Norton Sound red king crab stock assessment

Appendix B: Risk table and ecosystem considerations for the Norton Sound red king crab stock

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Introduction

In response to the requests from the SSC and CPT that stock assessment authors provide risk tables for all annually-assessed BSAI crab stocks, we present a draft risk table for the Norton Sound red king crab (NSRKC) stock. The following table was used to complete the draft risk table, with the CPT-proposed modification that levels 1, 2, and 3 correspond to "minimal to moderate concern", "substantial concern", and "extreme concern", respectively.

The table is applied by evaluating the severity of four types of considerations that could be used to support a scientific recommendation to reduce the ABC from the maximum permissible. These considerations are stock assessment considerations, population dynamics considerations, environmental/ecosystem considerations, and fishery performance. Examples of the types of concerns that might be relevant include the following:

1. Assessment considerations:
    a. Data-inputs: biased ages, skipped surveys, lack of fishery-independent trend data
    b. Model fits: poor fits to fishery or survey data, inability to simultaneously fit multiple data inputs
    c. Model performance: poor model convergence, multiple minima in the likelihood surface, parameters hitting bounds
    d. Estimation uncertainty: poorly-estimated but influential year classes
    e. Retrospective bias in biomass estimates.
2. Population dynamics considerations: decreasing biomass trend, poor recent recruitment, inability of the stock to rebuild, abrupt increase or decrease in stock abundance.
3. Environmental/ecosystem considerations: adverse trends in environmental/ecosystem indicators, ecosystem model results, decreases in ecosystem productivity, decreases in prey abundance or availability, increases or increases in predator abundance or productivity.
4. Fishery performance: fishery CPUE is showing a contrasting pattern from the stock biomass trend, unusual spatial pattern of fishing, changes in the percent of TAC taken, changes in the duration of fishery openings.

For crab stocks, an additional consideration type is used: tier considerations, which captures uncertainty due to the stock tier level.

	Assessment-related considerations	Population dynamics considerations	Environmental/ ecosystem considerations	Fishery performance
Level 1: No concern	Typical to moderately increased uncertainty/minor unresolved issues in assessment	Stock trends are typical for the stock; recent recruitment is within normal range	No apparent environmental/ ecosystem concerns	No apparent fishery/resource-use performance and/or behavior concerns
Level 2: major concern	Major problems with the stock assessment; very poor fits to data; high level of uncertainty; strong retrospective bias	Stock trends are highly unusual; very rapid changes in stock abundance, or highly atypical recruitment patterns	Multiple indicators showing consistent adverse signals a) across the same trophic level as the stock, and/or b) up or down trophic levels (i.e., predators and prey of the stock)	Multiple indicators showing consistent adverse signals a) across different sectors, and/or b) different gear types
Level 3: extreme concern	Severe problems with the stock assessment; severe retrospective bias. Assessment considered unreliable	Stock trends are unprecedented; more rapid changes in stock abundance than have ever been seen previously, or a very long stretch of poor recruitment compared to previous patterns	Extreme anomalies in multiple ecosystem indicators that are highly likely to impact the stock; potential for cascading effects on other ecosystem components	Extreme anomalies in multiple performance indicators that are highly likely to impact the stock

Summary and ABC recommendations

An Ecosystem and Socioeconomic Profile (ESP) has not yet been created for NSRKC. The information on environmental/ecosystems conditions used in this table is derived from the September 2025 Eastern Bering Sea (EBS) Ecosystem Status Report (ESR) presentation (Siddon 2025), as the 2025 report is not yet available.

The following is a summary of the risk table for Norton Sound red king crab:

Assessment-related considerations	Population dynamics considerations	Environmental/ ecosystem considerations	Fishery performance considerations
Level 2: uncertainty in stock versus survey areas; lack of discard data; higher M for large males	Level 1: low recent recruitment	Level 1: corrosive bottom waters (pH < 7.8) in Norton Sound	Level 1: crab per pot lift down from 2024 and below time series mean

Overall, the level of concern is similar to that in the previous assessment. The authors recommend using a 30% ABC buffer for 2026 harvest specifications, as was used for 2025 harvest specifications.

Details

Assessment considerations:

Level 2: substantial concern. As noted in the ABC buffer justifications for 2022-2024, uncertainty exists about the overlap between the stock and survey areas. The ADF&G and NOAA NBS trawl survey abundance estimates that are used in the stock assessment model are calculated over a spatial area that encompasses much of the historical harvest but likely not the complete distribution of the stock, meaning that survey abundance estimates may not accurately capture stock abundance. Work on developing a model-based index that unites information from the ADF&G and NOAA NBS trawl surveys while predicting abundance over an area that better represents the stock distribution is ongoing (Stern 2025). Other recurring concerns for the assessment include the lack of information about discards in the directed fisheries due to lack of observers, and the use of a higher natural mortality value for larger males in order to correct for the model's overestimation of the abundance of the largest male crab.

Population dynamics considerations:

Level 1: minimal to moderate concern. Recruitment estimates for the most recent years are low relative to the historical time series: recruitment estimates for 2022, 2023, and 2024 were 27%, 32%, and 41% of the time series mean recruitment, respectively. The 2025 EBS ESR presentation documented evidence of corrosive bottom waters (pH < 7.8) in Norton Sound, which may impact the growth and survival of red king crab (Siddon 2025). However, analyses linking these patterns are currently lacking.

Environmental/ecosystem considerations:

Level 1: minimal to moderate concern. In general, there is a lack of a mechanistic understanding for the direct and indirect effects of ecosystem indicators on the survival and productivity of NSRKC. Relevant

ecosystem indicator patterns documented in the 2025 EBS ESR presentation include sea surface temperatures in the Northern Bering Sea that were near average, bottom temperatures in Norton Sound that were similar to those measured in 2022 but warmer than in 2023, and corrosive bottom waters (pH < 7.8) in Norton Sound (Siddon 2025).

Fishery performance:

Level 1: minimal to moderate concern. Standardized catch-per-unit-effort (CPUE) of retained crab in the 2025 summer commercial fishery was down 57% from 2024, and was 22% below the time series mean. Total fishing mortality in 2025 was 369,426 lb, below the OFL (628,000 lb), ABC (440,000 lb), and GHL (410,000 lb).

Tier considerations:

NSRKC is a Tier 4 stock, and this tier placement indicates greater uncertainty associated with model outputs due to reduced data availability compared to the Tier 3 stocks.

Literature cited

Siddon E (2025) Eastern Bering Sea Ecosystem Status Report presentation. North Pacific Fishery Management Council, 1007 West 3rd Ave., Suite 400, Anchorage, Alaska 99501. PDF.

Stern CA (2025) Impacts of spatiotemporal index standardization on the stock assessment of Norton Sound red king crab. North Pacific Fishery Management Council, Anchorage, AK. PDF.