

## 7 Norton Sound red king crab

### *Fishery information relative to OFL setting*

The Norton Sound red king crab (NSRKC) stock supports three fisheries: summer commercial, winter commercial, and subsistence. The summer commercial fishery, which accounts for most of the catch, reached a peak in the late 1970s at a little over 1.313 kt retained catch. Retained catches since 1982 have been below 0.227 kt, averaging 0.136 kt., including several low years in the 1990s. As the crab population rebounded, retained catches increased to 0.231 kt in 2016, but decreased 69% to 0.073 kt. in 2019. The commercial crab fisheries did not operate in 2020 and only winter subsistence catch occurred.

### *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. The assessment is based on a length-based model of male crab abundance that combines multiple sources of data. A maximum likelihood approach was used to estimate quantities relevant in management. The assessment has been updated to include the following data: total catch and ADFG summer trawl survey. The standardized commercial catch CPUE indices were not updated due to no fisheries taking place, and no new tag recoveries. The current model assumes a constant  $M=0.18 \text{ yr}^{-1}$  for all length classes except the  $>123\text{mm}$  CL length-class, which had an estimated value of  $0.58 \text{ yr}^{-1}$ . Logistic functions are used to describe fishery and survey selectivities, except for a dome-shaped function used for the winter pot fishery.

The assessment author presented only the accepted model from last year based (model 19.0) based on the CPT's recommendation.

### *Stock biomass and recruitment trends*

Estimated mature male biomass was at an historic low in 1982 following a sharp decline from the peak biomass in 1977. MMB increased from a low in 1997 to a peak in 2010, after which it fluctuated about the  $B_{MSY \text{ proxy}}$ . Estimated MMB is currently increasing from low levels in 2019 that were comparable to the lowest estimates of MMB in 1982. Estimated recruitment has generally been variable and the most recent recruitment estimate is one of the largest since the late 1970s, but will not be corroborated until it enters the fishery in several years. The 2020 ADFG survey estimates of MMB declined sharply from the 2019 estimates, but the size composition data are still tracking the incoming cohort.

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

The CPT continues to recommend Tier 4a for Norton Sound red king crab. The  $B_{MSY}$  proxy, calculated as the average of mature male biomass on February 1 during 1980-2020 was 2.04 kt. The estimated 2021 mature male biomass on February 1 using Model 19.0 was 2,290 t which is above the  $B_{MSY}$  proxy for this stock, placing Norton Sound red king crab in status category 4a. The  $F_{MSY}$  proxy is  $M=0.18 \text{ yr}^{-1}$  and the  $F_{OFL}=0.18 \text{ yr}^{-1}$ , because the 2021 mature male biomass is greater than the  $B_{MSY}$  proxy and given the default  $\gamma=1.0$ .

The CPT recommended model 19.0 to set the OFL for 2021, resulting in an OFL of 0.59 million lb. (0.27 thousand t). The team recommended that the ABC for 2021 be set below the maximum permissible ABC. The team recommended that the SSC-endorsed buffer of 30% from the OFL be maintained given a list of concerns with the status of the stock (e.g. few legal males in the system) and assessment model (e.g. the OFL is based on legal crab, rather than retained size of crab, which, if caught, could inflate the realized mortality). The resulting ABC is 0.44 Milbs (0.20 kt). Previously, OFL was a retained catch OFL. The CPT-recommended OFL is a total catch OFL and incorporates a provisionally adopted method for calculating discard mortality.

*Status and catch specifications (million lb.)*

<b>Year</b>	<b>MSST</b>	<b>Biomass (MMB)</b>	<b>GHL</b>	<b>Retained Commercial Catch</b>	<b>Total Retained Catch</b>	<b>OFL*</b>	<b>ABC*</b>
2017	2.31	5.14	0.50	0.49	0.50	0.67	0.54
2018	2.41	4.08	0.30	0.31	0.34	0.43	0.35
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				0.63	0.44

*Status and catch specifications (1000t)*

<b>Year</b>	<b>MSST</b>	<b>Biomass (MMB)</b>	<b>GHL</b>	<b>Retained Commercial Catch</b>	<b>Total Retained Catch</b>	<b>OFL*</b>	<b>ABC*</b>
2017	1.05	2.33	0.23	0.22	0.24	0.30	0.24
2018	1.09	1.85	0.13	0.14	0.15	0.20	0.16
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				0.29	0.20

Notes:

MSST was calculated as  $B_{MSY}^{1/2}$

\*OFL/ABC is a total catch in 2021. (Retained OFL/ABC in previous years)

Conversion to Metric ton: 1 Metric ton (t) = 2.2046×1000 lb

Table 1. Summary recommendations for each BSAI crab stock from the final 2020 SAFE. Hatched areas indicate parameters not applicable for that tier. Biomass values are in thousand metric tons (kt).

SAFE Chapt.	Stock	Tier	F <sub>OFL</sub>	B <sub>MSY</sub> or B <sub>MSYproxy</sub>	B <sub>MSY</sub> basis years <sup>1</sup>	2020/21 <sup>2</sup> MMB	2020/21 MMB / MMB <sub>MSY</sub>	γ	Natural Mortality (M)	2020/21 <sup>[3]</sup> OFL	2020/21 ABC <sup>3</sup>	ABC Buffer	Add'l 2020 Buffer <sup>4</sup>
1	E. Bering Sea snow crab	3a	1.65	113.7	1982-2019 [recruitment]	276.7	2.43		0.34 (mat.fem) 0.36 (imm.) 0.36 (mat.male)	184.90	92.5	25%	25%
2	Bristol Bay red king crab	3b	0.16	25.4	1984-2019 [recruitment]	14.93	0.59		0.18	2.14	1.61	20%	5%
3	E. Bering Sea Tanner crab	3b	0.93	36.62	1982-2018 [recruitment]	35.31	0.96		0.32 (mat.fem) 0.24 (imm.) 0.29 (mat.male)	21.13	16.90	20%	50%
4	Pribilof Is. red king crab	4a	0.21	1.73	2001-2018 [MMB]	6.43	3.72	1	0.18	0.86	0.65	25%	
5	Pribilof Is. blue king crab	4c	0.18	4.11	1980/81-1984/85 & 1990/91-1997/98 [MMB]	0.175	0.04	1	0.18	0.00116	0.00087	25%	
6	St. Matthew blue king crab	4c	0.047	3.34	1978-2019 [MMB]	1.12	0.34	1	0.18	0.05	0.04	25%	0%
7	Norton Sound red king crab	4a	0.18	2.05	1980-2020 [MMB]	2.27	1.11	1	0.18 (0.58 >124 mm)	0.13	0.09	30%	
8	Aleutian Is. golden king crab	3a	EAG (0.61) WAG (0.56)	11.82	1987/88-2012/13	14.77	1.25		0.21	4.798	3.599	25%	
9	Pribilof Is. golden king crab	5	-	-	See intro chapter	-	-	-	-	0.093	0.070	25%	
10	W. Aleutian Is. red king crab	5	-	-	1995/96-2007/08	-	-	-	-	0.056	0.014	75%	

<sup>1</sup> 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 upon which the catch average for OFL is obtained.

<sup>2</sup> MMB as projected in Feb of this year for Norton Sound red king crab, and June of this year for AIGKC.

<sup>3</sup> AIGKC OFL and ABC calculated by author outside the chapter for using the Approach 2 combination of EAG and WAG and 25% buffer between OFL and ABC

<sup>4</sup> Additional ABC buffer added for some stock to address added uncertainty in OFL due to absence of 2020 trawl survey data

Table 2. Maximum permissible ABCs for 2020/21 and SSC recommended ABCs for three stocks where the SSC recommendation is below the maximum permissible ABC, as defined by Amendment 38 to the Crab FMP. Values are in thousand metric tons (kt).

Stock	Tier	2020/21 Max ABC	2020/21 ABC
EBS Snow Crab <sup>1</sup>	3	184.2	92.5
Bristol Bay RKC <sup>2</sup>	3	2.13	1.61
Tanner Crab <sup>3</sup>	3	20.87	16.90
Pribilof Islands RKC <sup>1</sup>	4	0.857	0.648
Pribilof Islands BKC <sup>4</sup>	4	0.00104	0.00087
Saint Matthew BKC <sup>2</sup>	4	0.05	0.04
Norton Sound RKC <sup>2</sup>	4	0.288	0.20
Aleutian Islands GKC <sup>2</sup>	3	4.773	3.599
Pribilof Islands GKC <sup>4</sup>	5	0.092	0.070
Western Aleutian Islands RKC <sup>4</sup>	5	0.056	0.014

Basis for P\* calculation of Max ABC:

<sup>1</sup>CV on terminal year biomass

<sup>2</sup>CV on OFL

<sup>3</sup>MCMC