

## 7 Norton Sound Red King Crab

### *Fishery information relative to OFL setting*

This stock supports three main fisheries: summer commercial, winter commercial, and winter subsistence. The summer commercial fishery, which accounts for the majority of the catch, reached a peak in the late 1970s at a little over 2.9 million pounds retained catch. Retained catches since 1982 have been below 0.5 million pounds, averaging 0.3 million pounds, including several low years in the 1990s. As the crab population rebounded, retained catches have increased to around 0.5 million pounds in recent years.

### *Data and assessment methodology*

Four types of surveys have occurred periodically during the last three decades: summer trawl, summer pot, winter pot, and preseason summer pot, but none of these surveys have been conducted every year. The assessment is based on a male-only length-based model of male crab abundance that combines multiple sources of data. A maximum likelihood approach was used to estimate abundance, recruitment, and selectivity and catchability of the commercial pot gear. The model has been updated to include the following data: total catch, catch length composition, discard length composition data from the 2017 summer commercial fishery, and 2016/17 winter commercial and subsistence catch. New trend data in the assessment included 2017 ADFG and NMFS surveys in Norton Sound. In addition, the standardized commercial catch CPUE indices were updated to include data for 1977-2017. The current model assumes a constant  $M=0.18 \text{ yr}^{-1}$  for all length classes except the 124-133mm and the  $> 134\text{mm}$  CL length-classes, which had an estimated value of  $0.579 \text{ yr}^{-1}$ . Logistic functions are used to describe fishery and survey selectivities, except for a dome-shaped function examined for the winter pot fishery.

The assessment author summarized five model run alternatives, a base model (model 0) identical to last year's assessment model, and several models that changed fisheries selectivity and added in estimation of natural mortality for the largest size classes in various ways (models 3, 4, and 5). A final model, model 6, included summer pot survey data. The CPT selected the base model (model 0) as the recommended model. This is also the author's recommended model. This model is also the same configuration as last year's assessment model. Several other models presented in the assessment improved model fits, but the model outputs such as fishery selectivity and estimated natural mortality were considered implausible and thus these models were not regarded as improvements by the CPT.

### *Stock biomass and recruitment trends*

Mature male biomass was estimated to be at an historic low in 1982 following a sharp decline from the peak biomass in 1977. The MMB then exhibited an increase from a low in 1997 to a peak in 2010, before showing minor declines and increases close to the  $B_{MSY \text{ proxy}}$ . The stock is current estimated to be on a downward trend. Estimated recruitment was weak during the late 1970s and high during the early 1980s, with a slight downward trend from 1983 to 1993. Estimated recruitment has generally been variable, with a slight decrease in the last several years.

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

The team continues to recommend Tier 4 for Norton Sound red king crab. The  $B_{MSY \text{ proxy}}$ , calculated as the average of mature male biomass on February 1 during 1980-2018 was 4.818 million lb. The estimated 2018 mature male biomass on February 1 using Model 0 is 4.079 million lb., which is below the  $B_{MSY \text{ proxy}}$  for this stock, placing Norton Sound red king crab in status category 4b.

The  $F_{MSY \text{ proxy}}$  is  $M=0.18 \text{ yr}^{-1}$  and the  $F_{OFL}=0.15 \text{ yr}^{-1}$ , because the 2018 mature male biomass is less than  $B_{MSY \text{ proxy}}$ , with the CPT choosing the default of  $\gamma=1.0$ .

The CPT recommends that the OFL for 2018 be set according to model 0, for which the calculated OFL is 0.43 million lb. (0.20 thousand t). The team recommends that the ABC for 2018 be set below the maximum permissible ABC. The team recommends that the SSC endorsed buffer of 20% from the OFL be used to set the ABC at 0.35 million lb. (0.16 thousand t). The OFL is retained catch OFL although a total catch OFL is computed as part of the assessment. The recommendation of an ABC less than the maximum permissible is due to concerns with model specification and unresolved competing hypotheses about whether the lack of large animals in catches and surveys is due to higher mortality or migration from the area.

*Status and catch specifications (1000 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)	GHL	Retained Catch <sup>1</sup>	Total Catch <sup>2</sup>	Retained Catch OFL	Retained catch ABC
2014/15	0.96	1.68	0.17	0.18	0.18	0.21	0.19
2015	1.09	2.33	0.18	0.18	0.24	0.33	0.26
2016	1.03	2.66	0.24	0.23	0.24	0.32	0.26
2017	1.05	2.33	0.23	0.22	0.24	0.30	0.24
2018	1.09	1.85	TBD	TBD	TBD	0.20	0.16

1: Summer commercial fishery

2: Summer commercial fishery, winter commercial fishery and subsistence fishery

*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 <sup>1</sup>	Total Catch <sup>2</sup>	Retained Catch OFL	Retained catch ABC
2014/15	2.11	3.71	0.38	0.39	0.39	0.46	0.42
2015	2.41	5.13	0.39	0.40	0.52	0.72	0.58
2016	2.26	5.87	0.52	0.51	0.52	0.71	0.57
2017	2.31	5.14	0.50	0.49	0.50	0.67	0.54
2018	2.41	4.08	TBD	TBD	TBD	0.43	0.35

Total retained catch during 2017 did not exceed the OFL for this stock, thus overfishing is not occurring. Stock biomass is above MSST; thus, the stock is not overfished.

#### *Additional Plan Team recommendations*

The CPT has the following recommendations for the next assessment:

- Evaluate methods to improve ADFG bottom trawl survey biomass estimation, including model-based approaches.
- Quantitatively evaluate the representativeness of observer sampling.
- Estimate a fishery retention curve. Consider alternative (2-parameter and 1-parameter) curves for both retention and selectivity.
- Provide tier 3 calculations for Norton Sound red king crab and evaluate its suitability for tier 3 status.