Crab Plan Team Report

North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501

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Crab Plan Team members present:
Bob Foy, Chair (NOAA Fisheries /AFSC – Kodiak)
Karla Bush, Vice-Chair (ADF&G – Juneau)
Diana Stram (NPFMC)
Ben Daly (ADF&G – Kodiak)
Laura Slater (ADF&G – Kodiak)
Miranda Westphal (ADF&G – Dutch Harbor)
Jack Turnock (NOAA Fisheries/AFSC – Seattle)
Shareef Siddeek (ADF&G – Juneau)
Martin Dorn (NOAA Fisheries /AFSC - Seattle)
William Stockhausen (NOAA Fisheries /AFSC - Seattle)
Bill Bechtol (Univ. of Alaska Fairbanks)
Brian Garber-Yonts (NOAA Fisheries – AFSC - Seattle)
Ginny Eckert (Univ. of Alaska Fairbanks/SFOS – Juneau)
André Punt (Univ. of Washington)

Members of the public and State of Alaska (ADF&G), Federal Agency (AFSC, NMFS), and Council (NPFMC) staff that were present (or participated through WebEx) for all or part of the meeting included: Linda Kozak, Keeley Kent, D'Arcy Weber, John Hilsinger, Jie Zheng, Scott Goodman, Toshide Hamazaki, Jim Ianelli, Ruth Christiansen, Gary Stauffer, Wes Jones, Caitlin Allen Akselrud, Madison Shipley and Chris Siddon

Administration

The attached agenda was agreed upon for the meeting. The Team notified the public that items will be taken up early if timing allows. The BBRKC PSC paper and the BSFRF survey were noted as candidates to be taken in advance.

The following upcoming meetings were identified:
EFH webex meeting: March 7, details and agenda TBD distributed on Council website.
May CPT: May 2-5, 2017. Juneau, AK. Federal building.
September CPT: September 18-22, 2017. AFSC, Seattle

Norton Sound Red King Crab

Model selection

Toshihide (Hamachan) Hamazaki presented the draft 2017 stock assessment of Norton Sound Red King Crab to the CPT. The draft assessment included six alternative model runs in addition to the 2016 base model (model 0):

- Model 1: as for model 0, but with length-class-specific molt probabilities and model estimated M for the largest length class..
- Model 2: as for model 1, except that + = 0.18 for all length classes.
- Model 3: as for model 0, but both of the parameters of the reverse logistic function are estimated (model 0 sets the molt probability for the 64-73 mm length-class to 0.9999).
- Model 4: as for model 3, but molt probability is assumed to vary as a random walk.
- Model 5: as for model 2, but the parameters for the commercial fishery and trawl survey selectivities are estimated by length-class.
- Model 6: as for model 5, but natural mortality is estimated.

The CPT recommends that the OFL be based on Model 3 because it fits the data better than Model 0 with only one additional parameter. Model 1 also fits the data better than Model 0, but has 6 more parameters. Both Models 2 and 3 estimate the molt probability for the 64-73 mm length-class, which appears to be main reason for the improved fit. Models 5 and 6 fit the data better than Model 0, but contain many more parameters as selectivity for the commercial fishery and the trawl survey are estimated as individual parameters. The CPT was also concerned about the estimate of 0.44 yr^{-1} for *M* for Model 6, which is considerably higher than the value assumed for *M* for other stocks of red king crab.

Model 3 provides an adequate fit to the available data, but exhibits a moderate retrospective pattern.

Calculation of the OFL and ABC

The parameter "p" determines the fraction of the OFL that occurs during the winter season. The assessment author suggested that p be set to 0.16 because 8% of the GHL is assigned to the winter fishery and the CDQ catch (7.5% of the GHL) has been occurring during the winter season. The CPT concurs with the approach taken by the analyst, but suggests that the next assessment report the full range of possible OFLs as a function of p since natural mortality is applied after the winter fishery. Additionally, the CPT suggests the proportion of catch that occurs during the summer and winter seasons continue to be examined periodically.

The CPT supports basing B_{MSY} on recruitment from 1980 to 2017 as there is no evidence to support not including the 2017 recruitment in the calculation of mean recruitment, but the time period used to set the proxy B_{MSY} needs to be addressed during a future CPT meeting.

Other

Hamachan explored biological rationale for separate timeframes for molting probabilities, including correlations between deviations and temperature (air temperature in Nome was the best available data source for temperature); no correlations were detected.

There is considerable uncertainty regarding whether the lack of large animals in fishery and survey catches is due to (a) higher natural mortality, or (b) migration. The CPT was informed that pop-up tags have been placed on a small number of animals. However, sample sizes are currently very small and tag technology is evolving. The CPT looks forward to future results from this effort.

The CPT expects that results from the 2017 NOAA survey will be available for the 2018 assessment. It is likely that results will also be available from an ADF&G survey. These surveys are conducted using different survey grids and gear, but have been assumed to have the same survey selectivity and catchability. The CPT requested Hamachan assess which data inputs are most influential for the assessment. This can be accomplished at the September CPT meeting using the results of model runs in which each data source (discard length data, survey data, etc.) are omitted in turn. The CPT also requested that the author explore bycatch data to see if it is possible to determine the OFL as total catch.

The CPT recommends breaking out natural mortality by size class for future model evaluation.

Aleutian Island Golden King Crab

At the September CPT meeting, the AIGKC assessment model was approved by the CPT for setting OFLs and ABCs, and the October meeting of the SSC also endorsed moving forward with the model. Goals at this meeting were to evaluate the model runs requested by the CPT in September and by the SSC in October, to consider the appropriate tier level for the AIGKC assessment, and to propose a set of model runs for evaluation and potential adoption at the May CPT meeting. Shareef Siddeek (ADF&G) presented a set of model scenarios that explored approaches to the estimation of natural mortality, contrasted methods to initialize the assessment model, evaluated the assumption that catchability is proportional to abundance, and compared alternative methods of data weighting.

Natural mortality was estimated using a combined EAG/WAG model as recommended by the SSC and a prior for natural mortality was also used. A likelihood profile that excluded the prior indicated that the AIGKC data were highly informative with respect to natural mortality. The prior had no discernable effect. The mean of the prior was set equal to the king crab natural mortality ($M = 0.18$). While the CPT accepts the approach of using a combined EAG/WAG model to estimate natural mortality, the team would also like to see evidence that tests have been done to show that the combined model gives precisely the same results as the two individual models, since only the individual models have undergone technical review. The assessment author should confirm that the combined profile (without the prior) has a minimum at 0.225 yr^{-1} because the step size for M was fairly small.

The likelihood profiles by data components for natural mortality showed that the WAG CPUE had a different profile than other data components, showing a strong improvement in fit at lower values of natural mortality. It would be good to confirm that this is correct.

Because of a poorly worded request by the CPT in September, the base model extended the observer CPUE time series used in the model back to 1991 (previously the first year had been 1995). What the CPT actually wanted was to evaluate use of the retained catch CPUE time series for the period 1985-1998. Model scenario 4, which did include retained catch CPUE, suggested that it provided useful information in the early years

of the fishery, and the CPT recommends that it be included in the base model for May. Examination of diagnostics for the observer CPUE data indicated there was justification for starting the observer CPUE time series in 1995, since the earlier data in 1991-1994 was based on fewer boats and different gear than was used subsequently. In addition, only the catcher-processor vessels carried observers prior to 1995.

One odd result for the EAG model is that the model estimates a declining trend in recruitment during the period prior to when there are data available to inform the assessment. This does not occur for the WAG model. To explore why this might be happening, Siddeek provided results where length-composition data were sequentially dropped, starting with the initial length composition in 1985 (Scenarios 1a-1d). When the 1985-1988 length composition data were removed from the model, the declining trend in recruitment disappeared, but the estimated abundance subsequent to 1985 was nearly identical to that for the base model. This suggests that the EAG pattern in early recruitment is being driven by the initial length compositions, which must indicate some pre-exploitation variation in recruitment. This analysis addresses the CPT concern.

The stock assessment initializes in 1960 using mean recruitment from a specified time period. In the base model, the period 1996-2015 was used, which seemed unexpected to the CPT. Models (Scenarios 14a, 14b, and 14c) in which that time period was varied had no impact on the estimated abundance after the initial burn-in period. In addition, Siddeek provided results for two rather extreme perturbations where the recruitment in 1960 was multiplied by 0.5 and 1.5. These model runs also indicated that estimated abundance after the initial burn-in period was not affected. The CPT recommends that CVs for the recruitment estimates be examined and that only those recruitment estimates that are informed by data (i.e., recruit CVs less than sigma R) be used to obtain mean recruitment to initialize the model and compute the B_{MSY} proxy under the Tier 3 control rule.

The scenario with domed-shaped fishery selectivity likely had selectivity parameters that were hitting their bounds. The rationale for dome-shaped fishery selectivity is not obvious, and does not appear to be based on knowledge of how the fishery operates. The CPT recommends that dome-shaped selectivity models not be carried forward for the May meeting.

Scenarios 5 and 6 applied square root and square transformations to CPUE to evaluate the impact of the assumption that CPUE and abundance are linearly related. Unsurprisingly, these scenarios showed that model results are sensitive to this assumption, but overall scale and abundance trends are similar. A model run requested by the CPT in which the CPUE index was entirely removed indicated that broadly similar results in both overall scale and abundance trends could be obtained without fitting the CPUE index, suggesting that the CPUE data and the size composition data are consistent. The CPT's attempts to understand how data were informing the overall scale of the stock were not entirely definitive. The most likely scenario appears to be that both length composition and CPUE data showed a consistent response to the historical period of high catches, which is when both data sets would be informative about overall scale of the stock.

Siddeek presented results from data-reweighting using both the Francis and the McAllister and Ianelli approaches. Both procedures gave reasonable results, though in some cases the McAllister and Ianelli method resulting in up-weighting data sets. Francis multipliers were between 0.4 and 0.8 depending on the

data set and area model. Estimated biomass and trends were not strongly affected by data weighting, suggesting again that the length-composition data and the CPUE trends are not in conflict. The CPT agrees with the author's recommendation that the Francis method be adopted as the preferred approach for selecting weights for length-composition data for AIGKC. The Francis method is based on important considerations (autocorrelation in the residuals) that the McAllister and Ianelli method does not take into account and gives reasonable results.

There were questions from industry analysts on whether the spatial distribution of fishing has changed over time, particularly since the number of participants in the fishery has declined. Though it was only cursory evaluation, the CPT looked at the spatial distribution of the fishery (slides from Chris Siddon) and did not see clumping or compression of area fished before and after rationalization. The CPT recommends that the changes in the spatial pattern of fishing be evaluated further for the May CPT meeting based on plots by year (or blocks of years). If the fishery has become more compressed spatially over time, CPUE indices could be providing misleading indices of abundance.

The CPT discussed whether AIGKC should be considered a Tier 3 or a Tier 4 stock. In the crab FMP, the criteria for a Tier 3 stock is that biological information is available to estimate F35%. An F35% calculation requires vectors for maturity, selectivity, and natural mortality—all of which are available for AIGKC. Therefore the CPT recommends that AIGKC be placed in Tier 3. If the SSC agrees with this recommendation in February, there would be no need to develop OFL/ABC tables for Tier 4 in the May assessment document.

The maturity vector for AIGKC is a knife-edge function, but is based on data collected in a maturity study for AIGKC. The CPT recommends that these data be re-evaluated for the May CPT meeting to determine whether a maturity ogive can be estimated reliably. The CPT also discussed whether t the primary abundance index for AIGKC as calculated from fishery data should be considered in recommending a Tier level. The CPT regards this as an important factor in assessment uncertainty, but recommends that this be considered when recommending a buffer for the ABC, not in determining the Tier level.

It should be noted that the preliminary base model results are reasonably consistent with the perception that the AIGKC fishery has been stable and the stock has been relatively lightly and sustainably exploited in recent years. In the EAG base model, the estimated fishing mortality has been below F35% since 2000, and stock is estimated to be above the BMSY reference point and increasing. The picture is more complex for the WAG base model. Fishing mortalities were below F35% from 2005 to around 2012, and then increased to above F35% in the last few years. Stock biomass has hovered around the BMSY reference point since 1990, but recently declined below it. As a caution, it should be noted that these results are from preliminary models and final models used in May could change.

The CPT **recommends** that the following base model be brought forward for May:
1. The observer CPUE time series should start in 1995.
2. Add the retained catch CPUE index for 1985-1998 (fish ticket data).
3. Model two time periods for selectivity (pre- and post-rationalization).
4. Do Francis reweighting for the length-composition data.

5. Estimate a single natural mortality value using a combined EAG/WAG model and do a likelihood on natural mortality. Then use the estimated value of natural mortality as a fixed value in separate EAG and WAG assessments for OFL and ABC projections and further model sensitivity analyses
6. Obtain mean recruitment to initialize the model using only recruitment estimates that are informed by data (i.e., recruit CVs less than sigma R)
7. Calculate BMSY reference point based on average recruitment from 1986-2016 (whole time series).

The CPT **recommends** that the following alternative scenarios be brought forward for evaluation in May:
- Scenario that drops the retained catch CPUE index.
- Scenario that includes the observer CPUE index from 1991-1994.
- Scenario with three selectivity periods rather than two.
- Scenarios with low and high bracketing values for natural mortality to demonstrate model sensitivity.
- Scenarios that use alternative time periods to estimate mean recruitment for the B_{MSY} reference point
- Scenario that compares a maturity ogive vs knife edge maturity.

The CPT **recommends** that jittering of model parameter initial values be done to confirm model convergence. Finally, the CPT would prefer to see similar runs grouped together for May, as it is hard to compare 15 model runs on one graph (for example, Figure 29 on p. 95).

BBRKC PSC

Diana Stram outlined the contents of a discussion paper that examines the steps and information available to consider the appropriateness of revising or implementing PSC limits or other management measures to minimize the bycatch of BBRKC in groundfish fisheries. The difficulty in evaluating the efficacy of current measures was also noted.

The Team discussed recent experiments that have been initiated that may help inform important RKC habitat. Pop-up satellite tags were deployed in southwest Bristol Bay to study the movement of spawning female RKC, but very few tags were recovered. Red king crab larval drift modeling work (Ben Daly et al. – NPRB grant) is expected to be finalized soon. The model includes temperature regimes (1999, cold; 2005, warm); different forecast years (2030(?)), larval behavior, and different initial conditions of females for release sites of larvae.

The current PSC limit (Zone 1 for trawl gear) is based on RKC abundance (effective spawning biomass) and applied based on numbers of crab (without mortality applied). Data to be presented included RKC bycatch in numbers and weight (without mortality applied). The Team suggested that survey data from inside and outside the RKC savings area from both the NMFS and BSFRF surveys could be included. In addition, a graduate student has been mapping logbook data from this fishery, which shows the movement of effort in the directed fishery and may allow inference of seasonal movement of RKC in and out of the savings area.

The Team highlights the following issues, and supports further analysis of RKC PSC measures.
- Should different mortality rates be applied if different gears (non-trawl) are included?
- Why has groundfish pot bycatch increased recently (increased observer coverage, warmer water creating fishery overlap?)?
- Mortality rates for RKC by gear are: 80% for trawl gear, 20% for pot gear, and ??% for HAL gear.
- What are the implications of the seasonality of groundfish fishing in relation to the size/sex of RKC bycatch (relative to mating and molting)?
- Look at bycatch relative to TAC instead of ABC/OFL.
- Evaluation of how bycatch is impacting the population.
- PSC limits are based on effective spawning biomass but crab bycatch estimates are summed irrespective of crab life stage.
- Should the metric (effective spawning biomass) and values of current thresholds be re-examined?
- Compare with recently-developed EFH models.

Future research is needed on ratio estimates – total bycatch/total catch. How are estimates of RKC bycatch expanded – is it a linear relationship? All ratio estimates likely don't meet assumptions for ratio estimators, and we need a comparison of whole haul sampling vs. observer samples. The assumption is that bottom time decreases when the fleet encounters high densities of flatfish so there's less crab bycatch; this needs to be tested with available data.

The Council should be clear on what the objectives are for PSC management. Additional information is needed to evaluate the impacts of PSC on the status and trends of the crab stock.

Tanner Crab

The 2016 assessment for EBS Tanner Crab was based on the TCSAM2013 model. A new model (denoted TCSAM02) is being developed that is more general than TCSAM2013 and has been tested using simulations. However, the estimates of recruitment from this new model differ in substantial ways from those provided by TCSAM2013. Dr. Buck Stockhausen reported on modifications to TCSAM2013 designed to better utilize the existing data and make it more similar to TCSAM02. These modifications are proposed for inclusion in the model configurations that will be presented to the May 2017 CPT meeting. The modifications are:
- Model AMa. Some small male crab caught during the survey are designated to be old shell (and hence mature). TCSAM2013 adjusted the numbers of such crab prior to their inclusion in the model fitting process (assuming that some proportion of small "old" shell crab are actually immature, under the assumption that this is a mis-classification). Model AMa dropped this "classification correction" as any such correction should be made as part of the likelihood calculation rather than by "correcting" the input data.
- Model AMb. TCSAM2013 is fitted to the observer length-composition data. These data include crab that will be landed as well as discarded. TCSAM2013 incorrectly assumed that the length-composition data reflected the length-composition of crab that die due to fishing rather than those that are captured. Model AMb corrected this error and, hence, estimated selectivity patterns shifted to the right compared to Model AMa.

- Model AMc. TCSAM2013 fitted to catch mortality biomass. Model AMc fitted to the observer-estimated total capture biomass. This change was intended to ensure that the model was fitted to actual data rather than to observed data following adjustment for discard mortality.
- Model AMd. Model AMc assumed that growth and terminal molt occurred at the end of the year (June 30). Model AMd corrected the model structure so that growth and terminal molt occurred after the fishery (February 15), which matters due to differential natural mortality for immature and mature crab.

The CPT endorsed these changes and corrections to model TCSAM2013, although marked changes were not seen in model outputs.

Dr. Stockhausen then compared TCSAM02 and Model AMd after setting the likelihood weights to be the same, setting the priors to be the same, and fitting the same data components. The model estimates of biomass were very similar (at least visually) between the two models when the parameters were set to the same values, but the likelihood values, particularly for the survey biomass, were more different than the CPT expected. Estimating the values for the parameters led to quite substantial differences in parameter estimates and hence biomass trajectories. This was partially due to the fact that TCSAM02 estimated capture selectivity in the directed fishery for the years before 1991 even though there are no data to estimate selectivity for these years. The CPT recommended that selectivity for these years in TCSAM02 be pre-specified or set to that for 1991 or the average selectivity over a period of years.

The CPT concluded that there are still differences between TCSAM2013 and TCSAM02 that need to be resolved before the latter can be adopted. It was suggested that the assessment author first check the estimates of the numbers-at-length and biomass between the two models as these should be (near) identical when the parameter values are set to be the same. If numbers-at-length and biomass are (near) identical, the reason for the differences in results must lie in how the likelihood function is coded.

The CPT recommends that model AMd be presented as the base model in May 2017 unless Dr. Stockhausen can identify the reasons for the differences in results between Model AMd and TCSAM02. Dr. Stockhausen noted that he is working on extending TCSAM02 by adding growth data to the likelihood function and adding the ability to fit to chela height data. The CPT agreed that these extensions should be considered for inclusion in the set of models presented to the May 2017 meeting, if the model can be updated and tested. The CPT also noted that consideration should be given to a model configuration with a change in retention from 2004 and that the fits to the retained catches east and west of 166^0 W separately, rather than combined, should be provided to the May CPT meeting in the draft assessment report.

BSFRF survey

Scott Goodman (Bering Sea Fisheries Research Foundation, BSFRF) provided an update on BSFRF-NMFS Cooperative Research studies to provide data for estimating NMFS trawl survey selectivity for eastern Bering Sea Tanner crab. As shown at the September 2016 meeting, Scott presented CPUE ratios (NMFS/(NMFS + BSFRF)), as used for red king crab, for Tanner crab caught during the BBRKC selectivity studies during 2013–2015. Additionally, CPUE ratios from 2016 were presented, which included both side-by-side station comparisons throughout Bristol Bay, stations extending further west, and an index site.

The index site data set included multiple tows in an area north of Unimak Island that overlapped with the area surveyed using this same approach during 2012. This area had many small crab, and Scott presented a comparison of the size frequencies of these smaller crab in the overlapped area. Of note, crab less than 20 mm CW were not measured in 2012, but were measured in 2016. These data may be useful for developing growth estimates for this small size range using cohort analysis.

Scott presented an overview of future plans. The BSFRF has a collaborative proposal pending with NPRB to survey in 2017 with side-by-side station comparisons extending further west and three index sites: a repeat of the area north of Unimak, an area around the Pribilof Islands, and an area around Zemchug Canyon. Some of these efforts will proceed even in the absence of funding. Variability in the spatial distribution of Tanner crab with bottom temperature was presented for the previous eight years. The index sites were chosen in part to evaluate connectivity between these areas. Additionally, a continuation of the growth study for snow and Tanner crabs, as conducted since 2012, is planned for spring 2017.

The next steps is to decide how to incorporate the Tanner crab selectivity data into the assessment model. This process will begin using an approach similar to that used for the snow crab, with the recognition that index sites are treated differently from side-by-side station comparisons. A suggestion was made to evaluate for spatial patterns in selectivity. This will be useful both in regards to how to incorporate data from the three index sites and to add context to evaluating differences in CPUE ratios among years, which represent different surveyed areas with some spatial overlap.

There was some discussion of the topic of herding of BBRKC. Scott summarized the differences in gear configurations between the NMFS and BSFRF surveys and acknowledged there were limited data available to examine this issue for crab. Herding has been shown to occur for fish, including flatfish, and there are some indications herding occurs for BBRKC. There may be differences in gear contact occurring between these trawl methods, but it would require data from each gear type, including the distance of the doors relative to each other and how sweeps are contacting the seafloor between the doors and net. Collecting such data would require deployment of new instrumentation and would be expensive to obtain. Scott speculates that based on vessel speeds, BBRKC would need to move fast for herding to have a large impact.

Bristol Bay Red King Crab GMACS Model Update

D'Arcy Webber and Jim Ianelli provided an update via teleconference of the status of the GMACS BBRKC model. The presentation started by noting that the 2016 St Matthew blue king crab GMACS model is now available on the github site. Changes to the BBRKC model since the last review include adding: sex-specific recruitment; sex-specific time-varying M[BB1]; sex-specific custom growth matrices; and sex-specific M by year (can be input externally). There were also updates to various input data, although this is also a work in progress.

D'Arcy identified several problems. For general GMACS issues, the model runs are now slower (~15 minutes/run for models as complex as that used for BBRKC), likely due to greater code complexity in an effort to increase model flexibility, but also resulting in difficulty obtaining a positive Hessian. The standard for comparison was the 2016 BBRKC stock assessment (referred to as the 2016 model) by Zheng and

Siddeek. It was noted that the 2016 model was initialized with no old shell male crab (to keep the number of parameters down), although these crab appear in the year after initialization, and that the 2016 model code was often difficult to follow, with document figures that were sometimes misleading. For the BBRKC GMACS model, Webber and Ianelli (1) had to fix initial numbers to values from the 2016 model as they could not otherwise generate the initialization values; (2) fix the growth matrix was in GMACS at the 2016 BBRKC model values; (3) found a poor fit to NMFS survey data, around 1990 when GMACS produced an unrealistic "bulge"; and (4) couldn't fit the BSFRF data if q=1.

Regarding the GMACS model being slow (runs ~15 minutes w/Hessian) for BBRKC, a total of 13,440 dimensions are currently being evaluated vs. 2,520 dimensions in the 2016 model. The CPT noted that several numbers-at-length bins have no data (e.g., old shell females), but the model code is still running calculations on these empty bins, which increases run time. Some suggestions were to set up ragged matrices, or to use vectored parameters, either of which could address only the valid data bins instead of multiplying out every size, sex, and shell class. Data incorporated into the GMACS model include 4 catch types, 3 surveys, and 9 length frequencies covering 1975–2016, but only retained catch, trawl bycatch, NMFS survey abundance, and NMFS length composition have values for every year in the time series.

Seasonal Timing - The CPT noted that this could be renamed to "Event Timing" given that some aspects occur instantaneously and also that the "seasons" as described were not entirely consistent with current biological and management events. Pot bycatch was noted to be missing. The CPT suggested developing a more explicit calendar year timeline to show events by date and that D'Arcy work with Jie Zheng to get timing correct.

Molting, growth, and recruitment – Assumptions are females molt annually and male molt probability declines w/carapace size, but GMACS applies a time-varying molt probability (1975-1970, 1980-present) as input data, fixed to be the same as the BBRKC 2016 model. Previous efforts explored time-varying growth increments, but there is little evidence to support this approach. Consequently the current growth matrix in GMACS is the 2016 model output. Female growth changes over time in the BBRKC 2016 model while GMACS uses an average of three time periods. The recruitment size distribution is not sex-specific because differences in the 2016 model were minor.

Initialization – Efforts to replicate initial time series values (year 1) and produce similar results were not successful without fixing initial numbers at those from the 2016 model. The current model structure tries to track old shell females (which don't exist). The CPT again suggested eliminating model dimensions that don't exist, such as old shell females.

Catch – The CPT discussed why the 2016 model doesn't use the data prior to 1975. Jie noted that historical models considered catch data to 1968, but survey data were inconsistent (different nets, areas, etc.), so the 2016 model catch starts in 1975. The CPT noted the GMACS model could start catch in 1968 and start survey data in 1974 if the stock is initialized by estimating recruitments to build up the stock.

The presenters had evaluated five GMACS model configurations: (1) Constant M=0.18; BSFRF q=1.0, and NMFS lambda = 1.0; (2) Model 1 with a random walk M; (3) Model 1 with M fixed at 2016 model values; (4) Model 3 with the BSFRF q estimated; (5) Model 3 with NMFS survey lambda = 4.0. Results from

various model configurations suggested major inconsistencies in model-predicted vs. observed data. In general, it was apparent that model estimates did not fit well with observed data. For example, all models seem to underestimate trawl bycatch abundance and overestimate pot retention in 1980s.

The CPT had the following suggestions: (1) create/revise the calendar for event timing; (2) output likelihoods for all components by observation to look for outliers; (3) look at parameterization of fishing mortality; (4) work on initial year parameters; (5) set all parameter values in GMACS to the BBRKC 2016 model values and compare output; and (6) set catch at zero and compare output to try to determine why Gmacs output is different than the BBRKC 2016 model. A presentation in May depends on a meaningful progress report. The CPT would be willing to evaluate a GMACS model for BBRKC in May 2017, contingent on progress and stabilization. As an aside, per review at previous meetings, the CPT will also expect the update of the BBRKC assessment from Jie.

Stock Prioritization

In September 2016, the CPT was introduced to the national effort by NMFS to determine target frequencies for commercial fishery stock assessments in all regions. In Alaska, the prioritization effort initially focused on groundfish stocks, but the CPT was also asked to prioritize crab stocks, which may be done on a qualitative basis. Kristin Blackhart (NOAA Headquarters) briefly explained the evaluation process. The prioritization effort was initiated in 2011 in response to budget inquiries and the 2013 Magnuson-Stevens Act reauthorization. The prioritization document was released to the public in August 2015 and input has been provided by the NPFMC.

The impetus for prioritization is that all stocks need some level of evaluation but the frequency of those analyses varies between stocks; moreover, assessment capacity is limited both by budget and time constraints. The goal is to create a portfolio of 'right-sized' assessments for each stock. It was noted that this process for crab may be more complicated than for groundfish since crab stocks have only been assessed since 2008 and involve a complex management dynamic between state and federal agencies.

A sub-group of the CPT outlined a process to evaluate crab stocks that would be consistent with the intent of prioritization but would not involve the modeling efforts that were pursued for groundfish stocks. For each crab stock in the FMP, four categories were evaluated consistent with the national stock prioritization categories: fishery importance, stock status, ecosystem importance, and assessment information. Each of these categories was further divided into twelve factors that were relevant to crab stocks and individually rated by consensus of the CPT (see Table below). The factors were defined as follows and rated as either high, medium, or low importance.

Fishery Importance
- Commercial importance – Relative value of the stock with respect to the most valuable regional stock (Bering Sea walleye Pollock was selected as the most valuable regional stock). High score indicates high commercial importance.
- Constituent demand – Level of demand by stakeholders for stock assessment or evaluation. High score indicates high demand for superior level of assessment due to quota share program, controversial assessments, and/or high socio-cultural importance.

- Subsistence/CDQ – Significance of the stock to subsistence fishers or CDQ groups.
- Rebuilding status – B/B_{MSY}; high score indicates that the stock is overfished or that overfishing is occurring, low score indicates the stock is not overfished and overfishing is not occurring.

Stock Status
- Stock abundance – High score indicates stock is above B_{MSY}, mid-level score indicates the stock is equal to B_{MSY}, low score indicates stock is below B_{MSY}.
- Stock Variability – Variability in recruitment, abundance, and fishing or natural mortality. High score indicates high variability in a stock, low scores indicate little to no variability.
- Fishing Mortality – High scores indicates a higher level of directed targeting, lower scores indicate a low level of targeting.

Ecosystem Importance
- Role in the ecosystem – Importance to the overall health and functioning of the ecosystem. Although important, determined not to be informative for crab stocks hence al were rated equally.

Assessment Factors
- Unexpected changes in stock indicators – How accurate and precise are model projections relative to the introduction of new data. High score indicates a poor match to new data, indicating high deviations from past predictions.
- Model maturity – Level of development and confidence in model performance. High scores indicate a need to continue with model development, high scores indicate the model is mature with a high level of confidence.
- New types of information – Representative information is currently entering into the assessment process. High score indicates new informative data will be provided in the near-term.
- Survey frequency – Scores reflect survey frequency as well as the number of data streams integrated into the assessment. High score indicates an annual survey plus at least one additional data stream, mid-level score indicates annual survey only, low score indicates infrequent or non-existent survey.

After a lengthy discussion on the above points, all of the FMP crab stocks were rated and scored from 1 to 3 for low to high levels of information/importance as defined above (See Table below).

Category	Factor	Importance: 3 High; 2 medium; 1 low									
		BBRKC	Snow	Tanner	PIRKC	PIBKC	SMBKC	NSRKC	AIGKC	PIGKC	WAIRKC
Fishery Importance	Commercial	3	3	3	1	1	2	2	3	1	1
	Constituent demand	3	3	3	2	1	2	3	3	1	2
	Subsistence/CDQ	3	3	3	3	3	2	3	2	1	1
	Rebuilding Status	1	1	1	1	3	1	1	1	1	3
	Stock Variability	3	3	3	3	1	3	1	2	2	1
Stock Status	Stock Abundance	2	2	1	1	3	2	1	2	2	3
	Fishing Mortality	1	1	1	1	2	1	1	1	1	1
Ecosystem	Role in Ecosystem	1	1	1	1	1	1	1	1	1	1
Assessment Factors	Unexpected Changes in Stock Indicators	3	3	3	3	1	3	1	2	1	1
	Model maturity	3	3	3	2	1	3	2	3	1	1
	New Type of Information	2	3	3	1	1	1	1	3	1	1
	Survey frequency	3	3	3	3	3	3	1	1	2	1
	Sum of scores	28	29	28	22	21	24	18	24	15	17
	Recommended target frequency in years	1	1	1	2	3	1	2	1	3	3
	Commercial value index	4.58	4.66	4.03			3.88	3.59	4.25	3.24	3.69

The CPT then used this information to provide a recommended target assessment frequency. The stocks are proposed to be assessed with the following frequencies:

Annual
       Bristol Bay red king crab
       Bering Sea Tanner crab
       Bering Sea snow crab
       St. Matthew blue king crab
       Aleutian Islands golden king crab

Biennial
       Pribilof Islands red king crab
       Norton Sound red king crab

Triennial
       Pribilof Islands blue king crab
       Pribilof Islands golden king crab
       Western Aleutian Islands, red king crab

For in-between assessment years, the OFL from the most recent assessment will be carried forward and no new assessment documents will be produced. The frequency of stock assessment may increase if the stock is overfished or overfishing is occurring, there is interest in a directed fishery, or there is indication of survey volatility. The CPT decided to work through a three year cycle of stock assessments at the above frequencies to see if less frequent evaluations for some stocks are practicable and revisit the prioritization evaluation in four years.