



BERING SEA FISHERIES RESEARCH FOUNDATION  
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FORGING COOPERATIVE RESEARCH PARTNERSHIPS IN THE BERING SEA

October 3, 2014

Dr. Pat Livingston (SSC, Chair)  
Alaska Fisheries Science Center, NMFS/NOAA  
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Seattle, WA 98115

Hello Pat and SSC members,

The Bering Sea Fisheries Research Foundation (BSFRF) is a non-profit research foundation formed in 2003 by the Bering Sea crab industry to help improve the science used to sustainably manage Bering Sea crab stocks. Our work has been primarily funded from voluntary industry-sponsored support and conducted as cooperative research partnering with the National Marine Fisheries Service Alaska Fisheries Science Center (AFSC) and the Alaska Department of Fish and Game (ADF&G). We've overcome some challenges and developed a best-practices approach to conducting effective research in a cooperative effort. Some of those methods include: conducting repeatable experiments, obtaining large sample sizes, collaborating with agency scientists, avoiding sensationalism, having agency scientists lead analyses, maintaining objectivity, and most importantly, working in a transparent manner.

This letter addresses a significant problem we faced with a lack of transparency during the recent CPT meetings. As direct participants in experimental research and analyses to improve Bering Sea crab stock assessments, and as supporters of improved stock assessment modeling via the Gmacs project, we were unable to adequately understand the treatment of NMFS survey results within the modeling process. Furthermore, we faced difficulties in communicating modeling results to research sponsors. Below, we've highlighted 1) our understanding of NMFS survey results, 2) key points of concern from assessments for the three large commercial stocks, 3) what we feel the SSC can do about our concerns and finally, 4) what we can do about these concerns.

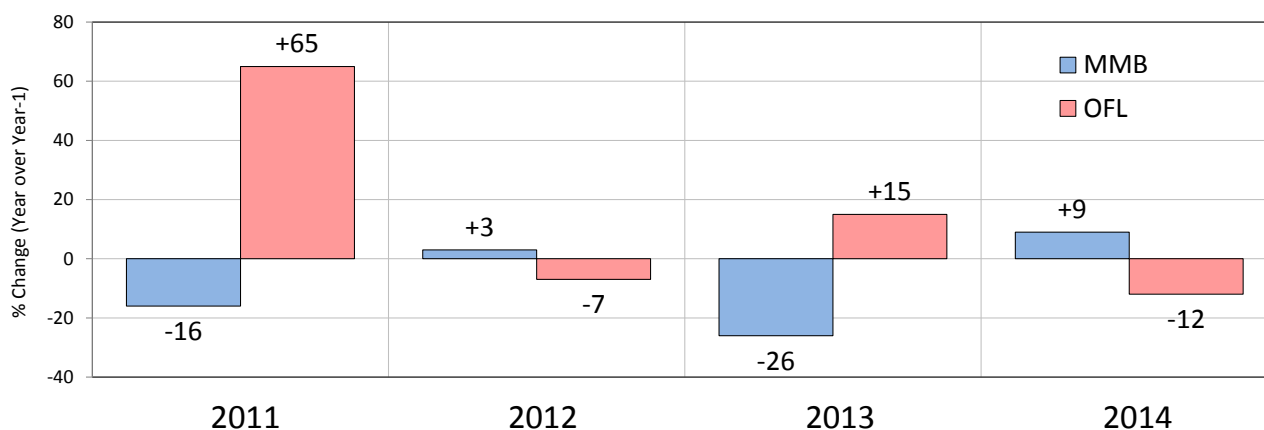
We were informed of preliminary results from the 2014 NMFS summer survey at the recent CPT, and were optimistic to learn that most commercial crab species sampled during the survey showed a strong positive signal in abundance and biomass, persisting across most size and sex categories. As you know, we have developed a close working knowledge of the NMFS survey in order to conduct collaborative but independent crab surveys alongside NMFS. Our crab survey research aims to augment NMFS survey results used for management and importantly, to improve the accuracy and precision of survey biomass estimates for Bering Sea crab stocks. In relative terms, the NMFS survey estimates of abundance and biomass for the three main Tier-3 commercial stocks (Bristol Bay red king crab, Bering Sea snow crab and Bering Sea Tanner

crab) showed increasing trends with better-than-typical precision. Aside from any methods improvements (cleaning up and revisions to time series), we understand there were no hot spots, no re-tows to resample changes in reproductive indices, and generally a more spatially broad and less patchy showing of crab in the survey. Accordingly, we expected to see a positive signal carry through in model results and management recommendations (OFL/ABC projections). We understand the current assessment models average and “dampen” such signals, but nevertheless were surprised by modeling results.

For Bristol Bay red king crab, abundance estimates from 2014 NMFS survey results showed substantial increases (over 2013) for legal males (+32.2%), mature males (+52.3%), and mature females (146.2%). The precision of these abundance estimates from 2014 was good (+/- 39%, 37%, 45%, respectively), relative to the historic time series when high abundance years' show poor precision (CIs of +/- 50-100%). The distribution of Bristol Bay red king crab sampled during the 2014 NMFS survey was spread out, near historical highs, where  $\geq 50$  stations contained legal males and no “hot spots” ( $>100$  legal males in one tow) were observed. Further, the length frequency distribution for male red king crab showed a strong mode near 90-95 mm carapace length which suggests a potential strong pre-recruit signal. The ADF&G assessment model for Bristol Bay red king crab appeared to find a poor match with 2014 survey length frequency distributions, and characterized the 2014 results as a “surprising” anomaly. Further difficulty with the model was apparent from concerns about NMFS trawl selectivity being informed by potentially mismatched methods (mis-specified), .i.e. fixing selectivity to a Bayesian prior (informed by an under-bag experiment) and fitting length frequency data to BSFRF trawl selectivity results. The results from the approved model scenario showed little or no influence from the strongly positive NMFS survey results, and in fact suggested a 9% declining trend in mature male biomass (MMB). In response to the suggested decline in MMB, OFL and ABC projections also went downward. In contrast, recent MMB abundance estimates directly from the NMFS survey from 2011-2014 are 8.1, 9.6, 12.8 and 19.5 million crab – showing a clear increasing trend.

For Bering Sea snow crab, abundance estimates from 2014 NMFS survey results showed substantial increases (over 2013); for legal males (+37.6%), and mature males (+81.5%), and little change in mature females (+1.0%). The precision of these abundance estimates from 2014 varied (38%, 28%, 40%, respectively) but were still lower, relative to the historic time series when high abundance years show poor precision (CIs of +/- 50-100%). The distribution of Bering Sea snow crab sampled during the 2014 NMFS survey was typical of recent survey years where  $>220$  stations contained legal males, and two high density areas were observed. While model scenarios presented for snow crab at the CPT covered the requested runs, there was unclear labeling of scenarios and some misunderstanding of the working “base model.” (2013 September approved model v. 2013 September w/new growth). Further, the results from the 2014 snow crab model approved by the CPT were difficult to interpret as there has been a large apparent correction in the last few years between predicted and observed biomass estimates at

the time of the survey. In 2013, the model predicted the survey biomass to be 1.5 times higher than observed and in 2014, the model substantially under-predicted the observed survey biomass. Corrections are expected as model fitting continues forward in a time series, but the scale of change in the two most recent years does not match with retrospective biomass estimation and actual OFL/ABC recommendations. Comparing current year to last, the last four years reflect an inverse relationship between biomass (MMB) and OFL - and model estimates of OFL go up each year as model estimates of MMB go down, and vice-versa (see figure below). While there has been some variability in recent years survey trends for the Bering Sea snow crab stock, as described above, the current model does not help to clarify 2014 survey results (+82% MMB) with corresponding OFL recommendations (-12%).



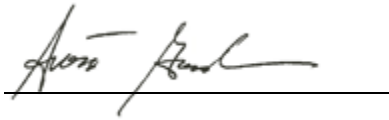
For Bering Sea Tanner crab, abundance estimates west of 166° W from 2014 NMFS survey results showed substantial increases (over 2013); for legal males (+62.1%), mature males (+71.4%) and preferred males (+49.7%), while mature females showed a small increase (+3.3%). For results east of 166° W from 2014 NMFS survey there was substantial increase (+143%) for preferred males, legal males (+13.2%) and declines for mature females (-33.3%), and mature males (-10.6%). Together, the two districts east and west show strong abundance increases for mature males (+19.1%), legal males (+33.8%) and preferred males (+81.1%) with a decrease in mature female (-18.4%) abundance. The precision of the abundance estimates from the survey results for males in both districts appear to be good (historically low) relative to the NMFS time series ranging from +/- 24-27% in the west and +/- 30-44% in the east, and poor for mature females (> +/- 50%) in both districts. Our understanding of the approved Tanner crab assessment recognizes there were policy choices (risk factors and buffer steps) being applied directly to estimates of OFL – and subsequently, the increases seen in the direct NMFS survey results are evident in an increase in the recommended ABC from 39.29 million lbs in 2013 to 55.51 million lbs in 2014 (+41%). Our concerns with the approved Tanner crab model run are specific to the inclusion of new data that lowered the estimates of handling mortality from 50% to 32.1%. Including this data affected model projections of OFL in an unexpected manner that was contrary to our expectations and contrary to the effects observed in the snow crab model (when a similar set of experimental data informed the lowering of snow crab handling mortality).

The CPT had an extended discussion of this relationship but did not provide a clear explanation as to why lowering the handling mortality might lead to lower estimates of stock productivity and lower recommended catches. To clarify, reducing the handling mortality in the Tanner crab model from 50% to 32.1% (a change of -36%) resulted in lower OFL projections (-7.3%), which was the opposite of the influence in the snow crab model where OFL projections increased by about +15% when handling mortality was lowered.

The primary role of BSFRF as a cooperative research foundation is to assist with improving science. Importantly, this includes the ability to raise valid concerns when there is an apparent lack of transparency or to ask questions about potentially mis-specified models and their effects on sustainable management. BSFRF acknowledges there has been a substantial amount of progress for assessment modeling of the three large Bering Sea crab stocks over recent years. We also appreciate recent improvements in the overall transparency of some steps in the process of evaluating the status of these crab stocks. Keeping stakeholders and research supporters informed about many complicated details is challenging but is an important part of sustainably managing Bering Sea crab fisheries. Industry supporters are generally aware that models will average the peaks and valleys of input (survey) data. The results from 2014 assessments however, have raised significant concerns as outlined above. We request that the SSC in their consideration of the recent CPT summary report and recommended OFL/ABC levels from assessment authors – see that the recommended values are very conservative and may not reflect a closer representation of reality from the direct survey results.

BSFRF is committed to helping improve the science for sustainably managing crab stocks. Our awareness of some modeling concerns in this year's assessment cycle has been coincidental to significant progress in the Generic Crab Modeling (Gmacs) effort. We are continuing to understand more about the Gmacs project and alter our expectations to align with recent progress reports. We now expect that the Gmacs project will provide a number of benefits: at the least, it should provide tools to run simulation-tests of assessment models and therefore efficiently identify sensitivities and help identify research needs; at most, it will enable the development of alternative assessment models that could replace current crab models under the guidance of the SSC. BSFRF is committing to help the Gmacs project continue its positive momentum by approving further support in the immediate future, before early 2015 when a new post-doctoral research associate will begin working on the project. There are several details of new support for the Gmacs project that will be deferred to CPT, assessment authors and modeling experts for work that BSFRF believes will improve the accuracy and efficiency of crab modeling and hopefully avoid gaps in transparency. We are available to respond with any questions you may have regarding this letter and thank you for your time and consideration.

Sincerely,



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BSFRF Executive Director,  
Scott Goodman



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BSFRF President  
Gary L. Painter

cc:

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