

Appendix B: Risk Table for Eastern Bering Sea Snow Crab

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The following is a synthesis and interpretation of the most recent ecosystem and socioeconomic information available for Eastern Bering Sea (EBS) snow crab from the ecosystem and socioeconomic profile (ESP, Fedewa et al., 2025) and the Eastern Bering Sea Ecosystem Status Report (ESR, [Siddon, 2024](#); Siddon, 2025, in press). This information may be helpful for evaluating risk table score levels and is organized below by the proposed risk table categories.

Using a Bayesian Adaptive Sampling (BAS) approach for indicator selection and importance, we identified no ecosystem indicators in the ESP that quantitatively predict recruitment of EBS snow crab. Because the suite of indicators tested using BAS did not strongly influence recruitment, population dynamics and ecosystem considerations below are interpreted as contextual information only (see Fedewa et al., 2025 for more details).

Category Summary:

Assessment-related Considerations	Population Dynamics Considerations	Ecosystem Considerations	Fishery-informed Stock Considerations
Level 2: Increased concern	Level 2: Increased concern	Level 1: Normal	Level 1: Normal
Instability in the model seen through jittering analyses increases uncertainty in output.	Stock-specific indicators related to natural mortality, growth and recruitment suggest no apparent population dynamics concerns. Directional downward shifts in male snow crab size at terminal molt have large implications for the fate of the medium-sized crab in the population.	Ecosystem indicators show current and projected warm conditions and reduced ice extent in the EBS, but warming is not yet approaching critical thresholds for highly stenothermic juvenile snow crab. Overall, ecosystem concerns are minor with uncertain impacts on the stock.	Fishery-informed indicators generally support improved stock condition relative to the most recent (2021/22) fishery. Despite continued extreme northerly shift in the center of distribution of fishing activity, no considerations observed in the most recent fishery suggest greater than normal risk of overfishing, independent of other considerations captured in the assessment and risk table.

Assessment-related Considerations:

Risk Level 2: Increased concern

- Jittering analyses produced two different clouds of ‘converged’ models that had markedly different OFLs, but nearly identical negative log likelihoods.
- Uncertainty around appropriate currency of management results in markedly different management advice.

Population Dynamics Considerations:

Risk Level 2: Increased concern

- The size at which 50% of the male snow crab population molted to maturity has been trending down for the past three decades, and decreased from 2024 to 2025. Mature female mean size at maturity increased substantially from 2024 to 2025, consistent with a cohort of large, immature females that were observed by the NOAA bottom trawl survey in 2024. These notable trends in growth and maturity alongside increased mature female abundance in 2025 point towards a strongly female-skewed operational sex ratio, although < 1% of mature females with empty clutches suggests high reproductive potential despite depressed abundances of large male snow crab (ESP: Fedewa et al., 2025).
- Juvenile snow crab energetic condition fell below laboratory-derived starvation thresholds during the population collapse, although a rebound in energetic condition post-collapse (2021-2025) coinciding with juvenile snow crab occupied temperatures < 1°C indicate conditions suitable for high survival, recruitment and stock recovery (ESP: Fedewa et al., 2025).
- Bitter crab disease and Pacific cod predation indicators that represent proximate mechanisms for increased mortality of juvenile snow crab have remained below average for the past 5 years (ESP: Fedewa et al., 2025; *Pacific cod consumption estimate for 2025 still in progress*).

Ecosystem Considerations:

Risk Level 1: Normal

Ecosystem indicators are organized into several categories to capture the scope of considerations available in the ESP and ESR reports:

- Distribution: December 2023 had significant along-shelf winds that could have driven offshore Ekman transport. March to May 2024 had weaker, but more sustained winds that also favored offshore transport (ESR: Hennon, 2024). Strong summer winds in 2024 resulted in a deep mixed layer (ESR: Hennon, 2024). A southward shift in the mature male snow crab center of abundance from 2021 to 2025 alongside a contraction in the area occupied by mature males coincided with a decline in the spatial extent of the cold pool since 2022 (ESP: Fedewa et al., 2025).
- Environmental Processes: During winter 2024-2025, the NPI was negative (ESR: Siddon, 2025) for the first time in 9 years, an indication of a stronger Aleutian Low Pressure System (ESR: Siddon, 2025). This means the Bering Sea was warm, stormy, and had less sea ice.
- Summer bottom trawl SSTs in the EBS were slightly cool, while mean bottom water temperature increased by 0.5°C from 2024 to 2025. The extent of the cold pool was below average and a 29% decrease from 2024 (ESR: Siddon, 2025).
- Winter/spring 2025 sea ice extent was below the 50-year time series mean, and declined substantially from 2024 to 2025 (ESP: Fedewa et al., 2025). Sea ice is expected to arrive in the northern Bering Sea later in winter 2025/2026 than 2024/2025 due to comparatively

low sea ice extent currently in the Chukchi Sea (ESR: Siddon, 2025 *forecast will be updated for final ESR*).

- The NMME ensemble forecasts as of today show moderate warm SST anomalies over much of the SEBS ($<0.5^{\circ}\text{C}$) into fall 2025, except Bristol Bay shows anomalies up to $+2^{\circ}\text{C}$. The NBS is projected to have SSTs close to the historical mean (ESR: Siddon, 2025 *forecast will be updated for final ESR*).
- Prey: Diatom abundance anomalies, based on the Continuous Plankton Recorder, remained positive from 2023 to 2024 (ESR: Siddon, 2025), indicating above-average feeding conditions for pelagic crab stages in 2023 and 2024.
- Competitors: Over the southern shelf, motile epifauna (e.g., sea stars, brittle stars) biomass increased from 2023 to 2024 and remains above the long term mean (ESR: Siddon, 2024). Benthic forager (i.e., small-mouthed flatfish) biomass increased from 2023 to 2024, but remains below the time series mean, suggesting competition for prey resources remains low in 2024 (ESR: Siddon, 2024).
- Predators: The biomass of Pacific cod during the standard bottom trawl survey decreased 5.5% from 2023 to 2024 (ESR: Siddon, 2024), indicating a reduction in predation pressure in 2024.

Fishery-informed Stock Considerations:

Risk Level 1: Normal

Considerations are from updated fishery performance indicators reported in the ESP (Fedewa et al., 2025) and results from the ABSC Skipper Survey regarding the 2024/2025 snow crab fishery.

- Total effort in the fishery, as measured by number of active vessels (25) and total potlifts, 15.7 thousand, was at a historical low during the 2024/25 fishery (ESP: Fedewa et al., 2025).
- CPUE of retained crab in the 2024/25 fishery increased to 219, well above the long term average, from a relatively extreme low of 124 during the last open season (2021/22), and the highest level since 2011/12 (ESP: Fedewa et al., 2025).
- Crab vessel captain observations on fishing conditions in the 2024/25 fishery, as reported in the ABSC Skipper Survey (ABSC, 2025), are consistent with high fishery CPUE. The majority (67%) of captains reported a greater than 10% increase in abundance of industry-preferred males relative to the previous open season, with 38% of respondents reporting a 25% or greater increase. The most commonly reported change in fishing practice from 2021/22 was setting pots at greater depth (48% of respondents) and the principal driver of change in fishing practices (43% of responses) was proportion of undesirable (dirty, low meat fill, bitter crab, etc) crab, compared to 10% of respondents indicating low CPUE as the principal driver.
- The center of distribution of fishing activity in the 2024/25 fishery remained near the extreme northern bound of the historical range, at 59.67 degrees North latitude, marginally north of the center of distribution during the 2021/22 season, and only slightly south of the 59.92 degree historical extreme observed during the 2020/21 season (ESP: Fedewa et al., 2025).

- Incidental catch of EBS snow crab to date in 2025 groundfish fisheries is at a historical low of 27.4 thousand metric tons (ESP: Fedewa et al., 2025).

References

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