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., >123mm 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. In order 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 $B_{MSY\,\text{proxy}}$. 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 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.)

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	0.31	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	0.683	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	0.14	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:

[1]2019:2020: Refers to commercial fisheries only; 2021-2023: refers to all (commercial + subsistence) retained catch

[2]2019:2020: Do not include discard mortality (total retained catch only); 2021-2023 include estimated discard mortality

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