applies for this assessment cycle. The total catch in 202/21, 2021/22, and 2022/23 was less than the OFL therefore overfishing did not occur.

Status and catch specifications (t) for Western Aleutian Islands red king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Fishing Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2018/19 | | | Closed | 0 | <1 | 56 | 14 |
| 2019/20 | | | Closed | 0 | <1 | 56 | 14 |
| 2020/21 | | | Closed | 0 | <1 | 56 | 14 |
| 2021/22 | | | Closed | 0 | <1 | 56 | 14 |
| 2022/23 | | | Closed | 0 | <1 | 56 | 14 |
| 2023/24 | | | Closed | 0 | <1 | 56 | 14 |
| 2024/25 | | | | | | 56 | 14 |
| 2025/26 | | | | | | 56 | 14 |

Status and catch specifications (million lb) for Western Aleutian Islands red king crab. Shaded values are new estimates or projections based on the current assessment. Other table entries are based on historical assessments and are not updated except for total and retained catch.

| Fishing Year | MSST | Biomass (MMB) | TAC | Retained Catch | Total Catch | OFL | ABC |
|---------------------|-------------|----------------------|------------|-----------------------|--------------------|------------|------------|
| 2018/19 | | | Closed | 0 | 0.00146 | 0.12387 | 0.07432 |
| 2019/20 | | | Closed | 0 | 0.00166 | 0.12387 | 0.03097 |
| 2020/21 | | | Closed | 0 | 0.00075 | 0.12387 | 0.03097 |
| 2021/22 | | | Closed | 0 | 0.00016 | 0.12387 | 0.03097 |
| 2022/23 | | | Closed | 0 | 0.00028 | 0.12387 | 0.03097 |
| 2023/24 | | | Closed | 0 | 0.00028 | 0.12387 | 0.03097 |
| 2024/25 | | | | | | 0.12387 | 0.03097 |
| 2025/26 | | | | | | 0.12387 | 0.03097 |

Figures and Tables

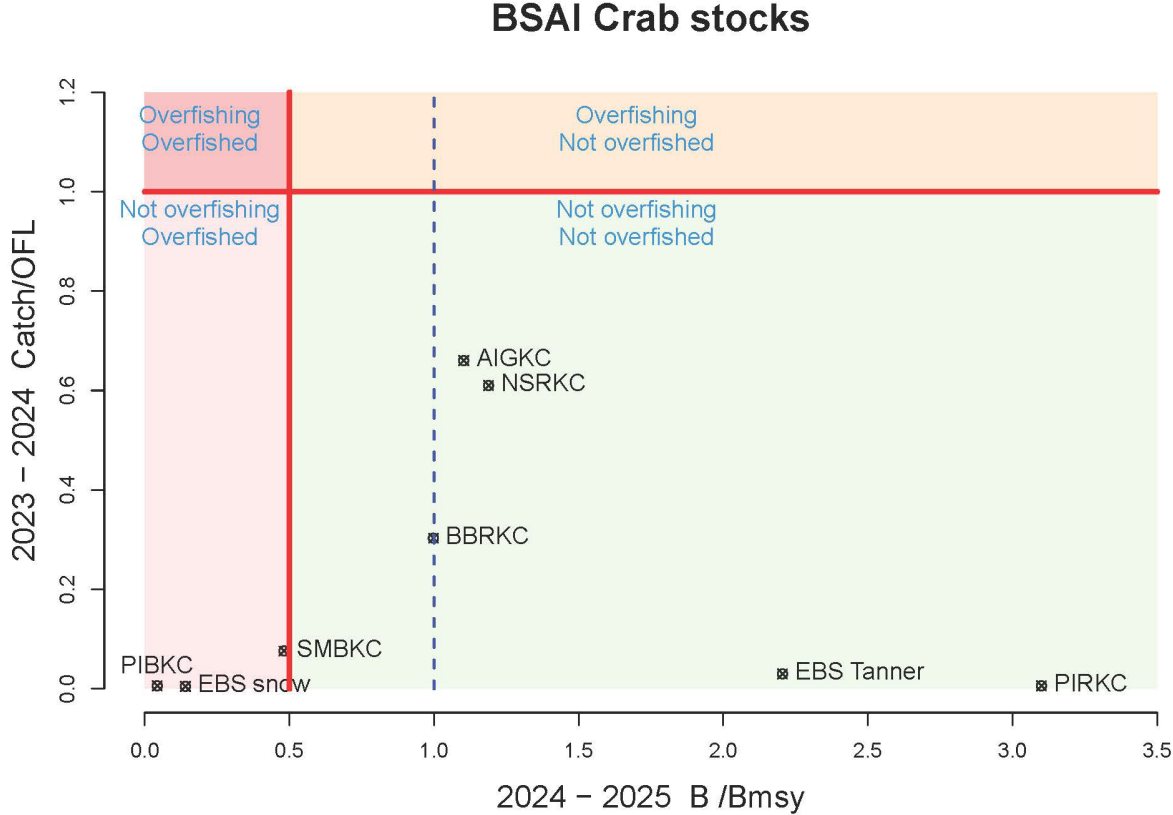


Figure 2: Status of eight Bering Sea and Aleutian Islands crab stocks in relation to status determination criteria (B_{MSY} , MSST, overfishing) for 2023/24. Note that information is insufficient to assess Tier 5 stocks according to these criteria (WAIRKC, PIGKC).

Table 4: Stock status in relation to status determination criteria for 2023/24 as estimated by the most recent assessment. Hatched areas indicate parameters not applicable for that tier. Values are in thousands of metric tons (kt).

| Chapter | Stock | Tier | MSST ¹ | BMSY or BMSYproxy | 2023/24 ¹ MMB | 2023/24 MMB/ MMBMSY | 2023/24 OFL | 2023/24 Total Catch | Rebuilding Status |
|---------|--|------|-------------------|---------------------|--------------------------|---------------------|-------------|---------------------|-------------------|
| 1 | EBS snow crab | 3 | 47.41 | 94.82 | 13.40 | 0.14 | 15.44 | 0.07 | overfished |
| 2 | BB red king crab | 3 | 9.35 | 18.69 | 18.65 | 1.00 | 4.42 | 1.34 | |
| 3 | EBS Tanner crab | 3 | 20.00 | 40.01 | 88.21 | 2.20 | 36.20 | 1.09 | |
| 4 | Pribilof Islands red king crab | 4 | 0.85 | 1.71 | 3.88 | 2.27 | 0.685 | 0.004 | |
| 5 | Pribilof Islands blue king crab | 4 | 2.10 | 4.20 | 0.181 | 0.043 | 0.00116 | 0.001 | overfished |
| 6 | St. Matthew Island blue king crab | 4 | 1.48 | 2.93 | 1.41 | 0.48 | 0.066 | 0.005 | overfished |
| 7 | Norton Sound red king crab | 4 | 1.00 ³ | 2.02 ^{3,4} | 2.40 | 1.19 | 0.31 | 0.20 | |
| 8 | AI golden king crab | 3 | 5.77 | 11.54 | 12.72 | 1.10 | 4.18 | 2.76 | |
| 9 | Pribilof Islands golden king crab ² | 5 | | | | | 0.095 | Conf | |
| 10 | Western AI red king crab | 5 | | | | | 0.056 | 0.001 | |

[1] MMB on 2/1/2023 for Norton Sound red king crab as estimated in the 2023 assessment and on 2/15/2024 for all other Tier 1-4 stocks using the 2024 assessments (this footnote is corrected from February 2024 and draft June 2024 SSC reports).

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

[3] Values are corrected from February 2024 and draft June 2024 SSC reports.

[4] BMSY proxy basis years for NSRKC are 1980 - 2023.

Table 5: CPT recommendations for Eastern Bering Sea crab stocks. Stocks for which specifications are rolled over between assessments (Pribilof Islands blue king crab, Pribilof Islands golden king crab and Western Aleutian Islands red king crab) or were set in February (Norton Sound red king crab) are also included. Biomass values are in thousand metric tons (kt). Tier designations in this table are based on the projected stock status in 2023/2024. Chapters 1 – 4 and 6 are set in October and Chapters 5 and 8 – 10 are set in June, in the year according to the assessment frequency cycle (see current SAFE Introduction for assessment cycle). Chapter 7 is set in February (for 2024).

| Chapter | Stock | Tier | FOFL | BMSY or BMSY proxy | BMSY basis years ¹ | 2024/2025 ² MMB | 2024/25 MMB / BMSY | Natural Mortality (M) | 2024/25 OFL | 2024/25 ABC | ABC Buffer |
|---------|--|------|---------------------------|--------------------|-------------------------------------|----------------------------|--------------------|-----------------------|-------------|-------------|------------|
| 1 | E. Bering Sea snow crab | 3c | 0 | 94.82 | 1984-2023 | 11.28 | 0.12 | 0.28 | 0.05 | 0.04 | 20% |
| 2 | Bristol Bay red king crab | 3b | 0.33 | 18.69 | 1984-2023 | 15.43 | 0.83 | 0.23 | 5.02 | 4.02 | 20% |
| 3 | E. Bering Sea Tanner crab | 3a | 1.23 | 40.01 | 1982-2023 | 56.06 | 1.40 | 0.23 | 41.29 | 33.03 | 20% |
| 4 | Pribilof Is. red king crab | 4a | 0.21 | 1.709 | 2000-2021 | 3.879 | 2.27 | 0.21 | 0.685 | 0.51 | 25% |
| 5 | Pribilof Is. blue king crab | 4c | 0 | 4.20 | 1980/81-1984/85; 1990/91-1997/98 | 0.181 | 0.04 | 0.18 | 0.00116 | 0.00087 | 25% |
| 6 | St. Matthew blue king crab | 4b | 0.11 | 2.93 | 1978-2023 | 1.53 | 0.52 | 0.23 | 0.129 | 0.097 | 25% |
| 7 | Norton Sound red king crab | 4a | 0.18 | 2.02 | 1980-2024 | 2.5 | 1.24 | 0.18 | 0.333 | 0.233 | 30% |
| 8 | Aleutian Is. golden king crab ³ | 3 | 0.55 (EAG), 0.44 (WAG) | 11.54 | 1987-2020 | 11.39 | 0.99 | 0.22 | 3.725 | 2.794 | 25% |
| 9 | Pribilof Is. golden king crab ⁴ | 5 | - | - | - | - | - | - | 0.114 | 0.085 | 25% |
| 10 | W. Aleutian Is. red king crab | 5 | - | - | - | - | - | - | 0.056 | 0.014 | 75% |

[1] For Tiers 3, 4 where BMSY proxy is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years from which the catch average for OFL is estimated.

[2] MMB is estimated on 2/1/2024 for Norton Sound red king crab and on 2/15/2024 for all other Tier 1-4 stocks, using the current assessments.

[3] AIGKC OFL and ABC are calculated by combining two separate assessment models for the EAG and WAG, as presented in the current assessment. Sub-tiers are set separately for each model and are detailed in the assessment document.

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