C-3 Norton Sound Red King Crab specifications

Diana Stram (NPFMC) presented an overview of the Norton Sound red king crab stock assessment and related Crab Plan Team (CPT) comments. There was no public testimony.

The catch specification process for Norton Sound red king crab occurs off-cycle at the February Council meeting and not later in the year with the other crab assessments because of the need for assessment in advance of the CDQ fishery, which occurs as early as May. Also, because of this advanced timing, the assessment model for Norton Sound red king crab now starts the assessment year on February 1 rather than February 15 as is used in other crab assessments.

The assessment was updated with new data, including the 2015 summer commercial fishery (total catch, catch length composition, and discard length composition), 2014/15 winter commercial catch, and 2014/15 subsistence catch. The assessment examined 15 model alternatives in addition to the base model (Model 0). Alternative models examined various combinations of the following modifications: (1) estimation of an M multiplier for crabs >123 mm carapace length (CL), (2) estimation of a single constant M for all length classes, (3) estimation of M for crabs ≤123 mm CL and an M multiplier for those >123 mm CL, (4) expansion of the size range included in the model from 74-124 to 64-134 mm CL, and (5) reduction of the length class intervals from 10 to 5 mm. The author and CPT recommended use of Model 5, which contains an estimated multiplier from the baseline natural mortality rate for the lengths >123mm CL, expanded length classes from the previous 6 length classes spanning 74 to >123mm CL to 8 length classes covering 64 to >133mm using the same 10 mm length intervals. Of all models considered, model 5 had no major retrospective pattern and the lowest Mohn's rho.

The SSC concurs with the choice of Model 5 and management of this stock under Tier 4a, as recommended by the assessment author and CPT. The SSC also agrees with the resultant 2016 OFL (equal to the max ABC) of 0.71 million lbs (0.32 thousand t) and the choice of a 20% buffer yielding a 2016 ABC of 0.57 million lbs (0.26 thousand t).

In recommending the 20% buffer, the CPT cited concerns with model specification, lack of bycatch data, and issues associated with high M in the largest size class. However, the SSC noted that, as indicated on page 12 of the SAFE document and as verified by ADF&G during questioning, there are no fisheries in Norton Sound with red king crab bycatch. So, bycatch should not contribute to uncertainty. Notwithstanding this, the SSC feels that the 20% buffer is appropriate, owing to uncertainties about model specification, particularly concerning the largest size class. In addition, the SSC noted that, while the model has no major retrospective biases (Fig. 17), there are some large discrepancies between predicted versus observed trawl survey abundance estimates in some years, including the most recent survey (Fig. 6).

The SSC appreciates the authors' replies to previous SSC comments. However, the SSC requests additional clarification on two replies. First, in response to a request to consider fixing trawl survey selectivity (did the author mean catchability?) to 1.0, the author indicated that this was not done because the parameter is not always 1.0. Please clarify the basis for this understanding that it is not always 1.0. Second, in reply to the SSC's alternative hypotheses about the "missing" large crabs (namely, localized depletion, high M or migration outside of the area), the author cited spring and fall surveys. The SSC was

uncertain whether the winter pot survey is meant by "spring" survey and summer trawl survey is meant by "fall" survey or something else. Please clarify. The timing of the "loss" may be informative with respect to the timing of molting. Namely, does the timing indicate that crab may go "missing" in association with the molting period? The SSC appreciates this additional information.

With regards to the issue of the "missing" large crab, the SSC offers two additional suggestions. First, a tagging project with satellite pop-off tags on the largest size class may offer new insights about the location of these large animals. Second, the SSC noted relatively high proportions of 134+ mm CL crab in the summer commercial catches taken during 1980-1982 (Table 4). The SSC requests the analyst investigate whether there are observer data that could be examined to verify those high proportions, including the geographic location of catches that included these animals. The SSC notes, however, that these apparent high proportions could instead simply be an artifact of poor recruitment (i.e., a relative lack of small crab, rather than relative increase in large animals).

The SSC was very interested in the conflicting observations about molt timing in April/May versus August/September. Moreover the comment about potential biennial mating is very intriguing. Both could have consequences on the assessment model. These topics should be priorities for future research.

The SSC thanks the author for the well-organized assessment, including the logical sequence of alternative models. Two minor comments follow:

1. In the heading for table b on p. 17, please explain what values are shown in the table.
2. For each figure, please indicate which model results are being shown.

Finally, the SSC endorses the excellent recommendations by the CPT.

D-5 Crab Modeling Workshop Report

Diana Stram (NPFMC) and Jim Ianelli (AFSC) presented a summary of the Crab Modeling Workshop held in Anchorage, AK January 13-16, 2016. This workshop has been held annually since 2008, with a focus in recent years on development of a Generalized Model for Alaska Crab Stocks (GMACS). This year's workshop resulted in: 1) updating participants on new GMACS model features and functionality, 2) side-by-side comparisons of GMACS and the existing model for St. Mathews blue king crab (SMBKC) as well as progress on a Bristol Bay red king crab (BBRKC) model in GMACS, and 3) discussions about next steps in GMACS implementation, coding priorities and tasks needed to bring a GMACS model to the CPT in May. There was no public comment on this issue.

Major updates to GMACS in the past year include an expansion of selectivity flexibility, improved prior and bound specification, increased flexibility for size composition fitting, code changes that allow for multiple models to be set up and run concurrently, continued progress on the simulation functionality, and improvements to plotting functions and documentation.

In February 2014 the SSC requested that the GMACS model receive external review. A CIE review was conducted in July 2015 and the reviewer comments were generally positive. The reviewers noted that more model generalization will be necessary to assess more stocks using GMACS, and they also

identified a suite of recommendations for future consideration. Many of the tasks and issues identified by the CIE reviews have already been addressed. Work is currently underway to allow seasonal time steps in the GMACS code. With the addition of seasons there was a suggestion that growth be handled as a seasonal event instead of a constant or continuous event, to mimic natural growth patterns. The GMACS model is able to accommodate catastrophic mortality events such as those observed in BBRKC.

The Crab Modeling workshop participants and the SSC discussed the need for continued funding and to identify a core group of code developers to provide modeling support in the future. There is an interest in reaching out to other regions where GMACS might be useful, such as the Northeast for lobster modeling, and an interest in providing a training session at some point to introduce assessment authors to GMACS. Future Crab Modeling Workshops will likely be held in Seattle to optimize participation and collaboration between AFSC, NOAA Office of Science and Technology, and UW faculty and students.

The SSC noted that the model documentation on the GMACS GitHub site and Wiki appears to be largely keeping pace with changes to the model structure, and encourages the core modeling team to continue to keep documentation up to date as the model evolves.

The SSC would like to recognize the extensive effort of the GMACS team since the inception of the project and in the progress made since the 2015 workshop. The GMACS authors, assessment authors, and workshop participants are commended for their continued hard work in bringing the SMBKC into GMACS so that a side-by-side comparison of the models could be made. The SSC looks forward to seeing the GMACS SMBKC model in June.