Crab Plan Team report

The North Pacific Fishery Management Council's Crab Plan Team (CPT) met May 7-10, 2012 at the Hilton Hotel in Anchorage, AK.

Crab Plan Team members present:

Bob Foy, Chair	***(NOAA Fisheries /AFSC – Kodiak)***
Ginny Eckert, Vice-Chair	***(Univ. of Alaska – Fairbanks)***
Diana Stram	***(NPFMC)***
Doug Pengilly	***(ADF&G – Kodiak)***
Jason Gasper	***(NOAA Fisheries / AKRO – Juneau)***
Wayne Donaldson	***(ADF&G – Kodiak)***
Jack Turnock	***(NOAA Fisheries/AFSC – Seattle)***
Shareef Siddeek	***(ADF&G – Juneau)***
Karla Bush	***(ADF&G – Juneau)***
Lou Rugolo	***(NOAA Fisheries /AFSC – Kodiak)***
André Punt	***(Univ. of Washington)***
Bill Bechtol	***(Univ. of Alaska – Fairbanks)***
Brian Garber-Yonts	***(NOAA Fisheries – AFSC Seattle)***
Heather Fitch	***(ADF&G – Dutch Harbor)***
Steve Martell	***(Univ. of British Columbia)***

CPT members absent:
Josh Greenberg (Univ. of Alaska – Fairbanks

Members of the public and State of Alaska (ADF&G), Federal Agency (AFSC, NMFS), and Council (NPFMC) staff present (or on teleconference) for all or part of the meeting included: Jack Tagart, Laura Stichert, Katie Howard, Jeff Stephen, Arni Thompson, Sam Cotton,, Linda Kozak, Toshihide Hamazaki, Steve Honnold, Jim Ianelli, Vicki Vanek, Charlie Lean, Joel Cladouhos, Earl Krygier, Dick Tremaine, Denby Lloyd, Jie Zheng, Neil Rodriguez, Rip Carlton, Anne Hollowed, Steve Hughes, and Bob Clark.

The attached agenda was approved for the meeting.

Administration

The team welcomes new member Jason Gasper of NMFS Juneau.

Agenda: After introductions by those attending, changes to the agenda were discussed, and assignments made for taking minutes.

A. CIE Review

Bob Foy summarized the April 2012 CIE review of the EBS bottom trawl survey. The overall intent of the review was to look at survey goals and the precision of estimates to see if changes are warranted to the underlying methodology. The review report is still being prepared, but should be available in another month. After the report is issued, NMFS will develop responses regarding how to move forward on some CIE recommendations. A formal presentation is anticipated at the September 2012 CPT meeting. Some of the major issues considered during the review included: (1) survey efficiency and vessel use (e.g., the utility of corner stations for Pribilof assessments); (2) use of retows for Bristol Bay red king crab in cold years vs. sampling in warmer years (e.g., is it important to go back for retows if the catch will primarily be newly molted and mated ovigerous females?); (3) randomization of tow locations within survey stations; and (4) tow duration (e.g., reducing from 30 to 15 minutes), potential bias in survey CPUE, and

how survey time could be used differently with shorter tow duration. A historical study suggested that shorter tows might result in 68% (Tanner crab), 78% (snow crab), and 24% (red king crab) increases in survey CPUE. However, which tow duration is more accurate is not known.

Another major issue is how to address "hotspots" (NMFS did no hotspot sampling in 2011). It is recognized that not resampling hotspots provides an unbiased estimate, but we also need to consider the tradeoff between bias and variance, and how variance impacts the ACL compared to an unbiased estimator. Lou noted that Tanner crab estimates have high uncertainty due to hotspots, and the Tanner crab model has trouble fitting abundance estimates for years with hotspots. Lou would like to examine the survey time series with all extra hotspot towstaken out to define a standardized time series without these 'extra' hotspot tows(Bob said this is presently being analyzed); Andre noted that the full data sets, including hotspots, should lead to unbiased estimates and removing the original hotspot tow will bias estimates toward low values.

The CPT expressed concerns over changes that would establish a new data time series needing to be calibrated with the existing data sets. Bob noted that changes to the survey as a result of CIE review will not occur in 2012.

B. Modeling Workshop Report

A technical crab modeling workshop was held in January 2012 at the AFSC to provide input to stock assessment authors on issues associated with model development for Aleutian Islands golden king crab and Eastern Bering Sea Tanner crab. Jim Ianelli chaired the workshop after preliminary chair Steve Martell encountered travel restrictions. Assessment authors presented models, and the workshop made recommendations which were implemented during the meeting.

Golden king crab – The workshop suggested imposing a prior on molt probability, a key, but poorly determined, parameter in the model. A major emphasis for this stock was addressing data issues. Additional issues were: (1) CPUE standardization; and (2) aggregating of data across shell condition (see item E below).

Tanner Crab – After finding much of the model code was hard-wired, the workshop recommended that more generic code that allows adaption to different scenarios be developed. Problems with fits to the 1980s survey data were addressed with either "hide 'em" or "kill 'em" scenarios in which crab disappear and are treated as either unavailable to survey gear or as suffering unexpected mortality. The workshop recommended weighting the compositional data. The weights for retained catch compositional data should be no larger than 200, with the weights for other data types $\leq$200. Jack and Lou commented that the workshop report should have included more detail on recommendations to assessment authors (although being more work for the rapporteur). Andre noted that some other model reviews summarize the runs requested of assessment authors, along with justifications, as report appendices.

Some meeting attendees noted that text under workshop report item 3.1.3 wasn't discussed during the workshop, but was added after the meeting. While recognizing that the text addresses important issues, it was recommended that such supplemental notes should be added as an appendix under the submitter's name.

Bob Foy requested that the CPT think about potential model workshop topics for 2013.

C. Estimating pdf's for the OFLs

Jim Ianelli (attending through Webex), discussed the part of the crab modeling workshop addressing different techniques for computing pdf's for the OFL. Crab assessments typically use either MCMC or bootstrap to construct these pdfs. Short-term panel and February 2012 SSC recommendations were to

standardize the pdf calculation approach (e.g., groundfish Tier 4 projection models are the same). Andre noted that the median of the distribution should match the point estimate. In response to questions about the short-term and long-term recommendations, Diana indicated she thought the short-term items are to be implemented during the current assessment cycle. Some CPT members noted the short-term recommendations (e.g., item #2) included three OFL types, with corresponding pdfs. It was also pointed out that Box 3 in the report has some examples of OFL pdf calculations, but it wasn't clear if this was a "must-do" list. Jim indicated that the panel did not want to be too prescriptive.

The CPT noted that many crab assessment authors are currently using Jack's R-code for Tier 4 stocks. It was suggested that a working group be assembled to verify the code and make the code commonly available. This code would provide a default from which authors could start for Tier 4 crab stocks. Bob Foy will coordinate a working group to formalize recommendations before the September 2012 CPT meeting.

D. Plan Team workgroup report on Recruitment

Bob Foy provided an overview of the "'Phase 1' Report of the Joint Plan Team Working Group on Assessment/Management Issues Related to Recruitment". This paper is still in draft form and was distributed to the CPT at this time to facilitate discussion of how to select the timeframes for recruitment when defining management reference points, and to address the possible impacts of environmental effects on the productivity of crab stocks. The CPT discussed the issues raised under sections A-Identification of regime shifts; B-1 Establishing criteria for excluding individual within-regime year classes from estimates; and C-Forecasting environmental variability. The CPT intent was to provide some recommendations for information to be brought forward in the final stock assessments for the fall.

A-Identification of regime shifts (A2 Possible improvements to current policy)

André presented some results of a study to test the provisional recommendation for A2.6 "Condition the productivity parameter of a two-parameter SRR on one or more F_{MSY} proxies specified or implied by the harvest control rules in the respective FMP, then estimate the scale parameter of the SRR for every age- or length-structured stock assessment, with breakpoints estimated using an appropriate statistical test such as AIC or likelihood ratio, and possibly employing additional constraints such as a minimum length for the current regime or a maximum permissible CV for parameter estimates." His analysis assumes that F_{MSY} equals $F_{35\%}$, then fits the stock-recruitment relationship to the stock and recruitment data points to estimate R_0. The output from the analysis is the fitted stock-recruitment relationship and the inferred 95% prediction intervals for recruitment given mature male biomass. This differs slightly from the current forecasting practice of selecting values for steepness and R_0 where the model-predicted values for B_{MSY} and F_{MSY} match those for $B_{35\%}$ and $F_{35\%}$. The team discussed the pros and cons of this approach and to what extent this is changing which tiers stocks are placed in (i.e., Tier 3 vs. *de facto* Tier 1). The team noted that within this framework one could fit two stock-recruitment relationships and try to find the breakpoints in R_0. One suggestion in this regard was to consider a moving window for R_0 and test each possible change in sequence.

Steve showed a plot of log of recruits-per-spawner vs MMB, noting that the slope of the line would be the juvenile survival rate, and that it is possible to test for changes over time in juvenile survival rates. Non-stationarity in juvenile survival rate would imply that whole time-series of recruitments could not be used to define management reference points. Jack noted that we still need to consider the history of a stock and the level of biomass over that timeframe. Others questioned why fitting the stock-recruitment curve would not effectively take this into account, i.e., if one stock-recruitment relationship adequately fits the data, then the major impact of stock size on recruitment was accounted for. Andre noted that one could treat fishing mortality as a covariate when fitting the stock-recruitment relationship if it was postulated that fishing-related effects could be disrupting spawning, independent of the size of the reproductive component of the population.

The CPT recommended that the default assumption for recruitment is to start with the full time series and use the alternatives listed in A2.2 – A2.6 (or other) to recommend a modification to the default timeframe. The team noted the necessity of consistency across stocks in how the set of recruitments is evaluated, and that all authors should look at several ways to detect breakpoints in productivity. Once a breakpoint has been identified, some plausible biological explanation or rationale should also be provided to support the identified change in productivity. The team stressed the need for transparency in how the breakpoint years are selected when defining reference point, and that the same software should be employed by all authors. The software would include all of the main approaches raised in the report and discussed by the team. André and Steve will pursue software for use by authors prior to the September assessments. The software will include the core methods to be used across all assessments.

Additional suggestions included looking at covariates of temperature, predation, etc., to explain some of the variation about the stock-recruitment relationship. This would help identify mechanisms for change, albeit the first step is to identify the breakpoints.

B-1 Establishing criteria for excluding individual within-regime year classes from estimates
The CPT noted that B1 only addresses whether the most recent recruitment estimates should be used when defining reference points (the team has, in the past excluded points from the middle of the time-series when defining B_{MSY} proxies owing to concerns about fishing-induced effects). Under the provisional recommendation of the workgroup, points would be excluded if their precision is low. Alternative approaches are: (a) ignore points based on whether the year-class concerned has entered the fishery and to what extent discards and surveys are monitoring the incoming recruits; (b) ignore points until the CVs for the estimates of year-class strength stabilize; and (c) ignore points until estimates based on retrospective analyses stabilize. The most recent reliable estimate of recruitment may also depend on the choice of the minimum length bin the model. For example, one might base reference points on almost all of the recruitment estimates for St. Matthews blue king crab because the first size-class includes relatively large animals, whereas there will be several cohorts between the first size-class and the size-at-recruitment to the fishery for EBS Tanner crab.

The team did not have an extensive discussion of C2: How knowledge of environmental forcing changes perceptions of reference points.

The CPT will review the full report from the workgroup at their September 2012 meeting and thanks the workgroup members (and in particular Grant Thompson) for their work on this thus far. The team looks forward to seeing the results of A2 in each of the assessments in the fall.

E. Tanner crab model
Lou Rugolo and Jack Turnock presented the updated version of the Tanner crab stock assessment model. Since being formally reviewed by the CPT in May 2011, the model, data inputs, and model software have been updated several times based on recommendations from the CPT, the SSC, and the January 2012 modeling workshop. Changes to the data inputs since the May 2011 CPT meeting included revising the time-series of removals, as well as the length-composition information for the fisheries. The major changes to the model between May and September 2011 included allowing selectivity for the survey, the directed fishery, and the fisheries which catch and discard Tanner crab (Bristol Bay red king crab, Eastern Bering Sea snow crab, and the groundfish fisheries) to change over time. The major changes to the assessment model following the January 2012 modeling workshop include:

(1) allowing for year-specific sample sizes for the compositional data (mean [over years] input effective sample size for the directed fishery of 200 scaled by the actual sample size by year; input sample sizes for other fisheries scaled to those for the directed fishery; all input effective sample sizes bounded at 4 [minimum] and 200 [maximum]);

(2) relating fishing mortality on Tanner crab in the Bristol Bay red king crab and Eastern Bering Sea snow crab fisheries to fishing effort by these fisheries;
(3) expressing the likelihood weights as CVs in the code;
(4) re-parameterizing the selectivity functions in terms of the lengths-at-50%-selectivity, and the differences between the lengths at-50% and at-95%-selectivity;
(5) allowing for time-varying M over a period of years rather than just one year; and
(6) changing the penalty on the directed fishery fishing mortality deviations (the F-deviations).

The CPT considered whether (i) the model could be accepted for use for management in September 2012, and (ii) whether the stock should be included in Tier 3 (it is currently in Tier 4).

In relation to (i), the CPT noted that the fits of the model to the biomass indices for males are substantially improved compared to those of previous versions of the model. While the model generally fits the data well, the CPT identified the following issues related to the data fits: (a) the residuals are still not completely random for males in the directed fishery (Fig. 20); (b) there are clear residual patterns for the length-frequency data for the groundfish fishery (Fig. 36); (c) the fit to the male length-frequency data (Fig. 23) shows a run of positive residuals from about 75 – 150 mm; (d) the model overpredicts the proportion of large crab in the total length-frequency (Fig. 32); (e) the model is unable to mimic some of the retained catches in the directed fishery (Fig. 13, perhaps related to there being a single selectivity pattern for 1991-96, and the model fitting to both total and retained catches); and (f) fits to catches by the Bristol Bay red king crab fishery are poor (Fig. 15; perhaps related to the penalty on the F-deviations, combined with high among-year variation in Tanner crab catches in the Bristol Bay red king crab fishery). The CPT also noted that the 2009 selectivity pattern for the directed fishery seemed anomalous (much higher length-at-50%-selectivity than for earlier years). Finally, the CPT emphasized that there is one line of the code that is non-differentiable. However, in relation to the impact of non-differentiability, the results for the reference model could be replicated by another analyst using a different compiler than that used by Rugolo and Turnock. Overall, the CPT was satisfied that the model (modified as outlined below) was sufficiently well-developed and mimics the data adequately. The CPT recommended that the model form the basis for the September 2012 assessment, as well as for the rebuilding analysis.

In relation to (ii), the CPT agreed that adequate information was available on maturity and selectivity for the stock to be placed in Tier 3. The discussion regarding estimation of B_{MSY} for Tanner crab (see below) is based on the assumption that it will be placed in Tier 3.

The CPT had the following recommendations for the analysts:
Presentational issues to be addressed by the September 2012 CPT meeting

(1) Update the weights in Table 1 (the weights for all compositional data should be 1.0). Also, replace weights by CVs where possible.
(2) Plot the input effective sample sizes for the compositional data versus the effective sample sizes inferred by the fit of the model (this is already a requirement of the Terms of Reference [ToR] for crab stock assessments)
(3) Indicate the reference size for defining survey-q on plots of survey-q versus size.
(4) Include a summary of the Somerton and Otto underbag experiments, expressing their estimates of survey-q (by sex; mixed species, etc.) in a way that allows direct comparison with the prior assumed for survey-q in the assessment. Confirm that the variance of survey-q from Somerton and Otto matches that assumed in the assessment.
(5) Add an appendix which details the effort series and their derivation.
(6) Add the formulae used to calculate the input effective sample sizes.
(7) Add equations which detail how full-selection fishing mortality is calculated for the years without catch using effort and a fishing mortality – effort relationship.
(8) Update the plot of M vs. time for Bristol Bay red king crab.

(9) Check that the bubble plots are based on Pearson residuals, and check that the summary plots are indeed sums over observed and predicted proportions. Add a key to the Pearson plots which indicates what the largest circle means.
(10) Add confidence intervals on the data to the summary plots for the compositional data.
(11) Label the selectivity patterns better so that which curve applies to which year can be better determined.
(12) Clearly indicate the current year on Fig. 39.
(13) Add horizontal lines to Fig. 1, indicating the average input effective samples by fleet.
(14) The biomass at the time of the survey should be a dotted line while the model estimate of survey biomass should be a solid line when plotting the fit to the survey data (e.g. Figs 17 & 18).

Analytical tasks to be completed by the September CPT meeting

(A) Use the ADMB derivative checker to check for possible impacts of the non-differentiability of the objective function implemented in the code.
(B) Explore sensitivity to dropping the lower bound for the input effective sample sizes (a lower bound of 4 was imposed for the reference model).
(C) Explore sensitivity to allowing the input effective sample sizes for the survey to vary over time (with an average effective sample size of 200). The effective sample size for a given a category of data in a given year would be 200 multiplied by the annual sample size divided by the average sample size (no caps or minimum effective sample sizes).
(D) Allow for a difference in selectivity by sex for the groundfish fishery to see if this resolves the poor residual pattern for this fishery.
(E) Allow M for immature as well as mature males to change during 1980-83 (the data on changes in abundance do not suggest that only mature males declined substantially) and test whether it is necessary to allow female M to change over time
(F) Include plots which show the fits to the survey biomass indices from the reference model presented to the September 2011 CPT meeting, the model at the end of the January 2012 workshop, and the final reference model.
(G) Include the following runs for consideration by the CPT as a potential reference model for September 2012:
    a. The current reference model (modified based on recommendations "C" and "D" above)
    b. Alternative specifications related to which Ms are estimated and which are fixed.
    c. A likelihood profile for survey-q for males
    d. The other runs identified in the ToR (e.g., retrospective patterns; runs based on changing the emphasis on different likelihood components).
(H) There are potentially a very large number of runs to conduct for the September 2012 CPT meeting. Therefore, the assessment document should only contain detailed results (see the assessment ToR for specifications) and diagnostics for the current reference model (as revised in "G-a" above), as well as plots of recruitment and MMB time-series and tables of likelihood components for the remaining analyses. The full set of diagnostic plots should be made available electronically (e.g., using a "Dropbox")

Longer-term tasks

(1) Consider implementing the ability to change the penalty weight on the F-deviations as a function of estimation phase (high penalty weight in the early phases, low penalty weight in the final phases).
(2) Consider treating all of the F-deviations (except those for which the catch is known to be zero) as parameters, and include the fishing mortality-effort relationship as a prior – this will allow the uncertainty associated with this relationship to be reflected in the measures of uncertainty.
(3) Consider different effective sample sizes for each category of survey compositional data (males+ females * mature+immature).

(4) Consider fitting to total biomass (by sex?) and to the compositional data rather than to mature biomass (include the fit to the mature biomass by sex as a diagnostic).
(5) Do not fit to male compositional data by maturity state for the years for which chela height – maturity relationships are not available.
(6) Base the assessment on code which is fully documented and for which the objective function is differentiable.

E. Tanner Crab Stock Projections and rebuilding analysis

Jack Turnock and Lou Rugolo presented preliminary stock projections and rebuilding analysis under a base model that has not been accepted by the CPT. For the preliminary runs, they used a stock-recruitment relationship parameterized in terms of an $F_{35\%}$=F_{MSY} of 0.625 and a $B_{35\%}$ of 161,762t. The $B_{35\%}$ was estimated as MMB/R at $F_{35\%}$ multiplied by mean recruitment during 1966-72. They considered the following six rebuilding scenarios:

i. $F_{35\%}$ control rule (CR) for the directed fishery and bycatch for all fisheries (snow crab, red king crab, and groundfish) mortality. The bycatch mortalities were average values for the last 3 years.
ii. The OFL control rule with maximum F for the directed fishery set to 75% of $F_{35\%}$ and bycatch mortality as for case i.
iii. F=0 for the directed fishery and bycatch mortality as for case i.
iv. F=0 for the directed fishery, groundfish bycatch as in i, and all other bycatch mortality F=0.
v. F=0 for the directed fishery, snow crab bycatch F= twice snow crab bycatch F in i, and all other bycatch mortality as in i.
vi. F=0 for the directed fishery, snow crab bycatch F= four times snow crab bycatch F in i, and all other bycatch mortality as in i.

The CPT discussed (a) the fishing mortality for Tanner crab from the snow crab fishery, (b) the implications of the (assumed) stock-recruitment relationship on rebuilding rates, and (c) adjustment of selectivity curves for west of 166^0W due to the recent change in minimum size limit for the fishery in that area.

The rebuilding projections look very optimistic. More pessimistic estimates of recruitment would result in lower average recruitment and slower recovery to the $B_{35\%}$. The rebuilding analysis allows for auto-correlation in the deviations about the stock-recruitment relationship as well as "implementation error" between set F and the realized F. While these are reasonable factors to include in a rebuilding analysis. the underlying values need to be justified. The CPT discussed how the selectivity curve should be modified to account for the change in retention size in the west (which will also impact the estimate of $F_{35\%}$). This modification involves two steps: (a) modifying the retained-selected curve for the fishery west of 166^0W, and (b) combining the selectivity patterns east and west of 166^0W. It was noted that biomass west of 166^0W has recently been higher than that east of 166^0W and that assuming the split of F between the west and east matches the biomass distribution in recent years is compatible with the current ADFG harvest strategy.

- **Action 1:** Add a scenario in which the full-selected F on Tanner crab due to the snow crab fishery is set based on snow crab $F_{35\%}$ (this would involve estimating a relationship between snow crab F and effort to compute the effort level corresponding to $F_{35\%,}$ and then using the effort-fishing mortality relationship to compute the full-selected F on Tanner crab due to the snow crab fishery).
- **Action 2:** Estimate the stock-recruitment relationship autocorrelation parameter and the extent of implementation error for Tanner crab.

- **Action 3:** Base analyses on a broad range of alternative $B_{35\%}$ definitions.
- **Action 4:** Keep the total selectivity the same, but change the retained selectivity for the fishery west of 166^0W to reflect the change to the minimum size limit.

The CPT agreed that the Tanner crab stock assessment model will be reviewed on the first day of the September 2012 CPT meeting. Authors are expected to include all the standard diagnostics in the assessment report and provide results of alternative runs (e.g. based on alternative model configurations) electronically. Once a base model is identified, rebuilding scenarios will be identified by the CPT for runs during the meeting week. The CPT will review the results of those runs before the end of meeting, and make necessary recommendations.

F. Norton Sound red king crab

Toshihide Hamazaki presented the draft assessment for Norton Sound red king crab to the CPT. The Team heard a request from ADF&G staff to move the timing for specifications for the NSRKC stock to earlier in the year to allow additional time to set the GHL prior to the start of the CDQ portion of the fishery in late May. The author proposed three options :

1. Move the May CPT meeting to March and do specifications for all four stocks and model evaluations prior to the April Council meeting;
2. Have a one day CPT meeting (or possible teleconference) in March to discuss NSRKC only and make recommendations;
3. Set specifications for NSRKC in September, understanding that this would entail dropping data from the assessment due to the time lag in acquiring the fishery-data.

The team discussed the different options, noting that the least desirable option is setting specifications in September when data are not available for inclusion in the model. In addition, March presented conflicts with other meetings and a teleconference option does not provide the same discussion and review opportunities as are available in a formal meeting. The Team deferred a recommendation on moving the specification timing until after the model is reviewed during the January 2013 workshop to determine if an annual mid-winter teleconference would be possible.

The team discussed changes to the model since the 2011 version. Decisions on model selection are contained in the SAFE Introduction. Additional concerns regarding data and model formulation included:

- Lack of bycatch data. The CPT requests that some data on bycatch be collected in conjunction with the NPRB project recently funded.
- Length composition data have been downweighted, but there still is apparent conflict within the model. This is a possible indication of model mis-specification.
- There is a need for better justification for the higher natural mortality on animals in the largest length bin (none of the models address dome vs. asymptotic M).
- Model does not fit early data, and it was suggested to start prospective analysis in 75, 76, 77, …
- use the derivative checker to verify that the objective function is differentiable.
- Plot histograms for effective sample sizes for the compositional data.

While the Team accepted the model (and recommended Model 12) for OFL and ABC specification, it recommends that this assessment model be reviewed at the January 2013 modeling meeting, particularly in light of requests to set specifications for this stock out of the current sequence in the future.

G. AIGKC Data

Doug Pengilly presented a comprehensive review of the sources of catch, catch-rate, and length-frequency data used in the Aleutian Islands golden king crab model; i.e., fish ticket, retained-catch ("dockside") sampling, and observer pot sample data. A fish ticket is produced for every catcher vessel

(CV) landing or for every week of processing by catcher-processor (CP). Pertinent data recorded on fish tickets include: the vessel ADFG number, CFEC permit number, date of landing, effort (pot lifts) per statistical area, and catch (numbers and pounds) per statistical area. Statistical areas fished and distribution of effort and catch are reported by the vessel skipper to the processor for recording on fish tickets; total weight of landing (whole weight, live and deadloss) is recorded by the processor. The statistical areas fished and catch and effort per statistical area that are initially recorded by the processor on the fish tickets are edited by ADF&G using dockside interviews with the vessel skipper, federal fishing logbooks filled out by the vessel skipper, or both; total weight of landing is never edited by ADF&G. The complete fish ticket data for the 1985/86–2010/11 Aleutian Islands golden king crab fishery were obtained for this review. The retained-catch sampling and observer pot sampling data were linked to the fish ticket data by linking the vessel ADF&G number and the sample date recorded with the sampling data with the vessel ADF&G number and date of landing recorded on fish tickets; linking the data sources is difficult, but was done to the extent possible.

Retained catch is sampled by observers or dockside samplers for size frequency data. Sampling rates are 100 crab/landing for CVs and 100 crab/day for CPs. All data from retained catch samples during the 1985/86–2010/11 seasons that have been entered into a database were obtained for this review. Retained-catch sampling data availability (percent of landings with retained-catch sampling data) is low for the 1985/86–1987/88 seasons and high for the 1995/96–2010/11 seasons. The available data include measurements of approximately 0.5% of all crab landed by CVs and 6.9% of the production of CPs (overall, 2%) during 1985/86-2010/11.

Pot sample data are collected by observers deployed on fishing vessels. Observer coverage has varied over time. Observers have been required on all CPs for 100% of fishing activity since the 1988/89 season. Observers were required only on CVs during the 1988/89–1994/95 seasons (ADF&G staff were deployed on a few CVs for a few trips beginning in 1990/91). Observers were also required on all CVs for 100% of fishing activity during the 1995/96–2004/05 seasons. Since the 2005/06 season, observers have been required on CVs for 50% of fishing activity. The available observer data for the 1990/91–2010/11 seasons were obtained for this review; data from 1988/89 and 1989/90 were not included because of poor data quality (mis-recording or non-recording of data). Percent of landings with available associated observer pot sample data by vessel type and season was presented. Observer data availability was reviewed: data are limited prior to the 1995/96 season. Percent of CV effort with observer coverage by month during 2005/06–2010/11 was presented. Observers are given general directions to fit the circumstances on the vessel for daily sampling of pots that are representative of the areas/strings fished each day; selection of pots is not based on their contents. The CPT suggested that the observer program consider using protocols in which pots are randomly sampled from a daily-established sampling frame of the pots to be lifted by the vessel. The CPT suggested that bias in sample pots could occur if anchor pots are never (or infrequently) sampled. Depth, soak time, lat/long, gear type, numbers of female, sublegal male, retained legal male, and non-retained legal male crab are recorded by observers for each sampled pot. Legal males in pot samples are scored as retained or non-retained by observers on the basis of consultations with the vessel crew and observations of the crew's sorting practices. The CPT suggested that the observer program consider having the vessel crew sort the catch into what will be retained and non-retained prior to being sampled by observers. For most of the pots sampled by observers, measurements (CL) and legal status of all crabs in the pot are recorded in addition to the counts by sex-size groups (the measured legal males have only been scored as retained or non-retained since the 1998/99 season). Daily observer pot sampling goals for either counts or measurements of crab were presented for vessel type (CV versus CP), season, and area. Actual daily numbers of pot samples for counts and measurements were presented by vessel type and season.

Estimated size frequencies of retained catch for each vessel from the retained-catch sampling data were shown for each individual vessel fishing in 2010/11 by area east and west of 174° W longitude; size

frequencies are not the same for all vessels. The estimated retained catch size frequency for all vessels for the entire 2010/11 season for the areas east and west of 174° W longitude produced by weighting retained-catch sample data by the size of the vessel's landing was only slightly different from the estimated size frequency produced without weighting. Retained catch size frequency (for individual vessels and all vessels combined for each area) estimated from the 2010/11 pot sample data are generally in agreement with those estimated from the 2010/11 retained-catch sampling data (more so for all vessels combined for the entire season). There is general agreement between the CPUE estimated from the pot sample data and the CPUE estimated from the fish ticket data; agreement increases with level of aggregation of catch and effort (i.e., from the level of individual landings by vessels to the level of season total for individual vessels and season total for all vessels).

The public noted that it is helpful to look at the quality of the data because it informs what we do moving forward.

Siddeek presented how the data are treated going into the GLM model and model formulation. Observer pot sample records and vessel registration codes were trimmed for missing values and 'core' vessels were selected. Core vessels were selected as those that have at least 5 trips/year with at least 3 years of data. The author used one pot haul as a 'record'; this assumes independence among pots (residuals are independent). Since pots are fished in a string, the pots are not likely to be independent. It was suggested to use string by statistical area or trip instead. The author should compute the variance of the residuals from the model fits for pots within a string vs. all pots. Residuals should be grouped by string, then the variance between vs. within strings examined. Unfortunately, the observer data do not identify the string that a sampled pot was selected from. Data by string are recorded by vessel skippers on the federal fishing logs; however, those data are not currently entered electronically, are aggregated at the string level (i.e., data are not pot-by-pot), and linking those data to the observer pot sampling data is not feasible. It was suggested that the author aggregate to the day at a minimum. Interactions among factors in the CPUE standardization have been ignored. The author needs to look at interactions (seasonally, different vessels, etc.).

The response variable is catch and the predictor variables are year; month; vessel (suggested to use vessel, skipper or other covariates of the vessel); pot-lifts; area (look at differences between stat areas within area or use GAM to estimate a CPUE surface); depth; soak days; and gear. The author determined the best model using a step-wise selection process. The CPT asked the author to examine a potential post-rationalization correlation between gear and soak time. Residual and q-q plots were presented. The author should add a 1x1 line to the q-q plots. He should also show residuals versus covariates and summarize such plots using, for example, box plots. Gear has changed since rationalization; smaller gear is used now (less 7x7 pots). The author could also look at year x gear interaction to see if there's an effect of the smaller gear over time; or look at pot lifts x gear interaction and see if that's an explanatory variable. A polynomial function was used to examine non-linear relationships between covariates and catch, a spline could be used instead.

The CPT asked if the length frequencies for the non-retained catch were plausible and suggested that the assessment author include one of the data sets as a 'ghost' fleet (included in the assessment, but weighted at zero) to determine whether the model can replicate all types of length-frequencies. The author should also see if there are some years that can be removed from the data set (early data) since those data might not be as representative; use a qualitative determination based on what we now know about the data.

The CPT notes that an implied increase in legal abundance CPUE is contradicted by standardized flat CPUE trend in sublegal catch. There was discussion of potential pot mesh size increased after rationalization, and Siddeek noted that the gear codes used in the analysis identify only pot size and do not address additional gear characteristics (e.g., mesh size or size or number of escape rings). It was clarified that the size of mesh did not increase but fishermen report that they exceed the minimum of how

much of a panel includes the mesh, i.e. minimum legal is 1/3 panel, but report using full panels. Selectivity should be reduced on the sublegal portion of the catch. Skipper could also be used as a factor in the model in association with the vessel. However, there is a need to verify that the CFEC permit number collected on the fish ticket is the same for each skipper every year. The author should calculate standard errors on the combined index – Dr. Jason Cope (NWFSC) has code that will do this. Finally, the commercial CPUE index may be hyperstable because (5x5) pots may saturate and we wouldn't see increases in CPUE if they existed. A standardized survey might help to address this issue.

In September, retained CPUE, tagging data, and the modifications requested by the CPT at this meeting should be presented. The model should be run again with the new data and compared that to model runs using the old data.

H. Saint Matthew blue king crab model

William Gaeuman presented the 3-stage assessment model proposed for use for the assessment of St Matthews blue king crab. There were no major changes to the model since the CPT meeting in September 2011. The only real change to the assessment since May 2011 was exploring alternative weights for the trawl and pot surveys. The CPT commented on appropriate procedures for weighting data and recommended providing a few additional diagnostics to better examine model fit. The CPT accepted the model for use in September 2012. There was some discussion if the assessment could be promoted to Tier 3 for this coming assessment, and the calculation of reference points for use with the OFL control rule (more information needed on maturity and years to select for the calculation of $B_{35\%}$).

The assessment author noted that, due to the use of a carapace length proxy for legal size (which is measured in carapace width) in the model, as much as 5-10% of the 120mm+ size (stage-3) males are not legally retainable. He also noted that a smaller portion of the legal size crab are scored by observers as "not retained." The issue seems to be different in using CW vs. CL. The CPT recommended that the observer discard data be examined more closely with the expectation that assessment authors treat these data in a consistent manner (e.g., fit to total and retained length-frequencies; fit to discarded and retained length-frequencies). The CPT recommended that the observer discard data be examined more closely with the expectation that assessment authors treat these data in a consistent manner (e.g., fit to total and retained length-frequencies; fit to discarded and retained length-frequencies)

CPT recommendations:

- Present alternative models for September which (a) represent different values to weight the trawl and pot surveys (including giving the pot survey more weight than the trawl survey), (b) assume the same selectivity for stages 2-3 in the trawl survey to address concerns about the 1.24 value for the stage-3 trawl survey selectivity, and (c) assume that Q=1 applies to stage-2 rather than stage-3.
- Avoid giving the pot or trawl surveys weights larger than 1.
- Base the distribution for the OFL on its asymptotic sampling distribution (i.e., use the standard error for the logarithm of the OFL from the assessment).
- Overlay model-predictions on Figure 1 showing the fits of the various alternative models to the trawl and pot survey data.
- Include retrospective runs with plots of the mature male biomass.
- Add a table of parameter correlations to aid in diagnosing potentially confounded parameters.
- Add a plot with the number of stage-1 recruits (that could be used to determine $B_{35\%}$ by multiplying $SPR_{35\%}$ if the CPT decided that this stock should be placed in Tier 3).
- Provide more information on the basis for the maturity assumption.
- Calculate effective multinomial sample sizes for the compositional data: Neff = sum(p(1-p))/sum((o-p)^2 and plot the Neff versus the assumed sqrt transformed numbers

with a 1:1 line on the graph. Consider using this to iteratively reweight sample sizes for a more parsimonious fit.

Plot standardized residuals and compute standard deviations of the mean absolute deviations (all should theoretically have an std=0.8 ~ sqrt(2/pi)) if all the data are properly weighted.

I. Snow Crab Growth

Laura Stichert provided a presentation on on-going work to evaluate snow crab growth. The main points of the presentation were:

- Immature snow crab were collected during surveys and held at 3 degrees Celsius (6 – 9 months) until molting.
- Snow crab measurements include premolt carapace width (CW), postmolt CW, maturity status, and date molted.
- Over the five year study, 9 percent of crab molted (more females than males molted).
- Important factors in the growth study were: sex, female molt (normal growth and terminal molt), and short term or long-term holding.
- Data presented included premolt CW vs. postmolt CW, and premolt CW vs. postmolt molt increment.
- The study detected differences in female crab molting to terminal molt verses normal growth molt (smaller molt increment for terminally molting female crab).
- Laboratory bias in growth of about 8 percent is less than other growth studies presented and is attributed to laboratory holding density and container size effects.
- There was no difference detected in molt size of terminal molt verses normal growth molt for male snow crab.
- Females have significantly greater growth at normal molts than males (though this difference is slight).
- Growth models used in the SAFE (2011) appear to capture male growth data well and either approximate female growth at a normal molt (Somerton) or split the difference between growth at female normal and terminal molts.

J. BSFRF Update

Steve Hughes summarized on-going research and research priorities for the Bering Sea Fisheries Research Foundation work on crab. The main points of the presentation are summarized below:

Snow Crab Handling

- Snow crab reflex handling studies continued (RAMP reflex).
- Four onboard observers hired spring 2012; obtained data for RAMP during colder air temps.

Tanner Crab Growth

- 30 tows conducted near Amak Island.
- Collected 647 premolt Tanner crab, held individually onboard and subsequently delivered to Dutch Harbor.
- 40 crab molted and size data collected; remainder died.

Inshore Bristol Bay Red King Crab

- Conduct 5 minute tows in each inshore selected NMFS survey station (20 x 20 nm).
- 2011 was a warmer year; more crab offshore
- 2012 should be a cold year; expecting more crab inshore.

Tanner Crab Net Efficiency

- 13 stations near Amak Island
- Look at all sizes of Tanner crab and both sexes.
- Net selects for up to 140 mm Tanner crab or a net efficiency of 0.4 to 0.5.

K. Handling Mortality
Bob Foy provided an overview of Dan Urban's study on estimating handling mortality rates for crab. The main points of the presentation are summarized below:

- Tanner and snow crabs RAMP study to establish mortality curve.
- Attempt to predict mortality with temperature.
- As RAMP determines reflexes are lost, mortality increases.
- Tanner crab: losing three or more reflexes results in near 100% mortality.
- Majority of study crab had zero impairments (no lost reflexes)
- This study assigns mortality differently than status quo mortality assumptions.
- Freezer experiments at - 23 Celsius with crabs exposed for 10 minutes, 5 minutes, and a control group; delayed mortality occurred several days after exposure.
- Future work to try to predict back deck temperatures, and associated mortality.

L. Snow Crab Model Discussion
Jack Turnock distributed a list of discussion topics for the September 2012 stock assessment of EBS snow crab including: (1) CPT recommendations from September 2011; (2) SSC recommendations from October 2011; and (3) a table of the 10 model scenarios presented in September 2011. The CPT had selected Model 6 in 2011 which, among other aspects, estimated M for immature and females, estimated mature male M with a prior, used a smooth selectivity curve for the BSFRF data, and provided a better fit to the NMFS trawl survey data. The CPT reiterates a request that the author explore estimation of M and potential confounding between growth and Q. The CPT also requested that the author explore use of the new male growth data. André suggested the use of 2D plots that evaluate two-dimensional likelihood profiles (Ian Stewart, NOAA, NWFSC, has some code).

M. Pribilof Blue King Crab
Stock Boundary issue: Diana Stram presented the Pribilof blue king crab stock boundary issue. Crab bycatch data from groundfish fisheries have historically been derived from federal reporting areas, but following crab rationalization, data are now available by state statistical areas. Federal reporting area 513 has been used in setting the Pribilof blue king crab OFL, which covers portions of the Pribilof and Bristol Bay areas. In identifying boundaries for accounting bycatch from groundfish fisheries, the areas chosen are not restricted to the crab rationalization boundaries, but can be modified to reflect actual stock distributions.

When discussing the use of the Pribilof district as the area to account for the Pribilof blue king crab OFL, the SSC previously noted that both the NMFS trawl survey and groundfish bycatch data indicate blue king crab that may be part of the Pribilof stock are found outside the Pribilof district. The trawl survey consistently finds blue king crab in stations 20 nm east of the Pribilof district. Groundfish bycatch of blue king crab also occurs throughout much of Bristol Bay. Another issue raised by the SSC in February is that the survey does not capture blue king crab in Bristol Bay where the groundfish bycatch appears high. The closure area is complicated because most blue king crab bycatch occurs outside the "birdcage" closure area. The SSC asked the CPT to comment and make recommendations on these issues.

The CPT first questioned if the blue king crab are being properly identified by groundfish observers and were assured, by a CPT member that had already made that inquiry, that the groundfish observer program is confident in the identification. It was noted that Pacific cod pot and hook and line fisheries, as well as yellowfin sole trawl fisheries, have the highest blue king crab bycatch rates. It was also noted that sample

sizes of blue king crab bycatch in Bristol Bay are likely quite small, with estimates based on sample extrapolations.

The CPT stressed that blue king crab bycatch is minimal to nonexistent from April through August due to low fishing effort, and because the survey occurs in the summer, there is no temporal overlap between the bycatch and the survey data. One possible reason for low survey catch is that blue king crab move to near-shore, rocky areas during the summer and would not be in Bristol Bay during that time. However, it was also thought that blue king crab found as far as Amak Island in winter might not migrate to the Pribilofs to mate in summer. Similarly, it was uncertain if blue king crab around Nunivak Island are really part of the St. Matthew blue king crab stock. Blue king crab leaving Bristol Bay during the summer to mate may be more likely associated with Nunivak Island rather than the Pribilof Islands based on currents. There is substantial uncertainty regarding the effect of the cold pool on blue king crab distribution. Because the cold pool can be in very different locations, any cold pool effect could impact annual blue king crab bycatch and survey catch. The ADF&G pot survey extends to the eastern boundary of the Pribilof District, but survey extension into Bristol Bay where the trawl survey catches blue king crab has been considered.

Fundamentally problematic, all FMP stocks were defined relative to fishery registration areas. For example, until 2002 there was a size limit and season for blue king crab in Bristol Bay, but no accompanying fishery. The existing Pribilof boundaries were designed for assessment purposes, and blue king crab caught in survey stations outside the Pribilof district are not incorporated in area-swept estimates, and, therefore, not currently counted as part of the Pribilof stock. Similarly, red king crab caught around Nunivak Island are not accounted for in the Bristol Bay stock. The CPT discussed inclusion of blue king crab found just north of the Pribilof district, but this idea was discounted because those crab are included with the St. Matthew blue king crab stock. Blue king crab found near Port Moeller have never been considered a part of the Pribilof stock. The team expressed concerns about the inability to adequately assess the blue king crab found in Bristol Bay, and how those crab relate to the Pribilof blue king crab stock.

It was noted that blue king crab only rarely occur as bycatch in groundfish fisheries of Bristol Bay. If blue king crab occur in Bristol Bay at extremely low rates, and survey effort (400 nm^2) is much lower than in groundfish fisheries, this could explain why the survey does not encounter blue king crab in Bristol Bay.

The CPT noted three potential options for areas used in OFL setting: 1) status quo; 2) move the boundary east 20 -40 nm based on survey blue king crab catches; and 3) include all of Bristol Bay. There are no criteria by which to separate the blue king crab found in Bristol Bay from those within the Pribilof district. The CPT did reach consensus that the current boundaries do not adequately describe the Pribilof blue king crab stock and should be modified for OFL accounting. Although the CPT could not determine how far east to move the boundary, many team members felt confident using the eastern extent of survey catches of blue king crab rather than including all areas of groundfish bycatch. Before formalizing a recommendation, the CPT would like to see data on the actual number of observer-sampled blue king crab, not just extrapolations to the tow or PSC calculations, in order to determine how much fishing effort occurs to account for the blue king crab bycatch.

How to calculate the OFL: Bob Foy presented information on how the OFL for Pribilof blue king crab is set, and opened the discussion of alternative methods. Because the Pribilof blue king crab stock is recommended as stock status C of tier 4, $F_{OFL} \leq F_{MSY}$. The OFL has been based on the average total catch from 1999/2000 to 2005/06, in order to stay away from years with extremely high catches and to freeze the end year. This OFL is not representative of the productivity of the stock, but rather is more for bycatch allowance. One alternative suggested was multiplying MMB by 0.18 to set a maximum OFL, being that F is equal to M.

If the area used for OFL setting is expanded, basing the OFL on average catch for that new area would still work, and would probably not be limiting as long as the entire area was used. If there are data quality issues with observer data, average catch is likely either under or over extrapolating. But, using an average catch OFL protects against large amounts of bycatch, an aspect unchanged by expanding the accounting area.

It was discussed that in a tier 5 approach, as is currently employed for stocks at status C of tier 4, years with sustainable catches should be used to set the OFL. There is no recent catch level that could be deemed sustainable for Pribilof blue king crab, but rather to set using years in which average mortality would not impede rebuilding. A biomass-based OFL would be preferable. The CPT discussed some ideas for approaches to the OFL and looks forward to further development of these for September by the author for consideration at that time. The CPT would like to see the results of the new bycatch accounting method for further discussing OFL setting methods.

N. B_{MSY} discussion:

Andre Punt presented an update on ongoing research projects investigating potential methods for improving estimation of F_{MSY} and B_{MSY}, and forecasting the effects of ocean acidification (OA) on control rule performance in Bristol Bay red king crab fishery management.

The first project Andre reported on is a study investigating use models of surplus production to estimate F_{MSY} and B_{MSY}. Surplus production can be defined as surplusy=biomassy+1-biomassy +catchy, which can be calculated for many BSAI crab stocks given the long time series available for these stocks. Models for estimation of surplus production are well-established in the literature and potentially offer a method for estimating Bmsy. To test the method using known results, Andre employed simulation models coded to snow crab and red king crab to generate estimates of various parameters using a variety of surplus production model specifications for comparison to the deterministic results defined by the models. The models have been presented to the CPT previously and Andre did not review the model details, but presented test results using both simulated data sets and actual crab data sets. The general conclusion drawn from using simulated data was that estimates of Fmsy and Bmsy were quite poor across all specifications. The most notable finding was that specifying Fmsy equal to M resulted in lower lost yield (i.e., minimized the potential for extreme errors). The factors that most influenced the accuracy of the estimations were high recruitment variability (e.g. blue king crab), high degree of measurement error or extreme outliers in stock survey (e.g. PI blue king crab). Results using actual crab survey data were similar across all six stocks for which a continuous survey time series is available. Results using assessment model estimates of MMB may produced improved results, but in general the method using surplus production does not seem to offer much promise for resolving data /model limitations for Tier 4 stocks.

Andre presented preliminary results from modeling stocks over the historical time series under historical exploitation and 5 different simulated harvest strategies: $F_{35\%}$, M, OFL control rule with $F_{MSY}=F_{35\%}$ and B_{MSY} set to the current proxy, and OFL control rule with $F_{MSY}=M$ and B_{MSY} set to the current proxy. Figures displaying estimated MMB and $F_y/ F_{35\%}$ for BBRKC and EBS snow crab were presented. The general findings illustrated by the estimates for BBRKC are that MMB would likely have been higher under all control rules, but not dramatically so. Results for snow crab showed that historical exploitation was lower that it would have been under all control rules, with the exception of some years during the late 80's-early90's and again in the late 90's, and MMB would have been somewhat lower during the 1980's, somewhat higher during the 90's, but not much different generally. Under assumptions of no measurement error in survey data and that current understanding of stocks is correct, the general conclusions are that both stocks appear to be quite robust to errors in harvest strategy determination, and MMB is more likely driven by recruitment variability than exploitation.

Andre briefly reviewed preliminary results of analyses that compare the stock and recruitment relationships currently assumed in assessments to stock and recruitment data. The analysis informs the use of proxies for F_{MSY} and B_{MSY}, and results for BBRKC and EBS snow crab show that current assumptions are in line with data time series. Andre noted that he would be requesting updated data set from all assessment authors for use in further work on this study.

Andre presented preliminary results of a study to forecast the expected effects of changes in BSAI pH on Bristol Bay red king crab under alternative management strategies. The research employs a full life-cycle model integrating a detailed staged model for pre-fishery recruitment (egg-juvenile) stages with the stock assessment models for post-recruit stages. Andre summarized the details of the life-cycle model, noting that it is limited to male crab. The data used to parameterize the model include assessment inputs (as used in the five class model), recruit/egg ratios used in the assessments, and results from Bob Foy's research at AFSC's Kodiak lab on juvenile mortality and growth under elevated pH. The prerecruit model incorporates 18 stages, each parameterized to match stage survival and growth rate (stage duration) under different pH levels. Andre presented estimates of recruit abundance illustrating the combined effect of different assumptions for prerecruit survival and stage duration. Increased stage duration alone reduces recruitment due to prolonged exposure to sources of mortality, but combined with increased pH-related mortality, produced dramatic results in simulations using IPCC forecasts of BSAI pH levels over the next 200 years. All scenarios modeled resulted in recruitment falling to near-zero by 2160 in the absence of fishery exploitation. Results were also presented showing results of the OFL control rules, with Fmsy and B_{MSY} defined currently, without pH-related changes. In all scenarios, catch is forecasted to decline to zero over the next century, as early as 2050 for the most extreme pH effects. Further research in this study will address changes in target F_{MSY} over time as a function of changing pH, which should be reduced as pH-related mortality increases, and an integrated model that incorporates both BBRKC and EBS snow crab.

In response to questions from Jack Taggart about the general conclusions of the research regarding the future of the fishery and whether harvest of the stock should be increased in the near term, effectively liquidating the resource, Bob Foy noted that such a conclusion assumes that limited results from laboratory experiments are accurate representations of pH effects in the ocean, and that there is no adaptive response in crab as a result of changing pH and spatial variation thereof, and no other mitigating factors will be in effect, such that the presented results represent a worst case scenario. CPT members questioned whether the pH forecast is realistic and Bob clarified that the most recent IPCC forecasts forecast somewhat faster increase in pH. but that ocean pH is not spatially uniform. Both Bob and Andre emphasized that the degree of uncertainty in the presented results is very high, and that the principal utility of the relatively simple models is to identify data gaps and other critical unknowns.

O. Crab Bycatch in the BSAI groundfish fisheries

Diana Stram presented an overview of Council motion C-2(c) titled Crab bycatch in BSAI groundfish fisheries from the June 2010 Council meeting (attached). The motion describes incongruity in the management structure between the BSAI Crab FMP and the groundfish FMPs. The crab ACLs include directed crab fishery catch, mortality in the crab fishery, and mortality in groundfish fishery. Crab mortality in excess of the ACL triggers accountability measures (AM) that reduce directed crab harvest the year following an overage. PSC bycatch mortality may trigger an AM, leading to a reduction in directed crab fishery catch the following year. Further, PSC measures exist for only three of the ten stocks: Bristol Bay red king crab, Bering Sea Tanner crab; and Bering Sea snow crab. Because the PSC limits do not circumscribe the full distributional range of the FMP species, bycatch mortality occurs without accrual towards PSC limits. The BSAI groundfish FMP must be amended to address crab bycatch in the groundfish fisheries.

The Council requested the CPT provide input on the alternatives in the motion. Diana provided an overview of the alternatives, indicating the CPT could inform the Council by recommending the types of

information needed to characterize crab biology and stock condition in relation to PSC alternatives. The CPT discussion included the following categories:

- the historical justification for PSC management measures under alternative 1 (status quo);
- the interaction between the PSC management measures and management under ACLs;
- whether the CPT should comment on allocation issues and whether the alternatives were allocative; and
- PSC catch accounting issues due to stock definitions.

The CPT discussed historical reasons for the current PSC management measures. There was discussion about why PSC management occurs for only three stocks. Diana indicated they were, at least in part, a reaction to rebuilding plans in the groundfish fishery and noted there are also PSC limits in the scallop fishery. Tanner crab is the primary bycatch species in the scallop fishery and they have a trigger cap. Diana also noted that PSC management measures only apply to the trawl fisheries.

The CPT discussed some issues associated with the interaction between State management and PSC. In particular, the State would have to accommodate PSC mortality in setting harvest limits or risk an overfishing determination for fully utilized stocks.

The PSC limits predate current OFL management and, thus, are not informed by the total catch OFL; The status quo alternative does not correspond to the current ACL control rules. The CPT discussed how a limit tied to the ACL control rules would link PSC to the condition of a crab stock. Alternative 3 would allow variability in the PSC limits and may allow linkage to the crab ACLs, whereas, neither Alternatives 1 nor 2 allow linkages with the ACL. **The CPT recommends retaining Alternative 3 (only) because it is responsive to changes in crab abundance and provides accountability for crab bycatch in the groundfish fishery.** The CPT also recommends the analysis delineate closure areas designed to protect habitat from those designed to manage crab PSC mortality. Closure areas designed to protect habitat have biological benefits beyond just controlling crab PSC mortality.

The CPT discussed the components under Alternative 3 and had several specific recommendations:

- Components 1 and 2 are options for the timing and location of closure areas. The CPT recommends the analysis be based on existing closure areas and associated time periods.
- Component 3 defines the sectors and fisheries to be included under the PSC limit. The CPT recommends that PSC limits be considered for all FMP crab stocks.
- Component 4 would trigger restrictive PSC measures for overfished stocks. The CPT believes this component is redundant and not necessary given the MSA requires a rebuilding plan for overfished stocks.
- Component 5 would provide accountability measures for the groundfish sector. The CPT recommends this component be included for further analysis. This measure is necessary to ensure the groundfish fleet is accountable for maintaining bycatch under the PSC limit. The CPT indicated it was not appropriate body to discuss allocation issues among sectors, but noted accountable measures are required to manage PSC limits.

It was also suggested that abundance estimates used for PSC determination should consider crab selectivity into the assessments such that bycatch of unassessed, new recruits does not drive PSC closures.

Finally, the CPT recognized the need for spatial definitions of stock areas. These definitions would be used for catch accounting. For the analysis, the CPT could provide spatial information on stock boundaries.

P. Total Catch accounting

Jason Gasper provided an overview of progress towards meeting the total catch accounting requirements of the 2009 ACL final rule. In 2011, an inter-agency workgroup comprised of staff from NMFS RO, IPHC, REFM, groundfish plan teams, and ADF&G was formed to discuss and recommend measures to meet the requirements and in particular to address research catches. The workgroup came up with a template for what information needs to be collected. The intent is to have a central repository of all data through AKFIN. Unfortunately, at the time communications did not include crab assessment needs, but this is now being discussed and addressed for compilation of similar data for crab research catches.

Currently a new workgroup is being formed of plan team members to assess how best to incorporate the compiled catches into the assessments themselves. Bob requested clarification on how best to report catch and whether it should include size and sex of catch? Jason noted this is for CPT discussion as the requirement is solely for total catch not detailed catch composition. For groundfish this includes catch from surveys, sport catch, subsistence catch.

Doug Pengilly noted that ADF&G pot surveys measure crab but do not weigh them. However, weight may be estimated with a length-weight conversion. Team members identified a need to standardize bycatch mortality estimation for surveys. The team thought this should be based on individual surveys as some crab are safely returned to sea, while others are dead. Currently, data are provided without mortality adjustments to assessment authors. The team discussed potential variation across surveys, but that authors could just select a handling mortality rate by gear type for application within individual assessments and note what is being applied.

Other questions that arose included: What to do with Kodiak lab information? Is the goal to go back historically? Jason noted that this is not consistent across datasets and varies by survey. The requirement is to report from 2010 on. Mortality should be accounted for in the assessment regardless of the survey platform. What to do with average weight on surveys? It is not appropriate to use an average weight from observers, it would be preferable to use the total weight as measured on the survey itself. For crab surveys, one suggestion is to pick an appropriate length-weight relationship, put this into the meta-data and then everyone would be employing the same relationship for all crab surveys. Team members noted that the relative amount of survey catch is very small in comparison with bycatch and retained catch.

The CPT recommended waiting to include research catches in assessments explicitly until the data are compiled and available through AKFIN and the plan team workgroup is able to make recommendations on how to account for these catch within assessments.

Q. Research Priorities

The CPT revised their research priorities for SSC consideration at the June Council meeting. The revised research priorities with additions in bold and deletions in strike-out are appended to the minutes.

R. Crab Economic SAFE report

Brian Garber Yonts reviewed the timing for completion of an update of the Crab Economic SAFE report. He noted that the Economic SAFE for crab has been delayed as a result of efforts to ensure continuity in production of the groundfish economic SAFE (due to pending personnel changes). The full Crab Economic SAFE document will be updated for the fall CPT meeting, incorporating finalized COAR data, and preliminary EDR data will available for preliminary cost and labor values for calendar year AKFIN is also being used as a repository for data used in EDR production, and efforts are underway to streamline production of both Economic SAFE documents.

The team discussed the intent of providing this information and to what extent it would be employed in assessments. The authors do not use economic data in their stock assessments. It's possible to include

some form of bio-economic modeling by stock. The Crab SAFE will be finalized for the September meeting. A workgroup is developing performance metrics for use in annual reporting on economic performance. This would be similar to the report card currently being used for the Ecosystem Considerations chapter.

Brian presented figures showing exvessel and first wholesale production and revenue, and average exvessel and wholesale prices. CPT members noted that the economic information is reported on a calendar year basis, but for some stocks the fishery spans the CFY not the annual reporting year over which the economic statistics presented are aggregated. Questions were posed regarding the sampling unit, the definition in this example of variance and dispersion. Brian noted that the dispersion indicated is in the price data. Brian provided an overview of annual revenue compared with volume. Volume is down when aggregated across all fisheries, but revenue is high. Prices are currently close to historical highs, so despite declining harvest, revenues are very high.

Siddeek questioned the influence of international markets. Brian noted that global production of snow crab is mostly Canadian thus the price setting occurs there. Asked about the apparent price increase in Norton Sound red king crab, Brian noted that he cannot report wholesale prices as there is only one processor. Also there is a difficulty in pulling price information for this stock, because it comes from fish tickets and CFEC estimates of price for red king crab in general, which could be contaminated by prices for BBRKC. It is difficult to isolate NSRKC from other red king crab in COAR data as reported to species level.

André noted that y-axis should start for all graphs at 0 to avoid confusion of relative trends and increases.

Brian noted that the currently reported numbers are preliminary and will be finalized for incorporation into the SAFE report introduction for the fall.

The team recommended consideration of the Crab Rationalization (official) abbreviations in the Crab SAFE for consistency with other reports (including the economic information) and management.

S. BBRKC spawning effects:
Diana Evans provided an overview of a discussion paper on spawning effects for BBRKC. This paper was presented to the Council in February 2012 and provided previously to the CPT. The paper describes the specific consideration of BBRKC spawning areas, as well as its history related to EFH action by the Council. She noted that the methodology for the EFH impact analysis and defining fishing effects has been dropped for current Council consideration with respect to revising this methodology. The CPT had recommended revising the methodology, but the current intent is to fold that into the 2015 EFH review when additional tools will be available.

The main discussion in the paper is to look at the specific area of southwest Bristol Bay in relation to spawning and to evaluate what distributional differences are apparent in the nearshore survey. Bob noted that a grant has been funded to tag adult red king crab to identify spawning locations for inclusion on what represents critical habitat for this stock. The Council's request was to look at this issue and what adaptive management measures could be considered to address differential needs in warm and cold years as part of the broader issue of red king closures under the Bering Sea FMP and the efficacy of those closures. The intent is to bring back a discussion paper for Council consideration in December. The Council's intent in making this paper available to the CPT at this time is to be responsive to concerns raised by the CPT despite the lack of available information at this time.

T. New Business:

Upcoming meetings:

Crab Plan Team meetings: September 18-21, AFSC. A draft agenda (attached) was circulated during the meeting, noting that Tanner assessment model recommendations will be made early in the week such that projections on the recommended base model could be run for rebuilding for discussion near the end of the week.

The Spring 2013 CPT meeting will be held April 29-May 2. Anchorage, place TBD.

Model workshop 2013: Similar format to previous workshop. Public meeting, two stocks, split review. The stocks identified are: NSRKC and AIGKC. Workshop at AFSC, Seattle January 7-11, 2013

Other issues:

Doug Pengilly raised the issue of information in stock assessments is often listed metric tons instead of in millions of pounds. Pengilly noted that in the most recent CPT instructions to authors on this issue (i.e., the May 2010 CPT minutes), the CPT instructed authors to use pounds as the currency for stock assessments, not metric tons.. While there was considerable reluctance to move towards reporting only in millions of pounds and not in metric tons, the authors agreed to ensure that every table in the assessment would be made available to Doug in millions of pounds in order to facilitate his calculations in a timely manner for TAC-setting. The CPT discussed making CSV files available at a central repository. Similar to discussions previously in the meeting the CPT discussed a shared folder (aka dropbox) or sharepoint system be established for use in making data files and additional tables available to the CPT, authors and the general public real-time during the meeting and prior to it. The CPT will look into setting up public access to multiple files for the September assessment cycle.

The meeting adjourned at 4pm on May 10th.

North Pacific Fishery Management Council Crab Plan Team Meeting

May 7-10, 2012

Hilton Hotel, Anchorage, AK

DRAFT AGENDA 05/04/2012 version

Monday, May 7		
9:00	**Administration**	Introductions, approve agenda, SAFE assignments, *research priorities assignments, additions to agenda: total catch accounting, BSFRF update*
9:15	**CIE review of survey**	CIE review of EBS survey (April 2012)
9:40	**Workshop report**	Review report from recruitment workshop (April 2012)
10:15	**Model workshop**	Review report and recommendations from model workshop (Jan 2012)
11:00	**Tanner crab**	Review model development, CPT decision on whether to recommend for use in specifications for 2012/13
Noon		Lunch
1:00	**Tanner crab (cont)**	Continue model discussion
4:15	**Tanner rebuilding**	Review model projections, rebuilding alternatives
Tuesday, May 8		
9:00	**Norton Sound**	Final assessment, OFL and ABC recommendation, model modification recommendations for Sept mtg.
10:45	**AIGKC**	January workshop summary Final assessment, OFL and ABC recommendation; data review for AIGKC model and plans for review in September
Noon		Lunch
1:00	**Adak RKC**	Final assessment, OFL and ABC recommendation
1:45	**PIGKC**	Final assessment, OFL and ABC recommendation
2:15	**Snow crab handling mortality**	Dan Urban study
3:15	***BSFRF update***	*Research priorities and update on selectivity studies (snow and Tanner crab)*
4:00	**Growth and maturity**	Report on growth and maturity study
Wednesday, May 9		
9:00	**Snow crab model**	Discuss model issues/development as needed Proposed modifications for 2012/13 specification cycle
10:30	**PIBKC**	Discussion of stock boundary, bycatch data and analysis of size/sex comp. CPT recommendation on appropriate boundary of stock; review alternate methods to set OFL in 2012/13
Noon		Lunch
1:00	**St Matthew BKC**	Review assessment changes for 2012/13; discuss model
2:00	**Bmsy study**	Report on NPRB study on crab Bmsy estimation
3:00	**Crab bycatch limits**	Review updated data on crab bycatch in GF fisheries, Council June motion 2010, provide recommendations to Council as needed
4:15	***Total Catch accounting***	*Review issues and progress (Plan Team Workgroup) towards meeting requirements*
Thursday, May 10		
9:00	**Research Priorities**	Review and revise
10:00	**Economic SAFE**	Review progress
11:00	**BBRKC spawning**	Review paper, Council action in February

	effects	
Noon		Lunch
1:00	**New business and Report review**	Model workshop 2013(?), CPT meeting 2013, CPT agenda topics for Sept 2012 mtg. Review recommendations, finalize
5:00	**Adjourn**	

Research Priorities May 2012

The CPT reviewed the 2011 NPFMC Research Priorities and would like to highlight, modify and add the following to the 2012 NPFMC Research priorities relating to crab. **Changes from 2011 NPFMC Priorities are noted with bold additions and strikethrough deletions.**

I. Fisheries

A. Fish and Fisheries Monitoring

*1. Non-recovering stocks. A pressing issue is why certain stocks have declined and failed to recover as anticipated (e.g., Pribilof Island blue king crab, Adak red king crab). Research into all life history components, including predation by groundfish on juvenile crab in nearshore areas, is needed to identify population bottlenecks, an aspect that is critically needed to develop and implement rebuilding plans.

2. Continuation of State and Federal annual and biennial surveys in the GOA, AI, and EBS, including BASIS surveys and crab pot surveys, is a critical aspect of fishery management off Alaska. It is important to give priority to these surveys, in light of recent ~~proposed~~ federal budgets in which funding may not be sufficient to conduct these surveys. ~~Recent substantial~~ Loss of funding for days at sea for NOAA ships jeopardizes these programs. These surveys provide baseline distribution, abundance, and life history data that form the foundation for stock assessments and the development of ecosystem approaches to management. These surveys are considered the highest priority research activity, contributing to assessment of commercial groundfish **and crab** fisheries off Alaska. **Explore alternative approaches to the triennial ADF&G Aleutian Islands golden king crab pot survey to acquire fishery-independent abundance data on stock distribution and recruitment, including the potential for future cooperative research efforts with Industry. Explore use of tagging studies on Aleutian Islands golden king crab to better measure absolute abundance that could be used to scale the stock assessment model.**

3. ~~Studies are needed to evaluate effects of the environment on survey catchability.~~ For crabs, studies are needed on catchability, as it directly bears on estimates of the stock size for setting of catch quotas. Research to refine the estimates of survey catchability, *q*, used to infer absolute, rather than relative abundance would substantially improve the quality of management advice. Particular emphasis should be placed on Tanner crab because of recent trends in stock status **and on fishery and fishing gear selectivity for Aleutian Island GKC to improve the stock assessment model**.

4. Advance research towards developing a quantitative female reproductive index for the surveyed BSAI crab stocks. The current stock-status assessment process for surveyed BSAI crab stocks uses the estimated mature male biomass at the presumed time of mating as the best available proxy for fertilized egg production. Research on mating, fecundity, fertilization rates, and, for snow and Tanner crab, sperm reserves and biennial spawning, is needed to develop annual indices of fertilized egg production that can be incorporated into the stock assessment process and to model the effects of sex ratios, stock distribution, and environmental change on stock productivity. Priority stocks for study are eastern Being Sea snow and Tanner crab and Bristol Bay red king crab.

5. Continue and expand cooperative research efforts to supplement existing surveys to provide seasonal or species-specific information for use in improved assessment and management. The SSC places a high priority on studies that provide data to assess seasonal diets and movements of fish and shellfish, for use in studies of species interactions in spatially explicit stock assessments.

B. Stock Assessment

*1. Improve handling mortality rate estimates for crab. Improved understanding on the post-release

mortality rate of discarded crab from directed and non-directed crab pot fisheries and principal groundfish (trawl, pot, and hook and line) fisheries is required. The magnitude of post-release mortality is an essential parameter in the determination of total annual catch used to evaluate overfishing in stock assessment and projection modeling. For example, assess discard mortality rates of Tanner crab by size, month, sex, and fishery type. (partially underway: Chionocetes RAMP study)

2. Acquire basic life history information (specifically, natural mortality, **growth**, size at maturity, and other basic indicators of stock production/productivity) for sharks, skates, sculpins, octopus, and squid and data-poor stocks of crab, ~~to allow application of Tier 5 or Tier 4 assessment criteria~~. ~~There are two possibilities that would require dedicated research: (1) directly estimate fishing mortalities through large-scale tagging programs; and (2) develop habitat-based estimates of abundance based on local density estimates in combination with large-scale habitat maps. Little information is available, especially for sculpins, skates, octopuses, squids, grenadiers, and some sharks. (partially underway).~~ **Stocks of particular concern include Norton Sound red king crab, as current model parameters based on Bristol Bay red king crab are not appropriate. Tagging studies to estimate growth of golden king crab in the western Aleutians are particularly needed to parameterize the Aleutian Islands golden king crab model.**

3. Improve estimates of natural mortality (M) for several stocks, including Pacific cod and BSAI crab stocks. **Develop and validate aging methods for crabs to improve estimates of M.**

4. Conduct a tagging study of red king crab in the region north of Bristol Bay to assess the movement between this region and the Bristol Bay registration area.

5. Quantify the effects of historical climate variability and climate change on recruitment and growth and develop standard environmental scenarios for present and future variability, based on observed patterns. There is also a clear need for information that covers a wider range of seasons than is presently available.

6. To identify stock boundaries, expanded studies are needed in the areas of genetics, reproductive biology, larval distribution, and advection. Expanded tagging efforts are needed to support the development of spatially explicit assessments. High priority species for spatially explicit models include: walleye pollock, Pacific cod, sablefish, yellowfin sole, rock sole, arrowtooth flounder, Pacific ocean perch, black spotted rockfish, rougheye rockfish, snow crab, and Atka mackerel. (partially underway)

C. Fishery Management

II. Fisheries Interactions

III. Habitats

A. Evaluate Habitats of Particular Concern

B. Baseline Habitat Assessment

*1. Research is needed on the effects of **the distribution and potential** habitat modifications on spawning and breeding female red king crab, particularly in nearshore areas of southwest Bristol Bay.**(partially underway)**

C. Fishing Effects on Habitat

D. Habitat Mapping

E. Function of Habitat

IV. Other Areas of Research Necessary for Management

A. Ecosystem Indicator Development and Maintenance

B. Research on Environmental Influences on Ecosystem Processes

1. Conduct Research on Ocean Acidification

a) Collect and maintain time series of ocean pH in the major water masses off Alaska. (partially underway)

b) Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels. (partially underway).

C. Basic Research on Trophic Interactions

D. Ecosystem Modeling

1. Develop spatially-structured models for key BSAI crab stocks and conduct an evaluation of the benefits and costs of moving to spatial models in terms of the ability to provide accurate and precise management advice.

2. Collect, analyze, and monitor diet information, from seasons in addition to summer, to assess spatial and temporal changes in predator-prey interactions, including marine mammals and seabirds. Diet information should be collected on the appropriate spatial scales for key predators and prey to determine how food webs may be changing in response to shifts in the range of crab and groundfish.

3. Ecosystem structure studies: Studies are needed on the implications of food web interactions of global warming, ocean acidification, and selective fishing. For instance, studies are needed to evaluate differential exploitation of some components of the ecosystem (e.g., Pacific cod, pollock, and crab) relative to others (e.g., arrowtooth flounder).

June 2010 C-2(c) Crab bycatch in BSAI groundfish fisheries

The Council moves the following problem statement and alternatives for analysis:

Problem Statement

Total catch overfishing levels (OFLs) are specified annually for the ten crab stocks included in the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP); these OFLs account for all sources of fishing mortality including directed crab fishery discards and bycatch mortality caused by groundfish, scallop, and Pacific halibut fisheries. Requirements to comply with Annual Catch Limits (ACLs), addressing uncertainty in OFL estimates, include Accountability Measures (AMs) that trigger a management action if an ACL is exceeded.

Crab bycatch in the directed crab and scallop fisheries is controlled by the State of Alaska, however current management structure does not link the crab and groundfish FMPs; if a crab ACL is exceeded due to bycatch mortality in a groundfish fishery the resulting AM would reduce directed crab fishery harvest the following year. Crab bycatch management measures were first adopted for BSAI groundfish trawl fisheries in 1986. These measures, established in the BSAI groundfish FMP, consist of triggered or fixed time and area closures and prohibited species catch (PSC) limits; PSC limits apply only to Bristol Bay red king, Bering Sea Tanner, and Bering Sea snow crab. There are no PSC limits for the remaining seven FMP crab stocks and the existing closure areas do not circumscribe the full distributional range of stocks they are intended to protect, thereby allowing bycatch mortality to occur without accrual towards PSC limits. Furthermore no bycatch management measures are imposed on the fixed gear groundfish or Pacific halibut sectors. In order to address crab bycatch in the BSAI groundfish fisheries the BSAI groundfish FMP must be amended.

Alternative 1 - No action

Maintain existing crab PSC limits and closure areas.

Alternative 2 - Fixed PSC limits

Crab PSC limits would be fixed in the BSAI groundfish FMP.

Alternative 3 - Variable PSC limits

Crab PSC limits would be set annually based on crab abundance.

Note: Different alternatives may be chosen for each FMP crab stock.

Components with options that could be applied to alternatives 2 and 3:

Component 1: Closure areas

a) Existing closure areas
b) Expand triggered closure areas to include full distribution of each crab stock
   Option: Triggered closure areas encompassing distribution of vulnerable size/sex components of crab stock

Component 2: Timing of closure areas

a) Fixed

i. Year-round
ii. Seasonal

Option: based on vulnerable life history or gear susceptibility

b) Triggered
   i. Full
   ii. Stair-stepped (area closed expands as bycatch triggers are reached)

Component 3: Groundfish sectors/target fisheries included

a) All trawl sectors
b) All fixed gear sectors
c) Halibut IFQ

Component 4: Overfished stocks

a) Overfished/overfishing determination would trigger more restrictive PSC limits
b) Overfished/overfishing determination would trigger more restrictive time and area closures

Component 5: Accountability measures

a) Crab bycatch would accrue inseason towards groundfish sector PSC limit and an overage would trigger accountability measures during the subsequent season or year for that groundfish sector

Component 6: Catch accounting issues

a) Account for PSC limit accrual against time/area closure thresholds on a crab fishing year (June-May)
b) Account PSC limit accrual against time/area closure thresholds on a groundfish fishing year (January - December)

Other considerations noted in Council discussion:
Staff should consult with Crab Plan Team regarding further refinements to alternative framework noting that Council may further refine alternatives at preliminary review. Staff could consider further break-outs of sectors to fishery-levels as possible. Information in the analysis should include reporting bycatch both in numbers of crab as well as weight.

North Pacific Fishery Management Council Crab Plan Team Meeting

September 18-21, 2012

AFSC, Seattle, WA

DRAFT AGENDA 05/10/2012 version

Tuesday, September 18		
9:00	**Administration**	Introductions, approve agenda, SAFE assignments,
9:15	**2012 EBS Survey results**	NMFS bottom trawl results, BSFRF cooperative study results
10:15	**PT Workgroup reports**	Recruitment report, total catch accounting report, retrospective analyses
11:00	**Tanner crab**	Final assessment, OFL and ABC recommendation. BSFRF Tanner selectivity study results
Noon		Lunch
1:00	**Tanner crab (cont)**	Continue discussion
Wednesday September 19		
9:00	**Snow Crab**	Final assessment, OFL and ABC recommendation.
Noon		Lunch
1:00	**BBRKC**	Final assessment, OFL and ABC recommendation
3:00	**St. Matthew BKC**	Final assessment, OFL and ABC recommendation
Thursday September 20		
9:00	**AIGKC**	Discuss model issues/development Proposed modifications for 2013/14 specification cycle
Noon		Lunch
1:00	**NSRKC**	Discuss model issues/development, plans for model workshop
2:00	**Tanner crab rebuilding**	Review projections with recommended base model, plans for rebuilding alternatives/analysis
4:00	**PIRKC**	Final assessment, OFL and ABC recommendation
4:30	**PIBKC**	Final assessment incl stock boundary issues, OFL and ABC recommendation
Friday September 21		
9:00	**Snow crab-Effective spawning biomass**	Snow crab reproductive biology (Joel Webb). Potential plans for revising use of MMB in specifications/assessments
10:00	**Economic SAFE review**	Summary information for Crab SAFE Intro
11:00	**Report review**	Final revisions 2012 SAFE introduction, specifications, tables
Noon		Lunch
1:00	**Report review cont.**	Final revisions 2012 SAFE introduction, specifications, tables
3:00	**New business**	
3:30	**Adjourn**	