AGENDA C-3(c)
OCTOBER 2011

MEMORANDUM

TO: Council and AP Members

FROM: Chris Oliver
Executive Director

DATE: September 16, 2011

SUBJECT: BSAI Crab SAFE Report

ESTIMATED TIME
12 HOURS
(All C-3 items)

ACTION REQUIRED

(c) Approve catch specifications/approve BSAI Crab SAFE Report

BACKGROUND

The Crab Plan Team met September 19-22 to review draft BSAI Crab stock assessments and provide recommendations for OFL and ABC for six of the ten stocks. There are 10 crab stocks in the BSAI Crab FMP and all 10 must have annually established OFLs. This year following approval of Amendment 38 to the Crab FMP, to comply with Annual Catch Limit provisions, annual ABCs are recommended by the SSC. Four stocks (Norton Sound red king crab, AI golden king crab, Pribilof Island golden king crab and Adak red king crab) had OFLs and ABCs recommended in the spring. The remaining stocks will have OFLs and ABCs recommended at this meeting. The stock assessments for these stocks as well as the Ecosystem Considerations Chapter were mailed to the SSC and copies are available at the meeting as needed. The Introduction to the Crab SAFE containing the CPT recommended OFLs and ABCs will be handed out at the meeting, as will the CPT Report containing additional recommendations and minutes from the September CPT meeting.

Crab Plan Team report

The North Pacific Fishery Management Council's Crab Plan Team (CPT) met September 19-22, 2011 at the Alaska Fisheries Science Center in Seattle, WA.

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)***
Gretchen Harrington	***(NOAA Fisheries – 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 for all or part of the meeting included: Jack Tagart, Brett Reasor, Lori Swanson, Dave Boisseau, Mike Woodley, Rob Rogers, Steve Hughes, Kevin Kaldestad, Anne Vanderhoeven, Pat Livingston, Guy Fleischer, Ray Nomura, Jie Zheng, Bill Prout, Linda Kozak, Scott Goodman, Hunter Burns, Gary Stauffer, Glenn Merrill, Clayton Jernigan and Tom Casey.

The attached agenda was approved for the meeting.

Administration

The team welcomes new member Dr. Steve Martell of UBC.

Agenda: Changes to the agenda include the following: add a discussion of survey catch in assessments (per total catch accounting under ACL amendments) and add 30 minutes each morning to review minutes from the previous day. Thus, each agenda item listed will start 30 minutes later than originally scheduled. *Meetings:* Timing of upcoming meetings and locations are as follows: January NPFMC crab modeling workshop (AFSC) January 9-13, 2012; May CPT meeting (Anchorage) May 7-11; September CPT meeting (AFSC) September 17-21. Further discussion will occur this week regarding stocks to be discussed at the modeling workshop, as well as workshop format.

SAFE report timing: Diana reminded the team and assessment authors of the compressed meeting timing relative to SSC review on Monday. Existing have already been distributed to the SSC, so no changes to assessment are possible during this meeting. However, errors in assessments may be updated for the final SAFE version to be posted on the Council's website in October.

BBRKC EFH update: The CPT was updated on the current status of a discussion paper on the EFH associated with Bristol Bay red king crab. To address the question about defining EFH associated with larval hatching locations AFSC scientists are seeking funding to conduct research in Bristol Bay. To address the validity of existing closure areas and their relative importance as EFH, NMFS scientists are working with industry representatives in groundfish and crab fisheries to mine existing data on crab and catch distributions. An update on this analysis will be available in 2012.

Survey overview

Bob Foy (AFSC) summarized preliminary results from 2011 NMFS survey. The standard 376 survey stations were sampled beginning June 5 in Bristol Bay and ending on July 25 in the western Bering Sea. Resampling occurred in 20 Bristol Bay stations through July 31 due to effects of cold water temperatures on the red king crab reproductive cycle. Additional data collection occurred for nine special projects including: nearshore sampling in Bristol Bay; Tanner diets; pathology; *Chionoecetes* spp. reproductive potential; hemolymph collections for monitoring of bitter crab syndrome and to study the effects of cold temperatures on hormones; genetic sampling for blue king crab stock structure and Tanner/snow crab hybridization; and finally live red king crab were collected for several ocean acidification experiments in the lab (maternal condition/reproductive success and larval condition/survival).

The cold pool did not extend as far to the southwest this year. Compared to 2010, warmer bottom temperatures were present in the southwest, at the nearshore stations along the Alaska Peninsula, and in the shallow waters around Nunivak Island. The 20 stations resampled in Bristol Bay warmed from 2-3°C in early June to 4-7°C in late July.

Abundance estimates and spatial distributions by sex and size were briefly summarized and new maps were presented which showed the percent frequency that individual stations contributed to the overall abundance estimates for each stock. The new maps were well received and a CPT member suggested that it may also be useful to see these changes over time. An additional request was made to update the centroid plots developed by Billy Ernst and to show variance in the proportion of the total survey catch in each grid cell in addition to the most recent value.

Total catch accounting

The team discussed the necessity of including survey catch into assessments for total catch accounting purposes as needed under the revised MSA. The CPT discussed how to incorporate survey or EFP catch data into the ABC process. All future assessments should include removals of historical survey catches. The team discussed how to accomplish this for the EBS trawl survey as well as ADF&G pot surveys. These removals must also account for handling mortality. Trawl survey catch is currently estimated with 100% mortality and pot survey catch was suggested to have a mortality rate of 10 – 20%. The team discussed that GOA data on that pot survey could help inform values for handling mortality for the BSAI pot survey. Bob Foy and Doug Pengilly will work to assess appropriate handling mortality rates for respective surveys and provide this information as well as survey data to authors for incorporation into the subsequent assessments.

Team members noted that these removals could be significant for some stocks (e.g. PIBKC). There are two primary surveys that need to be accounted for: the EBS trawl survey, and the ADF&G pot surveys. Some of the issues to consider are appropriate length-to-weight relationships, estimating historical time series, and a central access point for compiling these data to facilitate access by assessment authors. The team questioned to what extent additional consideration will be necessary for research permits for additional surveys or the need to tie the State permitting process tied to total catch accounting as well as what component of the catch accrues towards this. The team discussed that catch should be accounting for however the OFL is currently defined in for consistency by stock.

The team noted that it will be necessary to continue to have discussions of how best to ensure that all survey catches are included in the assessment and total catch accounting towards the OFL. It will also be important to ensure that catch is in same year as the year assumed when including the survey in the model, for example, 2010/11 survey would be included in the 2011/12 catch model year. Guidance will be sent out this winter in terms of the process for accounting for these catches in the next assessment cycle.

Stock Assessment Review

EBS Tanner crab: Assessment and OFL / ABC recommendations

Dr. Lou Rugolo presented the 2011 assessment for EBS Tanner crab. Although a model for this stock is in development, it has not yet been approved for use in providing management advice. The methodology on which the 2011 assessment is based is therefore essentially the same as that used for the 2010 assessment. However, the B_{MSY} proxy (B_{REF}) is based on the years 1974-80 rather than 1969-80, reflecting a recommendation from the February 2011 stock assessment workshop. The estimate of mature male biomass for 1974-75 is based on recalculated estimates of abundance rather than values from INPFC reports as was the case last year. Stock status is based on the calculated MMB on 15 February 2011 given the availability of catches and discards for 2010/11. The assessment also provided a projection of MMB to 15 February 2012 under a catch equal to the OFL. The author provided estimates of the breakdown of the OFL into catches of mature males, females, as well as the retained catch in the directed fishery for various levels of catch in (and hence bycatch by) the opilio fishery.

The analyst provided OFLs based on three B_{MSY} proxies: (a) 1974-80, (b) 1974-80 where the mature male biomasses are adjusted for catches under the F_{MSY} proxy rather than the actual catches, and (c) 1974-2010. The team agreed to base the 2010/11 OFL on a B_{MSY} proxy defined in terms of the years 1974-80 without the adjustment ("no bias correction" in the assessment report). In relation to the selection of a range of years to set B_{MSY}, the team recommends use of the *status-quo* (1974-80) because there was insufficient information provided in the assessment report to change the range of years recommended at the February 2011 stock assessment workshop. The team **recommends** that the analyst provide all of the information which the team identified in May 2011 related to the selection of years to define B_{MSY}, and rank each B_{MSY} alternative against each source of information. The team identified trends in recruitment as a key source of information which could inform the selection of a range of years to define B_{REF}. Recruitment estimates are not available for Tier 4 stocks, but an index of recruitment could be based on survey catch-rates for pre-recruit size-classes.

The OFL in the summary table (pg. 3 of the assessment report) does not include catches of females. An additional loss of 110t (243 thousand lbs) of females projected under assumptions for female bycatch and discard leads to a total-catch OFL of 1.57 thousand t (3.46 million lbs). The team based its recommendation for an OFL on the highest possible catch in the opilio fishery (42.77 thousand t), although the OFL was virtually unchanged if a lower catch in this fishery is assumed. The retained catch in the directed fishery depends critically on the size of the opilio fishery. The analyst reported that a bycatch in an opilio fishery with a catch of 42.77 thousand t would lead to the entire OFL being taken as bycatch given projected catches in the red king crab and groundfish fisheries. The OFL calculations are based on a predicted catch in the groundfish fisheries (both sexes) of 360t. This value reflects a declining trend in bycatch in the groundfish fisheries. Public comment to the team indicated that the reduced level of bycatch was appropriate for projection purposes owing to changes caused by rationalization of the groundfish fishery as well as shifts in Pacific cod fishery.

1. Future assessment reports should fully describe the process used to infer bycatch of females and the level of catch in the opilio fishery which corresponds to a zero catch by the directed fishery.

2. Future assessments should consider a survey time series which excludes "hot spot" re-samples throughout the time-series for consistency with how the 2011 survey was conducted.
3. Rather than sampling with replacement from the years used to calculate the B_{MSY} proxy, the uncertainty associated with this proxy should be quantified by sampling from the distributions from the survey estimates for each of the years on which the B_{MSY} proxy is based.

EBS Tanner crab: Stock assessment model

Drs Lou Rugolo and Jack Turnock presented the latest version of the TCSAM to the team. Model development started in 2010 and preliminary versions of the model were reviewed by the team and SSC three times during 2011. The authors reviewed and revised the data used in the model, extended the model to implement the suggestions by the team, the SSC and other reviewers, and provided results for several model variants. The team welcomed the new model and results, and noted that the fits to the data were markedly improved compared to those from earlier versions of the model. However, some of the implications of the assessment, specifically the very high fishing mortality rates in some years (>2yr^{-1}) and the marked changes in selectivity over time and among the sexes seemed unrealistic. The team **recommended** that revisions to the model should be further reviewed at the January methodology meeting. It made several **recommendations** for further model development:

1. exclude the 1995 retained length-composition data;
2. do not downweight the 1991 female discard length-composition data;
3. quantify the change in mean recruitment between the two "regimes"[1950-1973; 1974-current];
4. consider a scenario in which the β parameter of the growth model is estimated, subject to a prior based on the data for the GOA;
5. document how fishing mortalities are set for bycatch in the opilio and red king crab fisheries before discard catch biomass data are available - ideally move to an approach for specifying these bycatch levels based on the fishing mortality rate estimates for these stocks from their respective assessments;
6. include a table of correlations among the parameters;
7. consider a variant of model 2 in which survey catchability changes as a time-series, but female catchability is a multiple of that for males (37 instead of 72 parameters);
8. examine the sensitivity of the results to uncertainty in the foreign catches (and discards in the foreign fisheries);
9. fully document the priors for *M*;
10. include a likelihood profile for male survey Q in the last period in the assessment, show results for analyses with different values for male survey Q in the last period, and apply the model with the prior on male survey Q in the last period;
11. Include any new information on handling mortality rates from on-going studies by NMFS in groundfish and directed snow crab fisheries;
12. conduct runs in which a) recruitment before 1973 is constant, and b) in which it is selected so that the 1974-80 mean biomass is 30-35% of the unfished biomass – these runs will help the team select a series of years for defining the average recruitment used when computing $B_{35\%}$; and
13. conduct retrospective analyses for the various model configurations.

EBS Tanner crab: Rebuilding analyses

While the stock assessment is not yet capable of providing the basis for projections and hence a rebuilding analysis, the basic structure of the model is appropriate for this purpose. The team noted that catches in the directed fishery are computed east and west of 166^{0}W given the minimum sizes in these two areas. The current approach is based on different selection patterns east and west of 166^{0}W and the assumption that future fishing mortality will occur in proportion to the amount of survey biomass east and west of 166^{0}W. The approach should be modified so that the catches rather than fishing mortality rates match the assumed split.

In relation to the alternatives for rebuilding, the team noted that current results suggest that the stock should be able to recover to the proxy for B_{MSY} within 10 years with current rates of bycatch in the groundfish and red king crab fisheries (but this needs to be confirmed by the final version of the model). The team **recommends** that further management measures to constrain bycatch in the groundfish fisheries and in the Bristol bay red king crab fishery are not necessary in conjunction with the rebuilding alternatives. The impact of these fisheries bycatch on rebuilding time frames is marginal in comparison to bycatch from the snow crab and directed Tanner crab fisheries. The team **recommends** that the alternatives should be crafted around different years, T_{target}, for recovery to the B_{MSY} proxy and, given a T_{target}, the split of the removals between the opilio and directed Tanner crab fisheries. One of the alternatives should consider the maximum possible catch in the opilio fishery by assuming that future opilio catches are the lower of the maximum permissible ABC and the output of the ADF&G control rules.

The team **recommends** that an analysis of spatial bycatch rates of Tanner crab in the opilio fishery be undertaken with the possibility of alternatives which include spatial closures to reduce Tanner crab bycatch rates in the opilio fishery.

A key component of any rebuilding analysis will be the B_{MSY} proxy. Model output, e.g. the time series of recruitment estimates and estimates of recruits per spawner from the model should provide information needed to set this proxy.

Bering Sea snow crab

Jack Turnock presented results of the eastern Bering Sea snow crab assessment. This model is currently used for setting OFL using the Tier 3 OFL control rule. The assessment includes responses to recommendations from the May 2011 CPT meeting and the June 2011 SSC meeting. Thirteen alternative assessment scenarios relative to a base (Model 0, the Sept 2010 Model) scenario were presented. Alternative scenarios explored various treatments of BSFRF survey data, natural mortality for immature male and female crabs, and natural mortality for mature male crabs. Models 8-10 included new, but not fully reviewed, information on male crab growth.

Changes to data included: (1) side by side tows from the 2010 experimental study; (2) 2011 survey biomass and length frequency; and (3) 2010/11 fisheries catch, bycatch and discard and the associate length frequency data.

Information on snow crab growth was reviewed. The CPT commented on the growth increment data from the Kodiak holding studies of crabs captured in the Bering Sea; although these are assumed to be male only data, the study indicates that both male and sexually immature crab were included.

Assessment results primarily focused on Model 7, where M was fixed at 0.23 yr^{-1} in the model. Model selection was based on the fact that the author does not believe that M can be estimated within the model and that, in cases where M was estimated, the results are not credible based on the data available for longevity. There was some disagreement among CPT members as to how the estimate of natural mortality was derived. The CPT **recommends** that additional investigations are necessary to develop a better prior for natural mortality and the assessment should better specify the derivation of the estimated longevity. For example, simulation studies should be examined to determine if M could be jointly estimated, reliably. Team members commented that it could also be possible that M is higher than $0.23yr^{-1}$. Based on the model results, there is some confounding between catchability Q and M, therefore, a prior on M implies a prior on Q (Table 8; Figure 119 of the assessment report)

The model uses the average recruitment over the entire time series to estimate B_{35}. Model 7 ranks 7th in terms of AIC among the seven model configurations that estimate growth, but the effective number of parameters and the appropriate metric for model selection are unclear. The CPT **recommends** that a retrospective analysis be employed for help with model selection.

Fits to the NMFS trawl survey data are best for model 6, and worst for model 7. Models 8-10, are new, and the CPT has not had an opportunity to examine the new growth information that was used to fix the growth parameters within the assessment model. All of the assessments are robust with respect to estimates of trends in MMB relative to $B_{35\%}$; i.e., the stock is robustly estimated to be above $B_{35\%}$. This indicates that the stock is rebuilt.

The team endorsed the use of model 6 for stock status determination and OFL specification. This model: 1) estimated M; 2) smoothed the BSFRF data; and 3) better fit the NMFS trawl survey data.

Recommendations for next assessment:

1) add parameter bounds to Table 13;
2) add a table of parameter correlations;
3) include a plot overlaying the MMB trajectories for each of the scenarios for easier comparison (similar to Figure 87 but with all the runs);
4) the model description for the likelihood functions for the experimental data is incomplete and needs to be elaborated;
5) fix caption (legend) for Figure 24;
6) develop a more formal and reasonable model selection criterion based on statistical descriptions of the model fit to the data rather than having a zero prior for all models that don't have an M = $0.23yr^{-1}$;
7) provide retrospective estimates of Q and $B_{35\%}$; and
8) conduct further work on estimating M and the associated confounding of M, and growth with Q.

ABC deliberations:

The Team **recommends** an ABC less than the maximum permissible. This is due to multiple sources of uncertainty in the OFL that are not reflected in the model-based estimate of within-model uncertainty, σ_w, employed in the maxABC control rule. These uncertainties include: estimating M, the implications of the yet-to-be-reviewed new growth data, and structural uncertainty. These sources have not been fully considered in the calculation of maxABC. The team also expressed concern that the uncertainty in recruitment, as well as the declining trend in recruitment (indicating that biomass is likely to drop below B_{MSY} in the short-term), provides additional rationale for an ABC < maxABC.

The Team had difficulty in determining the buffer between the OFL and the ABC that appropriately addresses uncertainty. The Team considered many options for an ABC <maxABC permissible including the following options:

1) a default 10% buffer from the OFL;
2) use of the OFL from model 7 as an ABC;

3) using the recommended total uncertainty (i.e., σ_w and σ_b from the EA for amendment 38) to estimate a buffer using a P* of 0.49; and
4) using the ratios of OFL from model scenarios (e.g., use ratios between different model scenarios) to define a range of values to be used as a multiplier (buffer) for the ABC.

Despite extensive discussion of these items, the CPT was unable to recommend a specific ABC but wishes to identify the following information on uncertainty that should be captured in an ABC: a) using *M* fixed at prior value would have led to a lower OFL value; and b) use of the new growth data (which has not yet been reviewed in much detail) would have resulted in a lower value. However, the Team recognized that given the uncertainty noted, risk tolerance is required to choose an appropriate buffer based on the model results presented.

St. Matthew blue king crab

Bill Gaeuman presented the St. Matthew blue king crab stock assessment. He explained the methods used in the survey-based assessment. The estimate of biomass is high relative to historic abundance and may be at peak abundance. The team noted that the new assessment now includes all sources of fishery mortality. The assessment indicates that groundfish bycatch mortality is largely inconsequential (Figure 9). The author noted that approximately 48% of trawl survey catch occurred in one station, and that the ADF&G survey, fishery, and groundfish bycatch all occur in spatially different areas.

The author clarified that the OFL in the assessment was calculated for mature males only. The team discussed calculating the OFL in this manner and how to reconcile this with evaluating whether overfishing occurred. The team requested that the author recalculate the OFL to apply to total males. The OFL is not a total catch OFL because the OFL estimate does not include females.

The team discussed the years used to calculate B_{MSYproxy} and the author recommended the period from 1989/90 to 2009/10. The team **recommends** that the assessment provide further justification for this choice of this period at the May 2012 meeting.

The author recommended an ABC below maxABC, but did not provide a recommended ABC amount. Unaccounted for scientific uncertainty for this stock relates to the estimate of natural mortality, and that the survey does not cover the stock distribution (catchability) or the location of fishery. The trawl survey is a poor indication of abundance andmay underestimate abundance. However, how the abundance index in the survey relates to the crab caught in the fishery or the total population is uncertain. The team discussed how to use this uncertainty to calculate an ABC because there is no expectation for information or analyses to resolve these uncertainties in the near future. As a result, the team **recommends** a 10% buffer for the ABC.

St. Matthew model discussion: Bill Gaeuman presented the recent developments in the stock assessment model for St. Matthew blue king crab and requested the team's input on the next steps. The team noted that the model description is very clear and well written which makes review easier. The team discussed the equations and requested clarification on a few of the parameters. The author noted that, after the work in reconstructing the model, the new model results and formulation are similar to the original model which provides confidence in the historical use of the model for specifications purposes

The author explained the changes in the model from the version the team reviewed in May 2011, including removing shell condition and decreasing the weight of the pot survey data relative to trawl survey data. The team discussed the weighing of the different data sources; pot survey, trawl survey, and observer data (Table 5). The author notes that one (or both) of the trawl and pot surveys may not be representative of the population.

The team made **recommendations** to adopt a standardized weighting procedure based on CVs for indices and catch biomass, to provide several model configurations [along with an author-preferred model] for evaluation by the team, and to provide diagnostics to evaluate the choices. The issues of effective sample size and survey representation should be evaluated. The team noted that the report from the team's modeling workshop in 2009 (and annual SAFE guidelines) provide additional guidance for addressing these issues.

The team discussed whether or not this model should be reviewed at the January modeling workshop or at the May 2012 CPT meeting. The team intends to review the model in May for possible use in stock status determination in the 2012/13 assessment cycle.

Bristol Bay red king crab

Jie Zheng presented the stock assessment for Bristol Bay red king crab. Major changes to the assessment from September 2010, aside from the updating with data from the 2010/11 fishery year and the summer 2011 trawl survey, involve the use of assessment model Scenario 7ac, which is the Scenario 1 model from September 2010 with incorporated recommendations from the CPT in September 2010 and May 2011. Model Scenario 7ac assumes 3 levels of molting probabilities, incorporates the BSFRF biomass data, estimates effective sample sizes, estimates proportions in initial years, and (with respect to the "Bristol Bay retow data") uses only the standard survey data for males and only retow data for females for stations where retows took place. Only results for Scenario 7ac were presented.

This model also assumes that natural mortality is $M=0.18yr^{-1}$ for both sexes, regardless of size and shell condition, over the 1968–2011 period that is modeled, except that it also estimates additional naturalmortality for 1980–1984 for males, 1980–1984 for females, and 1976–1979 plus 1985–1993 for females. Additional natural mortality for males during the 1976–1979 plus 1985–1993 period was not estimated because previous model runs suggested that male natural mortality was not higher during this period. As in previous assessment reviews, the CPT asked if those periods of increased natural mortality could be related to some physical or biological mechanism or were only chosen to improve the fit because there is concern that estimable parameters are added to the model to fit the available data, without supporting evidence from outside the model. The CPT felt that the authors' response to the May 2011 comment raising this question was speculative; the authors suggested that increased mortality during those periods could be due to unknown fishing mortality or to increased predation, but offered no supporting evidence. The CPT **recommends** that the authors summarize available data on predation/mortality for the May 2012 meeting so that the CPT can assess the justification for invoking increased predation during the periods concerned.

Questions and comments concerning the use of the retow data and the standard survey data in the retow area were made by the CPT and the audience. The possibility of using the retow data as a separate survey series was raised. Zheng said that, given that the retows are performed only in unusual years (mainly unusually cold years), they are not a survey in same was as the standard survey, and hence do not represent a time-series. There were also questions on changes in densities between standard survey and retows in the resurvey area. Densities of females were markedly higher in the retow stations. There had been speculations that the increase in female densities was due to a large-scale redistribution of females from nearshore areas outside of the surveyed area into the resurveyed area. A nearshore survey performed early during the 2011 survey provided no evidence that females were aggregated in the nearshore area until after the standard survey (a report on the nearshore survey will be given later in the meeting). Rugolo suggested that the difference in female densities between standard and resurvey tows was due to a small-scale patchy, distribution of females with the survey area and noted that females in pre-molt and pre-mating become highly aggregated (mounding), which would result in a low probability of encounter of females by the widely-spaced tows during the standard survey; after molting/mating, the females spread out and encounter probabilities for the survey become higher. Following discussion of the mechanism for effecting the observed increase in female densities in the retow survey, the CPT **recommends** that in May 2012 the assessment authors and CPT settle on the proper use of the standard and retow survey data for males (i.e., use only standard tows, an average of the standard tows and retows, or only retows) and provide a justification for the choice.

Zheng reviewed the trend in the 2011 survey data. The area-swept estimates for mature females and, especially, for mature males declined from 2010, as would be expected given the poor recruitment inferred from recent surveys; the decline for mature males is larger than for mature females and is more than expected. A large catch of juvenile males and females in eastern Bristol Bay is a hopeful sign. However, that large catch is due to only one tow, so has high uncertainty.

Zheng reviewed the results of the current estimates from the model Scenario 7ac. Differences between the 2010 assessment and current scenario 7ac were noted: Lower total biomass, mature male biomass, and mature female biomass peaks for scenario 7ac than in the 2010 assessment in the peak years of late 1970s/early 80s.

The model fit to the survey size frequency distributions was reviewed. The "bubble plots" for the size frequency distribution residuals looks adequate for males, but there is a problem for the fit of the female size distribution at larger sizes in early survey years. There was a question about the 1984 survey size distributions for males and females; there is a marked discrepancy between the model fit and the peak in the lower end of observed size distribution. Zheng explained that the peak in the observed size frequency distribution was due to a single hotspot tow. The model also fits the retained catch and directed fishery bycatch size frequencies well for males. The model doesn't fit the bycatch size frequencies for females well, however; a result attributed by Zheng to the hit or miss nature of the female bycatch.

Zheng noted a slight negative trend through time in the standardized residuals of total biomass.

Zheng presented a retrospective analysis of the Scenario 7ac estimates of MMB and noted the clear and evident downward bias (sequentially adding each terminal year results in a lower biomass estimate for recent years). The CPT emphasized the importance of this trend, particularly when judging the uncertainty in the estimate of recent years' MMB; i.e., from this trend, it would be reasonable to expect that next year, should the declining survey trend continue, the model will estimate the 2011 MMB to be lower than it is presently estimated.

Zheng provided a review of information relevant to choosing the reference period for recruitment used to estimate $B_{35\%}$. Much of what was presented by Zheng was not in the assessment report that was available for review. Zheng stated that if we believe that the 1976/77 regime shift had a strong effect on the stock's productivity, estimates of recruitment and productivity from after 1983 (from within the period the 1984–2011) should be used; if not, the 1969–1983 period should be used as, or be included in, the reference period. The choice is important: the stock would be considered overfished and at a level necessitating closure of the fishery if 1969–1983 is used as the reference period, whereas the stock would be estimated to be above the proxy for B_{MSY} if 1984–2011 or 1995–2011 is used. Zheng showed that the estimates for annual recruitment during 1969–1983 were much higher than the mean recruitment during 1984–2011 (a t-test is significant). Likewise, the mean of annual productivity (R/MMB, appropriately lagged) was much higher for 1969–1983 than for 1984–2011 (statistically significant). Finally, Zheng showed that the stock-recruit relationship shows a difference between the pre-1984 and post-1983 recruitments. Zheng then proceeded with a presentation (also not in the assessment report) that showed that the differences in pre-1984 and post-1983 recruitment/productivity align well with effects that can be attributed to the 1976/77 regime shift: differences align well with the time series of bottom temperatures and PDO. The differences in recruitment also align with a distribution change in mature females from between the 1970s to the 1980s-through-present, which would have an effect on recruitment (the earlier distribution of mature females would favor larval drift to the "RKC nursery area" whereas the larvae may be carried away from the nursery area with the present distribution of mature females and warmer years. Finally, the differences align well with the time series of biomass of predators (cod and yellowfin sole) and with the possible effects of the regime shift on the prey availability to red king crab larvae. In summary, the effects of the 1976/77 regime shift – spring bloom composition and timing, shift in geographic distribution of mature females, predation on juveniles – support the use of a post-1983 recruitment when computing $B_{35\%}$.

The CPT commended the authors on the presentation pertaining to choice of reference period; it is exactly the sort of information that the CPT had requested as background for choosing reference periods. However, the CPT noted that this information – which is key for choosing the reference period – was not in the assessment report that was reviewed by the CPT and distributed to the SSC for their review. This information should be seen by the SSC; accordingly, the CPT decided that the key written information from Zheng's presentation pertaining to the regime shift and recruitment period will be provided as supplemental information to the SSC for their review next week. The CPT also questioned why, given what was presented, the assessment used 1995–2011 as the reference period rather than 1984–2011. Although average recruitment during 1995–2011 is extremely close to that during 1984–2011, the later period is more justified on the basis of what Zheng presented. Moreover, being as the stock is estimated to be close to $B_{35\%}$ small changes in the reference period become important for stock status determination, so the best, most-justifiable period should be used. The CPT **recommends** that 1984–2011 be used as the reference period in the 2011 assessment, rather than 1995–2011, necessitating some changes to the stock status tables. Additionally, the CPT **recommends** that a more detailed analysis of the choice of the reference period that includes the effects presented relative to assumed time lag until recruitment be prepared for the May 2012 CPT meeting for review given the stock is estimated to be close to B_{MSY}.
Zheng ended with some projections showing that we should expect declines in catch through 2015. Beyond that, an increase after 2015 may occur, contingent on whether the high catch of juveniles in the 2011 survey reappears in future surveys.

The CPT noted that the estimates of recruitment may be confounded with the assumed periods of higher natural mortality in model Scenario 7ac, which may, in turn, have an effect on the estimated trend in productivity that is used for determination of the reference period and estimation of B_{MSY}. The CPT cannot predict at this time what, if any, the variable-M assumption has on the estimates and estimated trend in recruitment and productivity. The CPT **recommends** that an analysis be prepared for May 2012 that includes a constant-M model (i.e., no periods of increased natural mortality) so that the effect of the Scenario 7ac mortality estimates on the estimates of and trends in recruitment and R/MMB can be assessed; overall, it is **recommended** that a constant-M always be included as one of the scenarios in assessments for this stock so that the effects of, and need for, the variable-M models on the stock assessment can be assessed.

Finally, the CPT noted that the total catch column in Table 1 doesn't add up with the columns to the left; the CPT **"recommends"** that this be corrected.

ABC determination

Zheng presented the estimated probability distribution for the OFL estimate and the maximum ABC computed according to the "P* =0.49" ABC control rule. The maximum ABC (19.35 million pounds, or 8.78 thousand t) is essentially equal to the OFL (19.39 million pounds, or 8.80 thousand t). The CPT was uncomfortable with recommending the maximum ABC because it believes that the estimate of within-model variance is unrealistically low and does not capture the full extent of the uncertainty in estimate of OFL. Specifically, the assessment is based on pre-specified values for survey Q and, for several years, natural mortality. Further estimates of recruitment may be confounded with the assumed periods of higher natural mortality in model Scenario 7ac, which may, in turn, have an effect on the estimated trend in productivity that is used for determination of the reference period and estimation of B_{MSY}.

The downward bias revealed by the model 7ac retrospective analysis suggests uncertainty in the present estimate of MMB. If the unexpectedly sharp downward trend in the survey results for MMB in 2011 is real (and not due to survey error in 2011) and the retrospective pattern in MMB estimates persists, it is reasonable to expect that next year's estimate of the 2011 MMB will be lower than the current estimate. To address this uncertainty, the CPT **recommends** that the ABC for 2011 be set by using the average percent bias (2011 assessment estimate versus terminal year assessment) in the MMB estimate over the last five years. The average percent bias estimated by linear regression (estimated slope for regression of terminal year estimate on 2011 assessment estimate = 0.817) resulted in an 18.3% buffer on the OFL. Hence, the CPT's recommended ABC is,

ABC = 0.817xOFL = 0.817*19.39-million pound = 15.84-million pounds, or 7.19-thousand t.

PIRKC assessment

Bob Foy presented the 2011 PIRKC SAFE. The team discussed the recommended change in years used in the calculation of the $B_{MSY\ Proxy}$ from the status quo (1991-2011) to a revised period, 2000-2011. The team reviewed results of various analyses conducted by the author following the recommendations of the CPT (May 2011) in establishing criteria to be used in estimating a $B_{MSY\ Proxy}$. No evidence was no found in the analysis to support a regime shift as the basis of truncating the MMB history to 2000-2011 to estimate $B_{MSY\ Proxy}$, nor to demonstrate a change in the reproductive potential of the stock between the 1991-2011 and 2000-2011 periods. The brief exploitation history of this stock makes it difficult to identify a period in the MMB history that could meet the criteria of the CPT in estimating the $B_{MSY\ Proxy}$. The team recommended maintaining the status quo time period of 1991-2011 in the calculation of $B_{MSY\ Proxy}$.

The team discussed the use of the 3-yr running average in calculating the $B_{MSY\ Proxy}$. It was suggested that the 3-yr average be used in estimating MMB at mating in any year t, but that the actual observed MMBs in each year over the reference period should be used to calculate the $B_{MSY\ Proxy}$. This 2011/12 assessment will use the 3-yr average in estimating the MMB at mating in 2011/12 as well as the 1991-2011 average of the 3-yr running average MMBs in the calculation of the $B_{MSY\ Proxy}$. This issue will be considered in more detail by the team in May 2012.

The team discussed that the simple 3-yr average used in this assessment is problematic since it does not consider the precision in the annual MMB estimates. As calculated, the 3-yr average equally weights each of the three MMB estimates regardless of its level of its level of precision. For example, if one estimate of MMB used in the average is highly imprecise, then three consecutive indices of MMB based on the 3-yr average will be contaminated until this highly imprecise estimate drops out of the calculation. In the case of a declining stock, the 3-yr running average would be biased high and underestimate the magnitude and rate of decline.

The running 3-yr average MMBs calculated in this assessment was based on the current year and the previous two years. The team recommended that the 3-yr average should be calculated based on the current year, the previous year and the following year, not the current year plus the preceding two years. These calculations will be corrected for the next assessment. The team also discussed alternative methods for deriving a 3-yr average index of MMB – e.g., an average weighted by the inverse of the coefficients of variation of each annual MMB, a lowess smoothed index, and a weighted index in which the weights reflected the relative importance of the years in the average. This issue will be considered in more detail by the team in May 2012.

The team agreed with the author's ABC calculation, and the rationale provided in the assessment for recommending an OFL multiplier of 0.78(based upon the Status quo $B_{MSYproxy}$ years). The general issue of uncertainty in this assessment was discussed. It is unlikely that we'll have better estimates of parameters in this assessment given the data quality. The team concurred with the author on the recommendation for an ABC less than the maximum permissible.

PIBKC assessment

The author presented information relative to criteria for determining the time period for estimating the B_{MSY} proxy discussed at the May 2011 CPT meeting. Exploitation history, surplus production and ln(recruits/MMB) were examined. The author recommended the period 1975/76 – 1979/80 for estimation of the B_{MSY} proxy (recalculated during the meeting as 20,138 t). The B_{MSY} proxy in the September 2010 assessment (4,210 t) was estimated using the time period 1980/81 -1984/85 plus 1990/1991-1997/1998, i.e. excluding the period 1985/1986-1989/1990.

Based on the information presented by the author there was no evidence of a change in reproductive potential of stock. The highest exploitation rates and declines in the stock occurred in the 1980/81-1984/85 period, which was included in period used to specify the B_{MSY} proxy at the September 2010. Since there are no catch or biomass data before 1975, the higher biomass estimates in 1975-1979 are difficult to interpret relative to what true B_{MSY} might be. After much discussion the CPT recommended adding the 1975-1979 biomass data to the time series for estimation of the B_{MSY} proxy. The recommended B_{MSY} was estimated at 4,493 t using the time period 1975/76-1984/85, plus 1990/91-1997/98.

Groundfish bycatch occurs mostly in the Pacific cod fishery, followed by the yellowfin and flathead sole fisheries. Most bycatch results from pot fisheries. Currently bycatch from area 513 is included. In future, groundfish bycatch will be available by ADFG statistical areas.

Current MMB is estimated using the 3 year average survey MMB (2009, 2010 and 2011). The CPT recommends examining different methods of estimating the average MMB using a weighted average of the last three years or a smoother that accounts for variances of the individual years. The team notes that the author calculated the average MMB using a running mean rather than a mean which is centered on the year for which an estimate is needed. This should be rectified for the May 2012 assessment but the results and conclusions of the current assessment are robust to changing how the average is computed.
The groundfish bycatch time series has been re-estimated to account for 'unidentified crab" during the time period 1999-2005. This issue was highlighted to the Team in 2009 and bycatch estimates re-estimated at that time. However the assessment author did not provide historical re-estimated catch estimates in the previous assessment. The result of these re-estimated catches result in lower bycatch estimates in these years than previously reported. As a result the average catch calculation over the same time frame for the OFL calculation in previous years results in a lower average. The team noted that groundfish bycatch (0.18 t in 2010/11) has been low compared to the recommended OFL (1.16 t).

The team concurred with the author's recommendation to set the ABC below the maximum permissible Tier 4 maxABC by using a 10% buffer from the OFL consistent with the Tier 5 calculation for this OFL for this stock based on its stock status.

Aleutian Island Golden King Crab Model Based Assessment

Siddeek updated the CPT on model development to move this stock out of Tier 5 average catch management. The model has been re-formulated and cleaned-up observer data were included. The author reviewed responses to CPT and SSC comments. One aspect of note was the author's implementation of asymptotic selectivity. The CPT **recommends** that dome-shaped selectivity should also be examined for the January 2012 model draft.

When asked about inconsistencies in the time series of observed retained data, Pengilly clarified that observed retained represents dockside samples whereas observed discarded represent at sea observations (a shorter time series). In addition, at-sea observers don't always sample slightly undersized crab that may be subsequently delivered. An observer effect may also be indicated in bubble plots of residuals (e.g., Fig 14). The observer and retained data should be treated similar to the EBS Tanner assessment, namely, the model is fit to the catch length-compositions for the retained catch (from dockside sampling) and to the length-compositions for the total catch (from observers) as this eliminates effects of observers assigned animals as discarded when they are actually landed. Fishery retained and bycatch CPUE were standardized by separating CPUE into two time periods and ignoring soak times longer than the 95^{th} percentile (≥456-hr before for 1985–2004 and ≥936 hr for 2005–2010). The public expressed concern about long soak times skewing the assessment owing to reduced catch from bio-twine degradation. Given the need for the bait to be effective, it was further noted that survey data was limited to soak times of 30–140 hrs. The authors could examine model sensitivity to further restrictions on long soak times.

The author discussed optimization scenarios and weighting factors for the EAG (Table 2) and WAG (Table 9). The CPT **recommends** the listing of sigmas instead of absolute weights as being more informative for factors such as L_{50} and β. Also, the team **recommends** specifying weights for the penalties on L_{50} and β from the standard errors from the analysis on which the estimates for these parameters were based. Three scenarios were examined, differing by weighting applied to pot survey CPUE, mean CPUE ratio, molt L_{50}, and β components of the negative log likelihood functions. The CPT discussed some of the model likelihood components. In particular, there may be an excessive number of penalty functions for aspects that might not be justified. An example is the mean CPUE penalty ratio (Eq. 37) for the pot fishery; because pot fishery CPUE is already incorporated into the model (Eq. 12), the CPUE penalty ratio represents additional inclusion of the same data. There was also substantial discussion about the QQ parameters. Many lambdas are listed in formulas, but their values are not presented in tables. The authors should be fitting the model to the data and not using lambdas to simply improve model fit. For example, Eq. 18 estimates catch, but another likelihood function treats catch data as being without error. The CPT was concerned by the very high weight (effectively a CV of 0.05 assigned to the estimates of legal male biomass). If such estimates (or preferably the associated exploitation rates) are to be included in the assessment, they should be weighted by their estimation variance. Also, care should be taken to ensure that the estimates pertain to the whole stock and not just a subset of the population. In examining parameter estimates, the CPT noted many estimates appear to be constrained, or nearly so, by bounds, particularly for the EAG (Table 4 and negative Hessian gradients in Table 7); the author noted that many bounds had been expanded. The CPT **suggested** expanding bounds or reducing weighting factors.

The CPT also noted:

1. large confidence intervals in early time series discarded CPUE data (Fig. 4b, perhaps due to small number of potlifts);
2. poor fit to fishery CPUE trend in post-rationalized years (Figs. 4a and 26);
3. poor fit to pot survey CPUE (Fig. 4c);
4. extremely good fit to retained catch length frequencies (Fig. 5);and
5. poor fit to groundfish discards for small crab sizes (Fig. 7).

There was insufficient time to provide a full discussion of the WAG. The CPT **requested** the model be updated and brought to the January 2012 workshop, with a preliminary distribution to André and Steve.

Crab B_{MSY}

André Punt presented his current NPRB project: "Evaluating methods for determining overfishing levels for Bering Sea and Aleutian Islands crab (BSAI) stocks". The project will run from September 2011 to February 2013, with the following three objectives: (a) develop and evaluate proxies for estimating the productivity of crab stocks (i.e. F_{MSY}), (b) assess how well simple assessment methods can estimate time-series of mature male biomass and hence proxies for F_{MSY}, and (c) develop and evaluate methods for estimating the reference biomass B_{ref}

For objective a, André evaluated two methods for estimating B_{MSY} and F_{MSY} based on estimated surplus production using simulated data. He then applied one of the candidate methods to actual data from Bristol Bay red king crab, EBS snow crab, and EBS Tanner crabs. He will be applying the surplus production model to all surveyed crab stocks with abundance data (in addition to the above three stocks, Pribilof red and blue king, St. Mathew blue king, and Norton Sound red king crab).

Regarding objective b, André Punt is fitting a simple five-size-class model to male-only data and estimating all management parameters as well as producing a number of diagnostic statistics. The candidate stocks are: Bristol Bay red king, EBS snow, EBS Tanner, Pribilof red king, Pribilof blue king, St. Mathews blue king, Aleutian Islands golden king, and Norton Sound red king crabs. Andre plans to compute $F_{35\%}$ and compare biomass projections under $F_{35\%}$, M, and the current B_{MSY} proxy (γM) for Tier 4 stocks. The final outcome of this project is to address the question whether $F_{35\%}$, M, or a multiple of M((γM) is a good proxy for F_{MSY} for these crab stocks. André plans to complete the simulation evaluation by February – March 2012 and present initial final results for all objectives at the May 2012 CPT meeting.

Ecosystem Considerations

Liz Chilton provided an overview of changes to the Ecosystem chapter for the SAFE. These changes primarily include supporting documentation on the ecosystem indicators section of the document. The CPT complimented the authors on the document and are enthusiastic about the possibilities for ecosystem information can be included in crab management. Information requested by the team to be added to the May 2012 Ecosystem chapter includes the following.

- Include historical information on sea surface and/or air temperature information throughout the Bering Sea (previous to the M2 mooring) that go back as far as possible, ideally to 1969.
- Include information from Aydin's group on stomach content analysis with regards to crab. Encourage Aydin's group to examine stomach contents from observers to get data from other seasons.
- Provide a time series of PDO, sea ice, benthic production, and other environmental indices, for as long a time period as possible, in a format that can be available for stock assessment authors to correlate these indices with crab population dynamics.
- Refine information on benthic productivity to develop an indicator of benthic productivity, including spatial variation.
- Consider spatial information on ecosystem indicators.
- Discuss and justify time lags used in this document.

In the future the final Ecosystem chapter will be produced in May so that stock assessment authors can include this information in stock assessments and analysis for September.

Bristol Bay Nearshore Survey

Scott Goodman (BSFRF) and Liz Childers (NMFS) provided an overview of the joint NMFS-BSFRF Bristol Bay RKC nearshore trawl survey research results from Summer, 2011. Liz reviewed the sampling design and study implementation, noting that the survey employed standard survey and sampling protocols, differing principally from typical surveys by extending the sampling area with additional nearshore stations to investigate whether the standard survey is missing large concentrations of crab in nearshore areas. Scott discussed survey results and presented figures depicting survey catch densities spatially and with respect to sea temperature measurements, noting that the survey did not find higher densities in south of survey area, contrary to expectations, and did not catch many mature females. Scott also noted the relatively high sea temperatures during the survey time period, which limited the utility of the survey in identifying an association between RKC movement nearshore in response to sea temperature.

The CPT discussed use of the survey results in the BBRKC stock assessment. The particularly high incidence of small (<65mm) juvenile females associated with a single tow was discussed, and it was noted that the BBRKC stock assessment had not incorporated the survey data for crab in that size range. Jack questioned whether the survey results were affected by net performance in nearshore benthic conditions and recommended investigating potentially systematic differences in female catch incidence, e.g., in leg 3. Bob appealed to CPT members for recommendations regarding the utility of replicating or modifying the survey in the future, noting that two research questions suggested/left unanswered by the study findings were 1. what is going on during the regular survey with respect to juvenile female, and 2: are there crab nearshore in cold water years? No additional recommendations were made by the CPT.

Economic SAFE

Brian Garber-Yonts provided a brief summary of economic status of fisheries and a walk-through of the economic section of the SAFE. Currently the economic chapter focus is on summarization of fishery economics (employment, labor income, and wholesale and ex-vessel values) over the past five years and not based on research findings or projections, though there is effort for future reports to include economic projections. Catch and earnings data are taken from fish ticket and COAR data. Author clarified that revenue is based on FOB (Alaska) from COAR data. The CPT recommends adding evaluation of expenses, such as product shipping and vessel fuel costs. The author has been working on obtaining this information, however such data is difficult to obtain and hopefully will be more accessible in the future. The CPT recommends that a balance between a brief summary of economic trends as well as a detailed discussion should be provided.

Increased prices in recent years have somewhat offset the economic effects of lower harvests. The CPT noted that the prices in 2010 went up for Bristol Bay red king crab but decreased for Bering Sea snow crab. Data is presented by calendar year, not fishery year. COAR data is released on a calendar year basis and is not available until well after the calendar year is over. The CPT recommends an estimate be provided from available data from the most recent fisheries that can be updated later; the CPT is more interested in economic trends than exact values.

Wholesale values are more variable than ex-vessel values; author noted this is because the processing section involves varying markets and products. Snow crab values are more based on Canadian snow crab then Bering Sea snow crab because of Canadian production is vastly higher than Alaskan snow crab production. CPT noted that Aleutian Islands golden king crab values are more varied than in other fisheries, author stated that this is likely more volatile because it is a relatively small fishery. Author noted the difficulty of reporting catcher-processor vessel values due to confidentiality issues involved with there being only five catcher-processors in the Bering Sea-Aleutian Islands crab fleet, and is working on ways to pool the catcher-processor data with other sectors, however permission may be needed from catcher-processors to disseminate some confidential information.

A future workshop is planned that will address improving data presented to be most useful. A potential SAFE document containing economic statuses of all Alaska fisheries will also be discussed at the workshop. The author noted that work is being done to streamline production of the economic SAFE chapter to provide for an earlier distribution date.

The CPT appreciated receiving the report and recommended attaching the summary provided as an appendix to the CPT report rather than including in the SAFE introduction at this time as it was not received in advance such that that team could fully review and discuss the material prior to including in the SAFE report. The team intends to include this type of information in the introduction to next year's SAFE report.

New Business

Model workshop

The Council has scheduled a crab modeling workshop for January 9-13, 2012 at the AFSC. This workshop will involve participation from crab and groundfish stock assessment authors, CPT members, SSC members and other invited participants. It will be hosted by the Council and open to the public. Steve Martell will chair the workshop and work with Council staff to produce the recommendations report from the workshop.

The team identified the two highest priority stocks for consideration at the workshop as Tanner crab and AIGKC. The format of the assessment review is intended to be a split-format review of both models. Model documentation and code must be provided at least 2 weeks in advance of the meeting (week of December 12th), with the authors expected to come to the meeting with a series of scenarios and questions for consideration at the workshop. Models are intended to be run real-time during the meeting to best facilitate feedback and problem-solving during the workshop week.

The workshop will also include a half-day meeting and discussion of the OFL pdf workgroup to establish a set of guidelines for estimating the pdf of the OFL for purposes of setting the maxABC according to the Council's maxABC control rule. Diana will coordinate with the 'pdf workgroup' previously identified to prepare for the workshop discussion.

Steve and Diana will work together to lay out a description of the overall modeling workshop objectives and draft agenda to circulate to the participants and to post on the Council's website.

Total catch OFL white paper

The team requested that Doug Pengilly provide a document to the CPT in May regarding the issues in establishing Tier 4 total catch OFLs and the allocative versus policy implications of doing so. Doug will work with stock assessment authors to compile the relevant issues, referencing the work done in the EA for amendment 24 which provides the rationale for the current use of a total catch OFL for all stocks. This paper will be distributed to the CPT prior to the May meeting as well as to the SSC for their consideration.

May meeting documentation and expectations for models

Full assessment reports will be provided in May for the AIGKC and 3 Tier 5 stocks. Note that the AIGKC assessment will include both the proposed model-based assessment as well as the current Tier 5 formulation. White papers describing developing models are to be prepared for the following stocks: Tanner crab and SMBKC. A white paper describing alternative methodologies for weighted averaging for the surveyed stocks such as the Pribilofs will be prepared for discussion and recommendations on the approach for the 2012 assessments at the May meeting. Any other major changes in assessment models or methodologies should be discussed at the May meeting with discussion papers prepared in advance of the meeting.

Other issues

Pribilof Island red king crab stock: The author highlighted that the current MMB/B_{MSY} ratio is 0.501. The team discussed the potential that the estimated survey-based MMB for this stock next year could drop it below MSST based on one survey data point. The team discussed the need for careful consideration of the year sets for these survey-based stocks given the potential ramifications of the time frames on the perception of stock status. This will be discussed further at the May 2012 meeting in conjunction with updated documentation and discussion of the B_{MSY} criteria.

Membership: The team discussed membership of the plan team and the role of economic participation on the plan team. The team would benefit from increased involvement of the team economists in discussions and appreciates the input provided by them at the plan team meetings. The team encourages all members to prioritize their scheduling such that they are able to participate in the entire plan team meeting, while understanding that work-related conflicts may preclude participation at times.

The meeting adjourned at 5pm Thursday September 22.

North Pacific Fishery Management Council Crab Plan Team Meeting

September 19-22, 2011

AFSC, Seattle WA

DRAFT AGENDA 8/17/2011 vers

Monday, Sept 19		**Traynor Room**
9:00	**Administration**	• Introductions, approve agenda, SAFE assignments, update on model workshop January 2012, review scheduling for May/September 2012 meetings, BBRKC EFH update
9:30	**Survey overview**	• Results of 2011 summer survey
	Break 10:30-10:45	
10:45	**Tanner crab**	• Final assessment, OFL and ABC recommendation, update on model progress, discussion of rebuilding plan alternatives and time frame for analysis
Noon		Lunch
1:00	**Tanner crab (cont).** Break 3:00 – 3:15	
3:15	**Snow crab**	• Final assessment, OFL and ABC recommendation
Tuesday, Sept 20		
9:00	**Snow crab (cont as necessary)** Break 10-10:15	• Final assessment, OFL and ABC recommendation (cont)
10:15	**BBRKC**	• Final assessment, OFL and ABC recommendation (cont)
Noon		Lunch
1:00	**St Matthew BKC**	• Final assessment, OFL and ABC recommendation; model description review
	Break 3:00-3:15	•
3:15	**St Matthew BKC (cont)**	• Final assessment, OFL and ABC recommendation; model description review
4:00	**PIRKC**	• Final assessment, OFL and ABC recommendation
4:45	**PIBKC**	• Final assessment, OFL and ABC recommendation
Wednesday, Sept 21		
9:00	**PIBKC (cont as necessary)**	• Final assessment, OFL and ABC recommendation (cont)
9:45	**Ecosystem Considerations** Break 10:15-10:30	• Review ecosystem indicators, finalize introduction section
10:30	**Economic SAFE**	• Review chapter, review/revise summary document (for inclusion in SAFE)

11:15	**AIGKC**	• Model review
Noon		Lunch
1:00	**AIGKC (cont as necessary)**	• Model review
2:00	**Crab B_{MSY}** Break 2:45-3:00	• Update on UW crab project; broader discussion of Bmsy proxy criteria and time frames based on results of current assessments and guidelines for upcoming assessment cycle
4:00	**BB nearshore survey**	• NMFS/BSRFR nearshore Bristol Bay survey overview

Thursday, Sept 22

9:00	**New business**	• Model workshop (January 9-13 AFSC): selection of stocks for review, format of workshop, other items for discussion (pdf of OFL)
9:30	**SAFE report**	• Finalize introduction sections
Noon		Lunch
1:00	**SAFE report (cont) /CPT minutes**	• Finalize introduction sections • Finalize minutes by section
5:00	Break 3:00 – 3:15 Adjourn	

Attachment: **Economic Status of the Fishery: Summary of economic conditions in the FMP crab fisheries**

The BSAI crab fisheries managed under the NPFMC's crab FMP are currently prosecuted by a fleet of approximately 100 catcher vessels and five catcher processors, and landed principally at 18-20 processing facilities throughout the region. Across all fisheries managed under the NPFMC's crab FMP, the total sold, retained catch during calendar year 2010 was approximately 70 million pounds (32×10^3 *t*), with an ex-vessel value of over \$170 million (Table X1). Total finished pounds reported by processors in 2010 across all FMP crab species and product forms was approximately 45 million pounds (20.5×10^3 *t*), with an estimated first wholesale value of over \$270 million (F.O.B Alaska). Total ex-vessel production for 2010 was reduced in volume relative to the previous year by 14 percent, corresponding to reductions in the TAC in the 2009/2010 snow crab and 2010/2011 Bristol Bay red king crab fisheries. Due to an upturn in first wholesale and ex-vessel prices in the red king crab and golden king crab markets, the reduced TAC's were somewhat offset, resulting in an overall 7.75 percent decrease in economic value accruing to the harvest sector relative to 2009. Total catch was approximately 3 percent above the average for 2005-2009, and aggregate gross revenue was decreased by 5.5 percent relative to the same period.

Reported data for finished production indicates that output in 2010 was reduced relative to 2009 by 11.3 percent. Estimated sales value of total production in 2010 increased by approximately 6 percent. Both first wholesale volume and sales value in 2010 were above the average for the previous five years (by 2 percent and 7 percent, respectively). Data for individual fisheries for 2005-2010 is presented in Table X1. The relative trends in production volume and revenue across the four largest crab fisheries in the harvest and processing sector are illustrated in Figure X1 below. Unweighted mean ex-vessel and first wholesale prices are displayed in Figure X2. Error bars (one standard deviation) in the figures depict the range of cross-sectional variation in prices over time, with the greater variation in wholesale prices reflective of both the effect of greater volatility of world market prices as well as the broader range of products, markets, and sales conditions observed in processed crab sales.

The most recent employment data available for crab fisheries is for the 2009 calendar year fisheries managed under the rationalization program, as reported in the BSAI Crab Economic Data Report program. Data for crew participation and payment by fishery is presented in Table X2. In 2009, approximately 715 unique individuals were employed as fishing crew (including deckhands, vessel captains, and other positions requiring commercial fishing crew or other form of licensure) on 88 fishing vessels prosecuting the IFQ and CDQ crab fisheries. Participation as crew members in individual crab fisheries is indicated by counts of share recipients by fishery, with individual crew members participating in multiple fisheries. In 2009, EDR records indicate 1,130 share recipients aggregated over crab fisheries. Based on average crew size reported in eLandings, the total number of crew positions on active crab vessels in

Total crew and captain payment amount is reported annually for rationalized fisheries in the crab EDR. Total share payments to crab vessel crews totaled approximately \$25.5 million in 2009, with an additional payment to vessel captains of \$11.4 million (noting that reported values for captain pay may to some degree reflect payments associated with vessel ownership and/or IFQ royalties as well as in-season labor contribution). Somewhat fewer vessels operated in 2009 that 2008, which combined with a reduction in average payment per vessel of approximately four percent resulted in a reduction of over 20 percent in total crew and captain share payments relative to 2008.

Table X3 presents data on crab processing labor employed in the crab fishery. It is estimated that nearly 830 thousand hours of processing labor was expended on crab production in 2009, generating $10.5 million in labor income. Most processing facilities that receive crab landings do not exclusively process crab, however, and it may difficult to attribute crab processing labor to specific employment effects. The high degree of variance in the measure of crab processing labor hours likely reflects variation in ability to track labor input by species for reporting compliance, as well as variation in use of processing labor.

Additional detail on economic conditions in the fishery is provided in the 2011 Economic Status Report (AFSC, forthcoming). Statistics on harvesting and processing activity, revenue, labor employment, labor compensation, operational costs, and quota usage and disposition among participants in the fisheries are provided in the report. Additionally, this report provides a summary of BSAI crab-related research being undertaken by the Economic and Social Sciences Research Program (ESSRP) at the Alaska Fisheries Science Center.

Table X1: Harvest and Processing Sector Production, Gross Revenue, and Average Prices, FMP Crab Fisheries, 2005-2010[1]

	Harvest Sector Gross Ex-vessel				Processing Sector Gross 1st Wholesale			
	Vessels	Landed volume million pounds (10^3 mt)	Total revenue $ million	Weighted average $/pound	Plants	Finished production million lbs (10^3mt)	Total revenue $ million	Weighted average $/pound
Aleutian Islands Golden King - Eastern and Western								
2005	9	4.44 (2.01)	$14.88	$3.36	6	3.03 (1.37)	$21.51	$7.10
2006	7	5.24 (2.38)	$11.20	$2.14	6	3.13 (1.42)	$15.50	$4.95
2007	6	5.44 (2.47)	$11.60	$2.13	6	3.42 (1.55)	$21.12	$6.17
2008	5	5.73 (2.6)	$18.07	$3.15	6	3.41 (1.55)	$25.05	$7.34
2009	5	5.51 (2.5)	$13.70	$2.48	8	3.3 (1.5)	$19.07	$5.78
2010	5	6.09 (2.76)	$17.42	$2.86	8	3.74 (1.7)	$28.99	$7.76
Bristol Bay Red King								
2005	89	18.14 (8.23)	$98.05	$5.41	16	12.3 (5.58)	$127.12	$10.33
2006	81	15.55 (7.05)	$65.02	$4.18	14	9.17 (4.16)	$78.99	$8.62
2007	73	20.17 (9.15)	$98.23	$4.87	17	13.09 (5.94)	$125.04	$9.55
2008	79	20.13 (9.13)	$107.68	$5.35	15	13.31 (6.04)	$138.33	$10.39
2009	70	15.78 (7.16)	$78.45	$4.97	15	10.4 (4.72)	$97.85	$9.41
2010	65	14.73 (6.68)	$92.58	$6.28	15	9.8 (4.45)	$132.17	$13.48
Eastern Bering Sea Snow								
2005	167	24.86 (11.28)	$55.08	$2.22	20	17.71 (8.03)	$83.22	$4.70
2006	78	38.02 (17.25)	$50.20	$1.32	13	24.92 (11.3)	$82.37	$3.31

1 Source: BSAI Crab Economic Data Reports database, CFEC Commercial Operators Annual Report database, and ADF&G eLandings database. Landed volume is calculated from commercial (sold) pounds recorded on fish tickets. Ex vessel revenue is the calculated using CFEC-adjusted landed values on commercial crab landings and average price is the weighted average value per pound calculated over individual fish ticket entries. EDR data provides the only stock-specific source of data for finished production volume and value. For years/stocks for which EDR data is unavailable (NSR; 2010, pre-2005), processed volume by stock is estimated by applying average product recovery rate to ex-vessel pounds recorded by processor in fish tickets. Weighted and unweighted wholesale prices are estimated by species from COAR data on FOB Alaska first wholesale price. Total wholesale value is estimated by applying weighted average wholesale price by species to estimated volume.

	Harvest Sector				Processing Sector			
	Gross Ex-vessel				Gross 1st Wholesale			
	Vessels	Landed volume million pounds (10^3 mt)	Total revenue $ million	Weighted average $/pound	Plants	Finished production million lbs (10^3mt)	Total revenue $ million	Weighted average $/pound
2007	68	34.76 (15.77)	$62.58	$1.80	16	22.66 (10.28)	$99.66	$4.40
2008	78	62.23 (28.23)	$112.84	$1.81	16	41.02 (18.61)	$176.80	$4.31
2009	77	57.69 (26.17)	$87.46	$1.52	16	35.97 (16.31)	$133.50	$3.71
2010	68	47.84 (21.7)	$54.05	$1.13	12	30.68 (13.91)	$100.19	$3.27
Eastern Bering Sea Tanner								
2005	4	0.26 (0.12)	$0.51	$2.00	4	0.18 (0.08)	$0.86	$4.81
2006	45	0.99 (0.45)	$1.63	$1.64	9	0.72 (0.33)	$2.89	$4.01
2007	29	2.25 (1.02)	$4.08	$1.82	8	1.46 (0.66)	$6.90	$4.73
2008	30	2.33 (1.06)	$4.24	$1.81	10	1.34 (0.61)	$6.06	$4.54
2009	18	2.14 (0.97)	$3.67	$1.72	10	1.39 (0.63)	$5.63	$4.06
2010	4	0.37 (0.17)	$0.55	$1.47	6	0.24 (0.11)	$0.98	$4.04
Norton Sound Red King								
2005	31	0.4 (0.18)	$1.67	$4.19				
2006	29	0.44 (0.2)	$1.29	$2.91				
2007	31	0.32 (0.14)	$1.00	$3.18				
2008	9	0.03 (0.01)	$0.07	$2.39				
2009	10	0.03 (0.01)	$0.14	$4.63				
2010	16	0.32 (0.15)	$1.37	$4.28				

		Harvest Sector Gross Ex-vessel				Processing Sector Gross 1st Wholesale		
	Vessels	Landed volume million pounds (10^3 mt)	Total revenue $ million	Weighted average $/pound	Plants	Finished production million lbs (10^3mt)	Total revenue $ million	Weighted average $/pound
Pribilof Island Golden King								
2005	4	--	--	--	--	--	--	--
2010	1	--	--	--	--	--	--	--
Saint Matthews Blue								
2009	7	0.45 (0.2)	$1.07	$2.38	3	--	--	--
2010	11	1.25 (0.57)	$5.16	$4.12	6	0.82 (0.37)	$9.49	$11.50
Total – All FMP Crab Fisheries								
2005		48.1 (21.82)	$170.20			33.23 (15.07)	$232.71	
2006		60.24 (27.33)	$129.33			37.94 (17.21)	$179.75	
2007		62.94 (28.55)	$177.50			40.63 (18.43)	$252.72	
2008		90.82 (41.2)	$244.35			59.07 (26.79)	$346.24	
2009		81.97 (37.18)	$185.72			51.06 (23.16)	$256.05	
2010		70.7 (32.07)	$171.33			45.28 (20.54)	$271.81	

Table X2: Crab vessel crew participation and share payment income[2]

		Crew participants		Deck crew positions		Crew share payment $ millions		Captain share payment $ millions	
Fishery	Obs	Total	Vessel mean (sd)	Total	Vessel mean (sd)	Total payment	Vessel mean (sd)	Total payment	Vessel mean(sd)
Aleutian Islands Golden King - Eastern and Western									
2005	10	72	7.2 (2.58)	58	5.8 (1.14)	$1.87	$0.17 (0.13)	$1.01	$0.09 (0.07)
2006	6	48	7.92 (2.58)	38	6.33 (0.52)	$0.87	$0.12 (0.09)	$0.48	$0.07 (0.04)
2007	6	40	6.67 (1.21)	38	6.33 (0.52)	$1.14	$0.19 (0.15)	$0.56	$0.09 (0.07)
2008	4	–	–	–	–	$1.83	$0.37 –	$0.77	$0.15 –
2009	5	43	8.6 –	31	6.2 –	$1.93	$0.39 –	$1.13	$0.23 –
Bristol Bay Red King									
2005	84	493	5.87 (1.04)	472	5.61 (0.82)	$12.39	$0.15 (0.09)	$6.51	$0.08 (0.05)
2006	79	465	5.89 (1.06)	445	5.63 (0.83)	$8.77	$0.11 (0.06)	$4.45	$0.06 (0.03)
2007	70	419	5.99 (0.86)	407	5.81 (0.79)	$11.92	$0.17 (0.08)	$5.94	$0.08 (0.04)
2008	76	473	6.22 (1.11)	454	5.97 (0.94)	$14.14	$0.19 (0.13)	$6.39	$0.09 (0.04)
2009	70	435	6.21 (1.01)	424	6.06 (0.98)	$9.66	$0.14 (0.06)	$4.57	$0.07 (0.03)
Eastern Bering Sea Snow									
2005	150	857	5.71 (0.73)	N/C	N/C	$11.10	$0.07 (0.03)	$5.71	$0.04 (0.02)
2006	74	448	6.05 (1.19)	418	5.65 (0.78)	$6.08	$0.08 (0.05)	$3.04	$0.04 (0.02)
2007	65	400	6.15 (1.08)	377	5.79 (0.79)	$9.01	$0.14 (0.09)	$4.28	$0.07 (0.03)
2008	74	489	6.61 (1.41)	450	6.07 (0.95)	$16.05	$0.22 (0.13)	$7.64	$0.1 (0.05)
2009	77	522	6.78 (1.82)	492	6.39 (1.66)	$13.17	$0.17 (0.1)	$5.83	$0.08 (0.04)

2 *Source: NOAA Fisheries, Alaska Fisheries Science Center. BSAI Crab Economic Data.*
Crew and captain payments reflect amounts paid for harvesting labor. Where applicable, these figures include post-season adjustments, bonuses, and deductions made to labor payments for shared expenses such as fuel, bait, and food and provisions. Payments to harvest crew and captains for IFQ are excluded. 2009 data is summarized over all harvesting sectors (CVCP) to preserve confidentiality. Cells displaying "—" are suppressed for confidentiality purposes, and N/C indicates that data was not collected for the fishery. Data reported in aggregate over all crab fisheries in Table X2 omits missing values where there are indicated. As a result, direct comparison of values over time is limited in instances where missing values are present.

Eastern Bering Sea Tanner									
2005	4	--	--	--	--	--	--	--	--
2006	25	143	5.72 (1.02)	140	5.6 (1)	$0.23	$0.01 (0.01)	$0.13	$0.01 (0.01)
2007	22	131	5.95 (0.84)	118	5.36 (0.66)	$0.62	$0.03 (0.02)	$0.32	$0.02 (0.01)
2008	26	162	6.23 (1.31)	149	5.73 (1.12)	$0.52	$0.02 (0.03)	$0.30	$0.01 (0.02)
2009	14	96	6.86 (2.54)	87	6.21 (1.48)	$0.55	$0.04 (0.05)	$0.34	$0.02 (0.03)
Saint Matthews Blue									
2009	7	40	5.71 (0.76)	39	5.57 (0.79)	$0.16	$0.02 (0.02)	$0.07	$0.01 --
All Crab Fisheries									
2005		1422		529		$25.36		$13.23	
2006		1104		1041		$15.95		$8.09	
2007		990		940		$22.69		$11.11	
2008		1124		1053		$32.54		$15.10	
2009		1136		1073		$25.46		$11.94	

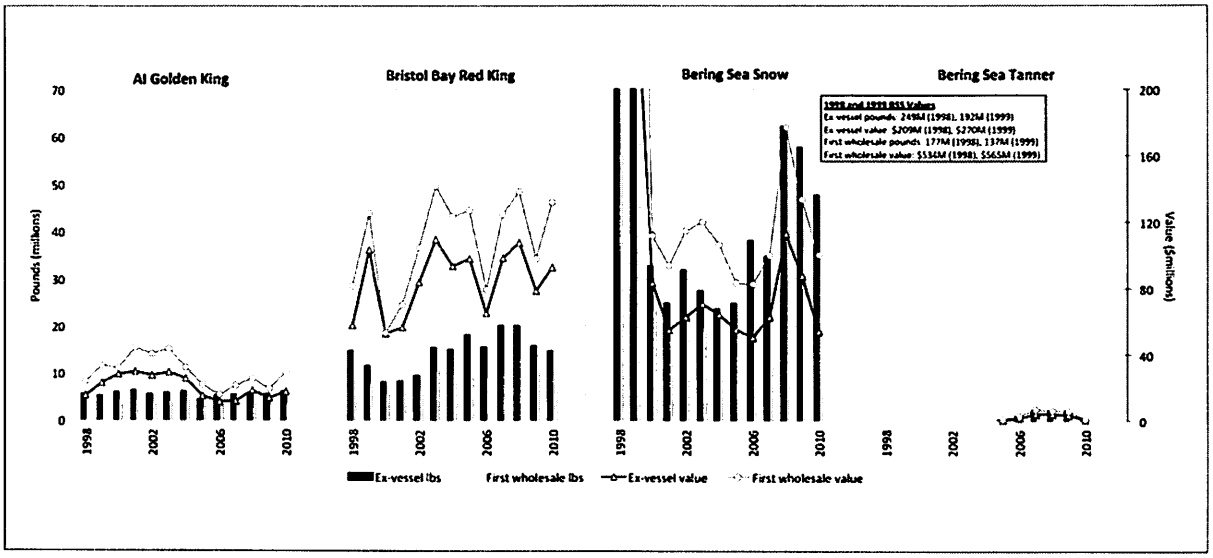
Table X3: Crab Processing Labor and Income[3]

		Crab Processing Labor			
Fishery	Obs	Total Man-hours (1000)	Average per plant mean (sd) (1000)	Total Labor payment ($1000)	Pay per hour
Aleutian Islands Golden King - Eastern and Western					
2005	4	--	--	--	--
2006	6	47.15	7.86 (11.58)	$510.99	12.66
2007	5	71.97	14.39 --	$770.34	13.25
2008	6	37.85	6.31 (6.35)	$554.19	12.13
2009	4	--	--	--	--
Bristol Bay Red King					
2005	11	201.82	18.35 (17.02)	$2,386.11	13.47
2006	11	180.16	16.38 (15.38)	$2,065.67	11.87
2007	11	260.51	23.68 (20.39)	$2,868.82	13.24
2008	11	244.92	22.27 (21.06)	$2,809.21	10.19
2009	10	198.90	19.89 (17.01)	$2,281.84	10.88
Eastern Bering Sea Snow					
2005	13	301.98	23.23 (16.62)	$3,805.65	11.65
2006	10	445.35	44.54 (34.78)	$4,749.05	11.45
2007	10	442.21	44.22 (37.81)	$5,170.08	11.18
2008	12	712.38	59.37 (77.49)	$8,936.86	10.26

3 *Source: NOAA Fisheries, Alaska Fisheries Science Center. BSAI Crab Economic Data.*
Processing labor payments exclude payments to salaried workers employed by processors. Where applicable, these figures include bonuses and deductions to labor payments for shared expenses such as food and provisions. Benefits and indirect expenses paid on behalf of processing workers are excluded. Note that observations for pro-rata statistics (pay per plant, worker, and finished pounds) may differ from the number of observations for total labor payments due to observations that are missing data for the denominator variable (average number of processing positions, processing man-hours, finished production lbs) in the fishery-year of interest. Outlier observations in the 2008 data have been excluded for pay per worker and pay per hour statistics. Data for EAG and WAG fisheries are summarized together as the 'AIG' fishery. Where a submitter reported separate labor payments and processing positions in the two fisheries, we use the maximum reported number of processing positions, rather than the sum of processing positions over the two fisheries, to calculate pay per worker statistics. All other variables used in pro-rata statistics for the AIG fisheries are treated cumulatively. 2009 data is summarized over all processing sectors (SFCP) due to confidentiality.

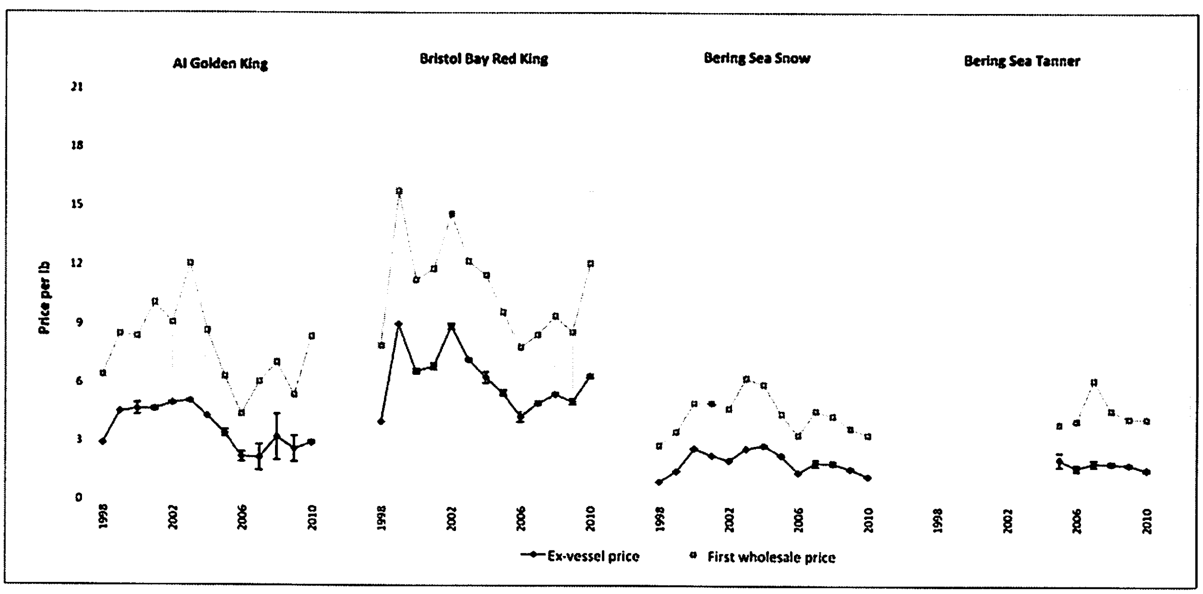
2009	10	600.07	60.01 (50.91)	$7,014.28	10.79
Eastern Bering Sea Tanner					
2005	7	8.34	1.19 (1.53)	$92.37	11.29
2006	8	14.00	1.75 (1.67)	$148.68	10.74
2007	7	34.90	4.99 (3.31)	$365.99	10.73
2008	8	27.02	3.38 (3.01)	$439.62	10.73
2009	7	29.32	4.19 (2.26)	$297.54	10.44
Pribilof Island Golden King					
2009		–	–	–	–
All Rationalized Crab Fisheries					
2005		512.14		$6,284.13	
2006		686.66		$7,474.40	
2007		809.59		$9,175.23	
2008		1022.17		$12,739.87	
2009		828.29		$10,483.59	

Figure X1: Ex-vessel and first wholesale production and value, BSAI crab, 1998-2010



Source: CFEC Commercial Operators Annual Report database and ADF&G eLandings database.

Figure X2: Ex-vessel and first wholesale production and value, BSAI crab, 1998-2010



Source: CFEC Commercial Operators Annual Report database and ADF&G eLandings database

2011 Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries in the Bering Sea and Aleutian Islands

Introduction

The annual stock assessment and fishery evaluation (SAFE) report is a requirement of the North Pacific Fishery Management Council's *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP)*, and a federal requirement [50 CFR Section 602.12(e)]. The SAFE report summarizes the current biological and economic status of fisheries, total allowable catch (TAC) or Guideline Harvest Level (GHL), and analytical information used for management decisions. Additional information on Bering Sea/Aleutian Islands (BSAI) king and Tanner crab is available on the NMFS web page at http://www.fakr.noaa.gov and the Alaska Department of Fish and Game (ADF&G) Westward Region Shellfish web page at: http://www.cf.adfg.state.ak.us/region4/shellfsh/shelhom4.php.

This FMP applies to 10 crab stocks in the BSAI: 4 red king crab, *Paralithodes camtschaticus*, stocks (Bristol Bay, Pribilof Islands, Norton Sound and Adak), 2 blue king crab, *Paralithodes platypus*, stocks (Pribilof District and St Matthew Island), 2 golden (or brown) king crab, *Lithodes aequispinus*, stocks (Aleutian Island and Pribilof Islands), EBS Tanner crab *Chionoecetes bairdi*, and EBS snow crab *Chionoecetes opilio*. All other BSAI crab stocks are exclusively managed by the State of Alaska.

The Crab Plan Team (CPT) annually assembles the SAFE report with contributions from ADF&G and the National Marine Fisheries Service (NMFS). This SAFE report is presented to the North Pacific Fishery Management Council (NPFMC) and is available to the public on the NPFMC web page at: http://fakr.noaa.gov/npfmc/membership/plan_teams/CRAB_team.htm. Under a process approved in 2008 for revised overfishing level (OFL) determinations, and new ACL requirements in 2011, the Crab Plan Team reviews four assessments in May to provide recommendations on OFL, ABC and stock status specifications for review by the Council's Science and Statistical Committee (SSC) in June. In September, the CPT reviews the remaining assessments and provides final OFL and ABC recommendations and stock status determinations. Additional information on the OFL and ABC determination process is contained in this report.

The Crab Plan Team met from September 19-22, 2011 in Seattle, WA to review the final stock assessments as well as additional related issues, in order to provide the recommendations and status determinations contained in this SAFE report. This final 2011 Crab SAFE report contains all recommendations for all 10 stocks including those whose OFL and ABC were determined in June 2011. This SAFE report will be presented to the Council in October for their annual review of the status of BSAI Crab stocks. Members of the team who participated in this review include the following: Bob (Chair), Ginny Eckert (Vice-Chair), Wayne Donaldson, Bill Bechtol, Karla Bush, Heather Fitch, Brian Garber-Yonts, Gretchen Harrington, Steve Martell, Doug Pengilly André Punt, Lou Rugolo, Shareef Siddeek, Diana Stram and Jack Turnock.

Stock Status Definitions

The FMP (incorporating all changes made following adoption of Amendment 24) contains the following stock status definitions:

Acceptable biological catch (ABC) is a level of annual catch of a stock that accounts for the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty and is set to prevent, with a greater than 50 percent probability, the OFL from being exceeded. The ABC is set below the OFL.

ABC Control Rule is the specified approach in the five-tier system for setting the maximum permissible ABC for each stock as a function of the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty.

Annual catch limit (ACL) is the level of annual catch of a stock that serves as the basis for invoking accountability measures. For crab stocks, the ACL will be set at the ABC.

Total allowable catch (TAC) is the annual catch target for the directed fishery for a stock, set to prevent exceeding the ACL for that stock and in accordance with section 8.2.2 of the FMP.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available.

F_{MSY} control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.

B_{MSY} stock size is the biomass that results from fishing at constant F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Maximum fishing mortality threshold (MFMT) is defined by the F_{OFL} control rule, and is expressed as the fishing mortality rate.

Minimum stock size threshold (MSST) is one half the B_{MSY} stock size.

Overfished is determined by comparing annual biomass estimates to the established MSST. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished.

Overfishing is defined as any amount of catch in excess of the overfishing level (OFL). The OFL is calculated by applying the F_{OFL} control rule annually estimated using the tier system in Chapter 6.0 to abundance estimates.

Status Determination Criteria

The FMP defines the following status determination criteria and the process by which these are defined following adoption of amendment 24 and 38.

Status determination criteria for crab stocks are annually calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criteria and acceptable biological catch (ABC) levels are annually formulated. The annual catch limit (ACL) for each stock equals the ABC for that stock. Each crab stock is annually assessed to determine its status and whether (1) overfishing is occurring or the rate or level of fishing mortality for the stock is approaching overfishing, (2) the stock is overfished or the stock is approaching an overfished condition, and (3) the catch has exceeded the ACL.

For crab stocks, the overfishing level (OFL) equals maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Overfishing is determined by comparing the OFL with the catch estimates for that crab fishing year. For the previous crab fishing year, NMFS will determine whether overfishing occurred by comparing the previous year's OFL with the catch from the previous crab fishing year. For the previous crab fishing year, NMFS will also determine whether the ACL was exceeded by comparing the ACL with the catch estimates for that crab fishing year. Catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL and ACL will be set for and compared to the retained catch.

NMFS will determine whether a stock is in an overfished condition by comparing annual biomass estimates to the established MSST, defined as ½ B_{MSY}. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. MSSTs or proxies are set for stocks in Tiers 1-4. For Tier 5 stocks, it is not possible to set an MSST because there are no reliable estimates of biomass.

If overfishing occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the Council to immediately end overfishing and rebuild affected stocks.

The Magnuson-Stevens Act requires that FMPs include accountability measures to prevent ACLs from being exceeded and to correct overages of the ACL if they do occur. Accountability measures to prevent TACs and GHLs from being exceeded have been used under this FMP for the management of the BSAI crab fisheries and will continue to be used to prevent ACLs from being exceeded. These include: individual fishing quotas and the measures to ensure that individual fishing quotas are not exceeded, measures to minimize crab bycatch in directed crab fisheries, and monitoring and catch accounting measures. Accountability measures in the harvest specification process include downward adjustments to the ACL and TAC in the fishing year after an ACL has been exceeded.

Annually, the Council, Scientific and Statistical Committee, and Crab Plan Team will review (1) the stock assessment documents, (2) the OFLs and ABCs, and total allowable catches or guideline harvest levels, (3) NMFS's determination of whether overfishing occurred in the previous crab fishing year, (4) NMFS's determination of whether any stocks are overfished and (5) NMFS's determination of whether catch exceeded the ACL in the previous crab fishing year.

Optimum yield is defined in the FMP Chapter 4. Information pertaining to economic, social and ecological factors relevant to the determination of optimum yield is provided in several sections of the FMP, including sections 7.2 (Management Objectives), Chapter 11, Appendix D (Biological and Environmental Characteristics of the Resource), and Appendix H (Community Profiles).

For each crab fishery, the optimum yield range is 0 to < OFL catch. For crab stocks, the OFL is the annualized maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Recognizing the relatively volatile reproductive potential of crab stocks, the cooperative management structure of the FMP, and the past practice of restricting or even prohibiting directed harvests of some stocks out of ecological considerations, this optimum yield range is intended to facilitate the achievement of the biological objectives and economic and social objectives of the FMP (see sections 7.2.1 and 7.2.2) under a variety of future biological and ecological conditions. It enables the State to determine the appropriate TAC levels below the OFL to prevent overfishing or address other biological concerns that may affect the reproductive potential of a stock but that are not reflected in the OFL itself. Under FMP section 8.2.2, the State establishes TACs at levels that maximize harvests, and associated economic and social benefits, when biological and ecological conditions warrant doing so.

Five-Tier System

The OFL and ABC for each stock are annually estimated for the upcoming crab fishing year using the five-tier system, detailed in Table 6-1 and 6-2. First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the Crab Plan Team process to the Council's Scientific and Statistical Committee. The Council's Scientific and Statistical Committee recommends tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the proposed OFLs and ABCs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the determination of stock status level is based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the F_{OFL}. Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 6-1). The F_{MSY} control rule reduces the F_{OFL} as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the B_{MSY}. For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β).

In stock status level "c," the ratio of current biomass to B_{MSY} (or a proxy for B_{MSY}) is below β. At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the MSST.

For Tiers 1 through 3, the coefficient α is set at a default value of 0.1, and β set at a default value of 0.25, with the understanding that the Scientific and Statistical Committee may recommend different values for a specific stock or stock complex as merited by the best available scientific information.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}.

In Tier 5, the OFL is specified in terms of an average catch value over an historical time period, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

Second, the assessment author prepares the stock assessment and calculates the proposed OFLs by applying the F_{OFL} and using the most recent abundance estimates. The assessment authors calculate the proposed ABCs by applying the ABC control rule to the proposed OFL.

Stock assessment documents shall:

- use risk-neutral assumptions;
- specify how the probability distribution of the OFL used in the ABC control rule is calculated for each stock; and
- specify the factors influencing scientific uncertainty that are accounted for in calculation of the probability distribution of the OFL.

Second, the Crab Plan Team annually reviews stock assessment documents, the most recent abundance estimates, the proposed OFLs and ABCs, and complies the Stock Assessment and Fishery Evaluation Report. The Crab Plan Team then makes recommendations to the Scientific and Statistical Committee on the OFLs, ABCs, and any other issues related to the crab stocks.

Third, the Scientific and Statistical Committee annually reviews the Stock Assessment and Fishery Evaluation Report, including the stock assessment documents, recommendations from the Crab Plan Team, and the methods to address scientific uncertainty.

In reviewing the Stock Assessment and Fishery Evaluation Report, the Crab Plan Team and the Scientific and Statistical Committee shall evaluate and make recommendations, as necessary, on:

- the assumptions made for stock assessment models and estimation of OFLs;
- the specifications of the probability distribution of the OFL;
- the methods to appropriately quantify uncertainty in the ABC control rule; and
- the factors influencing scientific uncertainty that the State has accounted for and will account for on an annual basis in TAC setting.

The Scientific and Statistical Committee will then set the final OFLs and ABCs for the upcoming crab fishing year. The Scientific and Statistical Committee may set an ABC lower than the result of the ABC control rule, but it must provide an explanation for setting the ABC less that the maximum ABC.

As an accountability measure, the total catch estimate used in the stock assessment will include any amount of harvest that may have exceeded the ACL in the previous fishing season. For stocks managed under Tiers 1 through 4, this would result in a lower maximum ABC in the subsequent year, all else being equal, because maximum ABC varies directly with biomass. For Tier 5 stocks, the information used to establish the ABC is insufficient to reliably estimate abundance or discern the existence or extent of biological consequences caused by an overage in the preceding year. Consequently, the subsequent year's maximum ABC will not automatically decrease. However, when the ACL for a Tier 5 stock has been exceeded, the Scientific and Statistical Committee may decrease the ABC for the subsequent fishing season as an accountability measure.

<u>Tiers 1 through 3</u>

For Tiers 1 through 3, reliable estimates of B, B_{MSY}, and F_{MSY}, or their respective proxy values, are available. Tiers 1 and 2 are for stocks with a reliable estimate of the spawner/recruit relationship, thereby enabling the estimation of the limit reference points B_{MSY} and F_{MSY}.

- Tier 1 is for stocks with assessment models in which the probability density function (pdf) of F_{MSY} is estimated.
- Tier 2 is for stocks with assessment models in which a reliable point estimate, but not the pdf, of F_{MSY} is made.
- Tier 3 is for stocks where reliable estimates of the spawner/recruit relationship are not available, but proxies for F_{MSY} and B_{MSY} can be estimated.

For Tier 3 stocks, maturity and other essential life-history information are available to estimate proxy limit reference points. For Tier 3, a designation of the form "F_X" refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or its proxy such as mature male biomass at mating) per recruit equal to X% of the equilibrium level in the absence of any fishing.

The OFL and ABC calculation accounts for all losses to the stock not attributable to natural mortality. The OFL and ACL are total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, the handling mortality rate is multiplied by bycatch discards in each fishery. Overfishing would occur if, in any year, the sum of all three catch components exceeds the OFL.

Tier 4

Tier 4 is for stocks where essential life-history, recruitment information, and understanding are insufficient to achieve Tier 3. Therefore, it is not possible to estimate the spawner-recruit relationship. However, there is sufficient information for simulation modeling that captures the essential population dynamics of the stock as well as the performance of the fisheries. The simulation modeling approach employed in the derivation of the annual OFLs captures the historical performance of the fisheries as seen in observer data from the early 1990s to present and thus borrows information from other stocks as necessary to estimate biological parameters such as γ.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}. Explicit to Tier 4 are reliable estimates of current survey biomass and the instantaneous M. The proxy B_{MSY} is the average biomass over a specified time period, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information. A scalar, γ, is multiplied by M to estimate the F_{OFL} for stocks at status levels "a" and "b," and γ is allowed to be less than or greater than unity. Use of the scalar γ is intended to allow adjustments in the overfishing definitions to account for differences in biomass measures. A default value of γ is set at 1.0, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information.

If the information necessary to determine total catch OFLs and ACLs is available for a Tier 4 stock, then the OFL and ACL will be total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. If the information necessary to determine total catch OFLs and ACLs is not available for a Tier 4 stock, then the OFL and ACL are determined for retained catch. In the future, as information improves, data would be available for some stocks to allow the formulation and use of selectivity curves for the discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models. The resulting OFL and ACL from this approach, therefore, would be the total catch OFL and ACL.

Tier 5

Tier 5 stocks have no reliable estimates of biomass and only historical catch data is available. For Tier 5 stocks, the OFL is set equal to the average catch from a time period determined to be representative of the production potential of the stock, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information. The ABC control rule sets the maximum ABC at less than or equal to 90 percent of the OFL and the ACL equals the ABC.

For Tier 5 stocks where only retained catch information is available, the OFL and ACL will be set for the retained catch portion only, with the corresponding limits applying to the retained catch only. For Tier 5 stocks where information on bycatch mortality is available, the OFL and ACL calculations could include discard losses, at which point the OFL and ACL would be applied to the retained catch plus the discard losses from directed and non-directed fisheries.

Figure 1. **Overfishing control rule for Tiers 1 through 4. Directed fishing mortality is 0 below β.**

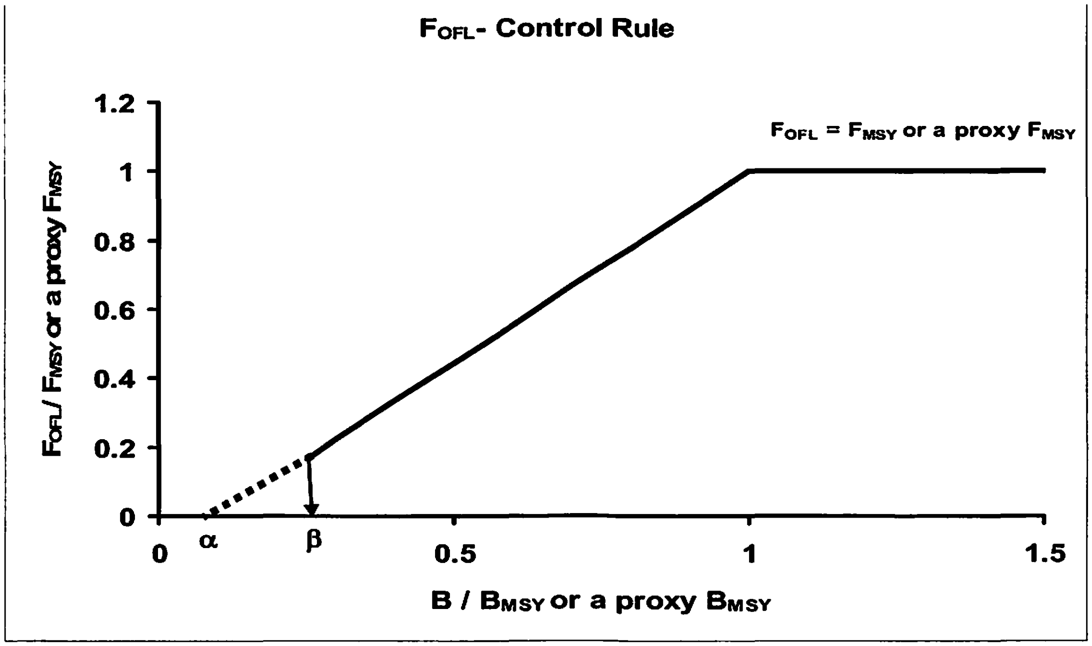


Table 1 **Five-Tier System for setting overfishing limits (OFLs) and Acceptable Biological Catches (ABCs) for crab stocks. The tiers are listed in descending order of information availability. Table 2 contains a guide for understanding the five-tier system.**

Information available	Tier	Stock status level	F_{OFL}	ABC control rule
B, B_{MSY}, F_{MSY}, and pdf of F_{MSY}	1	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ =arithmetic mean of the pdf	
		b. $\beta < \frac{B}{B_{msy}} \le 1$	$F_{OFL} = \mu_A \frac{B/B_{msy} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, B_{MSY}, F_{MSY}	2	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$	
		b. $\beta < \frac{B}{B_{msy}} \le 1$	$F_{OFL} = F_{msy} \frac{B/B_{msy} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, $F_{35\%}$*, $B_{35\%}$*	3	a. $\frac{B}{B_{35\%*}} > 1$	$F_{OFL} = F_{35\%}$ *	
		b. $\beta < \frac{B}{B_{35\%}*} \le 1$	$F_{OFL} = F^*_{35\%} \frac{\frac{B}{B^*_{35\%}} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{35\%}*} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, M, $B_{msy^{prox}}$	4	a. $\frac{B}{B_{msy^{prox}}} > 1$	$F_{OFL} = \gamma M$	
		b. $\beta < \frac{B}{B_{msy^{prox}}} \le 1$	$F_{OFL} = \gamma M \frac{B/B_{msy^{prox}} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy^{prox}}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
Stocks with no reliable estimates of biomass or M.	5		OFL = average catch from a time period to be determined, unless the SSC recommends an alternative value based on the best available scientific information.	ABC≤0.90 * OFL

*35% is the default value unless the SSC recommends a different value based on the best available scientific information.
† An $F_{OFL} \le F_{MSY}$ will be determined in the development of the rebuilding plan for an overfished stock.

Table 2 A guide for understanding the five-tier system.

- F_{OFL} — the instantaneous fishing mortality (F) from the directed fishery that is used in the calculation of the overfishing limit (OFL). F_{OFL} is determined as a function of:
  - F_{MSY} — the instantaneous F that will produce MSY at the MSY-producing biomass
    - A proxy of F_{MSY} may be used; e.g., $F_{x\%}$, the instantaneous F that results in x% of the equilibrium spawning per recruit relative to the unfished value
  - B — a measure of the productive capacity of the stock, such as spawning biomass or fertilized egg production.
    - A proxy of B may be used; e.g., mature male biomass
  - B_{MSY} — the value of B at the MSY-producing level
    - A proxy of B_{MSY} may be used; e.g., mature male biomass at the MSY-producing level
  - β — a parameter with restriction that $0 \leq \beta < 1$.
  - α — a parameter with restriction that $0 \leq \alpha \leq \beta$.
- The maximum value of F_{OFL} is F_{MSY}. $F_{OFL} = F_{MSY}$ when $B > B_{MSY}$.
- F_{OFL} decreases linearly from F_{MSY} to $F_{MSY} \cdot (\beta-\alpha)/(1-\alpha)$ as B decreases from B_{MSY} to $\beta \cdot B_{MSY}$
- When $B \leq \beta \cdot B_{MSY}$, $F = 0$ for the directed fishery and $F_{OFL} \leq F_{MSY}$ for the non-directed fisheries, which will be determined in the development of the rebuilding plan.
- The parameter, β, determines the threshold level of B at or below which directed fishing is prohibited.
- The parameter, α, determines the value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$ and the rate at which F_{OFL} decreases with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$.
  - Larger values of α result in a smaller value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$.
  - Larger values of α result in F_{OFL} decreasing at a higher rate with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$.
- The parameter, b_y, is the value for the annual buffer calculated from a P* of 0.49 and a probability distribution for the OFL that accounts for scientific uncertainty in the estimate of OFL.
- P* is the probability that the estimate of ABC, which is calculated from the estimate of OFL, exceeds the "true" OFL (noted as OFL') (P(ABC>OFL').

Crab Plan Team Recommendations

Table 3 lists the team's recommendations for 2011/2012 on Tier assignments, model parameterizations, time periods for reference biomass estimation or appropriate catch averages, OFLs and ABCs. The team recommends two stocks be placed in Tier 3 (EBS snow crab and Bristol Bay red king crab), five stocks in Tier 4 (EBS Tanner crab, St. Matthew blue king crab, Pribilof Island blue king crab, Pribilof Island red king crab and Norton Sound red king crab) and three stocks in Tier 5 (AI golden king crab, Pribilof Island golden king crab and Adak red king crab). Table 4 lists those stocks for which the team recommends an ABC less than the maximum permissible ABC for 2011/12. Stock status in relation to status determination criteria are shown in Table 5.

The team has general recommendations for all assessments and specific comments related to individual assessments. All recommendations are for consideration for the 2012 assessment. The general comments are listed below while the comments related to individual assessments are contained within the summary of plan team deliberations and recommendations contained in the stock specific summary section. Additional details regarding recommendations are contained in the Crab Plan Team Report (September 2011 CPT Report).

General recommendations for all assessments

1. In relation to whether mature male biomasses should be reduced by the actual catches or the projected catches using an F_{MSY} strategy when computing the B_{MSY} proxy for Tier 4 stocks, the team recommended that the analysts provide a more complete and general analysis supporting the possible application of "bias" corrections for the May 2012 meeting.
2. The team had a further discussion of the relative merits of male-catch-only versus total-catch OFLs. While the team has striven to calculate total-catch OFLs in recent years, there are good reasons why a male-catch-only OFL may better satisfy the aims of OFL setting, including: (a) the formulae used to calculate OFLs are generally based on data for males, with females as an 'add on', and (b) if the OFL is calculated including females, the entire OFL could be males without the conclusion that overfishing occurred. The team requests that the SSC reconsider whether the team can recommend male-only OFLs when the situation suggests that this is warranted, even when it is possible to calculate a total-catch OFL (e.g. EBS Tanner crab). A white paper is being developed to discuss this issue further at the May 2012 CPT meeting and will be provided to the SSC for their consideration in June 2012.
3. The team recommends that analysts provide a list of the parameters (e.g. natural mortality, Q, the appropriateness of F_{MSY} and B_{MSY} proxies), an indication of whether the estimates / assumption used to compute the OFL is likely wrong in systematic way (leading to under- or over-estimation of the OFL) and a range for the extent of error. The analysts should then calculate how the OFL would change for the extremes of the ranges. The team will discuss this approach to quantifying error further at the January modeling workshop.
4. The team recommends that all assessment authors document assumptions and simulate data under those assumptions to test the ability of the model to estimate key parameters in an unbiased manner. These simulations would be used to demonstrate precision and bias in estimated model parameters.
5. The CPT recommends the listing of sigmas instead of absolute weights as being more informative for factors such as L_{50} and β. Also, the team recommends specifying weights for the penalties on L_{50} and β from the standard errors from the analysis on which the estimates for these parameters were based.
6. The team requests that to the extent possible assessments include a listing of the tables and figures in the assessment (i.e., Table of Tables, Table of Figures).

By convention the CPT used the following conversions to include tables in both lbs and t in the status status summary sections:

- lbs to t [/2.204624]
- t to lbs [x 0.453592]

Ecosystem SAFE overview

The ecosystem chapter is composed of three main sections 1) ecosystem assessment, 2) current status of ecosystem indicators, and 3) ecosystem-based management indicators. The objectives of this chapter are to assess the BSAI ecosystem trends, identify and provide annual updates of ecosystem status indicators and research priorities for BSAI crab stocks, and to update management status indicators.

A summary of the most recent ecosystem trends affecting BSAI crab is summarized below with additional information detailed in the ecosystem consideration indicators chapter. Crab Plan Team comments and recommendations on the ecosystem chapter are contained in the September 2011 CPT report.

Recent trends in the 2011 ecosystem indicators (physical & biological trends)

- Extensive sea ice coverage in 2010 persisted into late spring, resulting in one of the largest summer cold pools in 2010.
- Analysis of sea ice extent suggests that the northern Bering Sea will remain relatively cold in the future; affecting distribution of species (crab and predators).
- Pacific cod and pollock on 2010 EBS survey distributed outside the cold pool.
- Winter 2011 was a moderately cold compared to previous five years, although winter ice cover advanced in late spring (April 2011).
- Moderate La Niña for winter 2011 may result in a transitional year in summer 2011.

2010/2011 Status of Predators

- Pacific cod biomass of 0.84 t doubled from 2009.
- Pollock biomass of 3.75 t highest since 2007.
- YFS, NRS, SRS, ATF and HAB all increasing.
- Overall predator abundance is increasing including a significant increase in age 2-3 Pacific cod.

Stock Status Summaries

1 Eastern Bering Sea Snow Crab

Fishery information relative to OFL setting

The total catch in the 2010/11 fishery was estimated at 26,720 t (including model estimated bycatch). This is below the 2010/11 OFL of 44,400 t. Since 1992 when observers were placed on the boats, estimated discard mortality from the directed pot fishery has averaged 15.5% with an assumed discard mortality rate of 50%. Retained catch in the 2010/11 fishery was 24,670 t, which is a slight increase over the 2009/10 fishery of 21,785 t. Snow crab is taken as bycatch in the trawl fishery and estimates of trawl bycatch in recent years are less than 1% of the total snow crab catch. Current estimates of stock status have been above B_{MSY}(418,150 t) for the past three years. Recent trends in mature biomass have continued to increase since 2008. Since 1999, estimates of exploitation rates on mature male biomass have been well below estimates of exploitation rates corresponding to fishing at $F_{35\%}$.

Data and assessment methodology

The stock assessment is based on a size- and sex-structured model in which crabs are categorized into immature, mature, new and old shell. The growth transition matrix is based on an exponential growth function with the transition probability based on a gamma distribution where the variance term for the growth increment is fixed. The model is fitted to abundance data from the NMFS trawl survey, total catch data from the directed fishery and the bycatch data from the trawl fishery, size frequency data by maturity status for the male crab pot fishery, female bycatch in the crab pot fishery, trawl fishery bycatch. The model is also fitted to the 2009 and 2010 BSFRF study area biomass estimates and length frequency data. Changes to the model for 2011 include: i) immature M for male and females, ii) mature male M that is either fixed or estimated depending on the model scenario, iii) reformulation of the survey selectivity in the BSFRF study areas in 2009 and 2010, iv) a nonparametric availability curve for the BSFRF study area in 2009 and 2010,, v) model scenarios with a fixed growth curve based on data from a 2011 growth study.

A total of 13 alternative model scenarios were evaluated. The base model chosen by the author was scenario 7 where natural mortality rates for all stages were fixed at 0.23 yr^{-1} and a logistic curve was used for the availability BSFRF survey data. The Crab Plan Team recommends scenario 6, where a nonparametric availability model was used and natural mortality rates were estimated in conjunction with an informative prior for adult M (see CPT minutes for discussions regarding model selection and natural mortality rates).

Stock biomass and recruitment trends

All model scenarios investigated indicated that the stock is above the B_{MSY} proxy. This indicates that under any model scenario the stock is rebuilt. Estimated trends (model 7) in mature male biomass (MMB) at mating have increased since 2002/03 to 2010/11, and 2011/12 estimates (179,000 t) are slightly less than 2010/11 (184,900 t). Observed survey mature male biomass increased from 157,310 t in summer 2010 to 167,400 t in summer 2011. Trends in recruits per mature male biomass have increased between 2001/02 and 2005/06, and the estimates of recruitment (25-50 mm size class) in the last 5 years are dominated by an above average cohort in 2009/10.

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

The CPT recommends that the EBS snow crab is a tier 3 stock so the OFL will be determined by $F_{35\%}$ control rule. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating is 147,500 t, based on average recruitment over 1979 to present, and the minimum stock size threshold is 73,700 t. The CPT recommends that the ABC be less than maxABC

The Team had difficulty in determining the buffer between the OFL and the ABC that appropriately addresses uncertainty. The Team considered many options for an ABC <maxABC permissible including the following options:

1. a default 10% buffer;
2. use of the OFL from model 7 as an ABC;
3. using the recommended total uncertainty (i.e., σw and σb from the EA for amendment 38) to estimate a buffer using a P* of 0.49; and
4. using the ratios of OFL from model scenarios (e.g., use ratios between different model scenarios) to define a range of values to be used as a multiplier (buffer) for the ABC.

Despite extensive discussion of these items, the CPT was unable to recommend a specific ABC but wishes to identify the following information on uncertainty that should be captured in an ABC: a) using M fixed at prior value would have led to a lower OFL value; and b) use of the new growth data (which has not yet been reviewed in much detail) would have resulted in a lower value. However, the Team recognized that given the uncertainty noted, risk tolerance is required to choose an appropriate buffer based on the model results presented.

Historical status and catch specifications for snow crab (kt).

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	72.1	98.9	28.6	28.6	35.0		
2008/09	74.1	109.3	26.6	26.5	31.5	35.1	
2009/10	66.6	127.7	21.8	21.8	23.9	33.1	
2010/11	73.7	196.6	24.6	24.7	26.7	44.4	
2011/12		133.8*				73.5	<maxABC

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Historical status and catch specifications for snow crab (millions of lb.).

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	159.0	218.0	63.1	63.1	77.2	NA	
2008/09	163.4	241.0	58.6	58.4	69.4	77.4	
2009/10	146.8	281.5	48.1	48.1	52.7	73.0	
2010/11	162.5	433.4	54.2	54.5	58.9	97.9	
2011/12		295.0*				162.0	<maxABC

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Additional Plan Team recommendations

See the CPT Report (September 2011) for additional recommendations on the Snow Crab assessment for

2012 specification cycle.

2 Bristol Bay red king crab

Fishery information relative to OFL setting.

The commercial harvest of Bristol Bay red king crab (BBRKC) dates to the 1930s, initially prosecuted mostly by foreign fleets but shifting to a largely domestic fishery in the early 1970s. Retained catch peaked in 1980 at 129.9 million lbs (58.9 thousand t), but harvests dropped sharply in the early 1980s, and population abundance has remained at relatively low levels over the last two decades compared to those seen in the 1970s. The fishery is managed for a total allowable catch (TAC) coupled with restrictions for size (≥ 165.1mm (6.5-in) carapace width), sex (male only), and season (no fishing during mating/molting periods). Prior to 1990, the harvest rate was based on estimated population size and prerecruit and postrecruit abundances at survey time, and varied from 20% to 60% of legal males. In 1990, the harvest strategy became 20% of the mature male (≥120-mm CL) abundance, with a maximum of 60% on legal males, and a threshold abundance of 8.4 million mature females. The current stepped harvest strategy allows a maximum harvest rate of 15% of mature males, but also incorporates a maximum harvest rate of 50% of legal males, a threshold of 14.5 million lb (6.6 thousand t) of effective spawning biomass (ESB), and a minimum GHL of 4.0 million lb (8.8 thousand t) to prosecute a fishery. The TAC increased from 15.5 million lb (34.2 thousand t) for the 2006/07 season to 20.4 million lb (45.0 thousand t) for the 2007/08 and 2008/09 seasons, and then declined through the next two seasons to 14.9 million lb (32.8 thousand t) for 2010/2011. Catch of legal males per pot lift was relatively high in the 1970s and low in the 1980s to mid-1990s. Following implementation of the crab rationalization program in 2005, CPUE increased to31 crab/pot in 2006, but fell to 18 crab/pot by 2010/11. Annual non-retained catch of female and sublegal male RKC during the fishery averaged less than 3.9 million lb (8.6 thousand t) since data collection began in 1990. Estimated fishing mortality ranged from 0.3 to 0.4 yr^{-1} following implementation of crab rationalization. Total catch (retained and bycatch mortality) increased from 17.0 million lb (7.7 thousand t) in 2010/11 to 23.4 million lb (10.6 thousand t) in 2008/09.

Data and assessment methodology

The stock assessment model is based on a length-structured population dynamics model incorporating data from the NMFS eastern Bering Sea trawl survey, commercial catch, and at-sea observer data program. Annual stock abundance is estimated for male and female crabs ≥ 65-mm carapace length during 1968/69–2010/11 to the time of the 2011 survey and mature male biomass is projected for 15 February 2012. Catch data (retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date from the fishery which targets males ≥ 165mm (6.5 in. carapace width) were obtained from ADF&G fish tickets and reports, red king crab and Tanner crab fisheries bycatch data from the ADF&G observer database, and groundfish trawl bycatch data from the NMFS trawl observer database. Catch and bycatch data were updated with data from the 2010/11 crab fishery year. The 2011 assessment was based on model scenario 7ac. Model scenario 7ac assumes three levels of molting probabilities, a constant natural mortality $M = 0.18yr^{-1}$ (but with additional natural mortality for males and females during 1980–1984 and for females during the "split period" 1976–1979 and 1985–1993), incorporates the BSFRF data, estimates effective sample sizes, estimates proportions in initial years, and (with respect to the "Bristol Bay retow data") uses only the standard survey data for males and uses the retow data for females.

Stock biomass and recruitment trends

Model estimates of total survey biomass increased from 162.5 million lb (73.7 thousand t) in 1968 to 631.1 million lb (286.3 thousand t) in 1978, fell to 77.0 million lb (34.9 thousand t) in 1985, generally increased to 201.2 million lb (91.3 thousand t) in 2007, and declined to 166.9 million lb (75.7 thousand t) in 2011. Model estimates of mature male biomass at mating (15 February) generally increased from 48.3 million lb (21.9 thousand t) in 1993/94 to 73.8 million lb (33.5 thousand t) in 2009/10 and to 72.0 million lb (32.6 thousand t) in 2010/11; the projected value for mature male biomass on 15 February 2012 is 65.6 million lb (29.8 thousand t) if the 2011/12 catch equals the OFL. Estimated recruitment was high during the 1970s and early 1980s and has been generally low since 1985. Estimated recruitment to the modeled size classes (i.e., ≥65 mm CL) from the 2007–2011 surveys has been below the average for 1984–2011. The 2011 survey produced a high catch of juvenile males and females <65 mm CL, but that catch occurred in only one survey tow and hence has high uncertainty as a predictor of future recruitment.

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

This assessment showed improvement in exploring the use of the data that are available, particularly with regard to exploring physical and biological oceanographic trends to support the choice of 1984–2011 as recruitment period to use in estimating $B_{35\%}$. The CPT supports the use of model scenario 7ac for the 2011 assessment for stock status determination.

The Plan Team recommends Bristol Bay red king crab as a Tier 3 stock. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating, computed as the average recruitment from 1984 to the last year of the assessment (2011) multiplied by the mature male biomass-per-recruit corresponding to $F_{35\%}$ less the mature male catch under an $F_{35\%}$ harvest strategy. Estimated $B_{35\%}$ for 2010/11 is 27.3 t (60.0 million lb). Total catch includes retained male catch and all other bycatch sources.

The team recommends that the OFL for 2011/12 be set according to the model scenario 7ac results at 19.39 million pounds (8.80 thousand t). The team recommends that the ABC for 2011/12 be set below the maximum ABC (19.35 million pounds, or 8.78 thousand t). The team identified uncertainty in the OFL estimation due to the unknown effects on the recruitment time series of the assumption of periods of additional mortality in the model. A downward bias trend in the male abundance estimates that was revealed in a retrospective analysis of model scenario 7ac was also identified as a source of uncertainty in OFL estimation. The team recommends that the ABC be set at 15.84 million lb (7.19 thousand t) to account for the uncertainty arising from that downward bias trend based on an analysis of the retrospective pattern contained in the assessment (see CPT Report for additional details on this adjustment).

Status and catch specifications (kt) of Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	20.32	37.69	9.24	9.30	10.54		
2008/09	17.06	39.83	9.24	9.22	10.48	10.98	
2009/10	15.56	40.37	7.26	7.27	8.31	10.23	
2010/11	13.63	32.64	6.73	6.76	7.71	10.66	
2011/12		29.76[D]				8.80	7.19

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Status and catch specifications (million lb.) of Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	44.8	85.9	20.38	20.51	23.23		
2008/09	37.6	87.8	20.37	20.32	23.10	24.20	
2009/10	34.3	89.0	16.0	16.0	18.31	22.56	
2010/11	30.0	72.0	14.84	14.91	17.00	23.52	
2011/12		65.6*				19.39	15.84

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

The 2010/2011 MMB estimate exceeds the MSST for 2010/11, so the stock is not currently overfished (the 2010/11 MMB is 109% of the B_{MSY} proxy of $B_{35\%}$). The total catch for 2010/11 (17.00 million lb, or 7.71 thousand t) was less than the 2010/11 OFL (23.52 million lb, or 10.66 thousand t), so overfishing did not occur during 2010/11.

Additional Plan Team comments

See the September 2011 Crab Plan Team report for additional comments and recommendations on the assessment.

3 Eastern Bering Sea Tanner crab

Fishery information relative to OFL setting.

Eastern Bering Sea (EBS) Tanner crabs are caught as bycatch in the groundfish fisheries, scallop fisheries, in the directed Tanner crab fishery (principally as non-retained females and sublegal males), and in other crab fisheries (notably, eastern Bering Sea snow crab and to a lesser extent in the fishery for Bristol Bay red king crab). Two directed fisheries, one east and one west of 166° W. longitude, harvest EBS Tanner crab. Under the Crab Rationalization Program, ADF&G sets separate TACs and NMFS issues separate individual fishing quota (IFQ) for these two fisheries. However, one OFL is set for the EBS Tanner crab because there is no evidence that the EBS Tanner crab is not one stock. Both fisheries were closed from 1997 to 2005 due to low abundance and the fisheries were closed again for the 2010/11 crab fishery year. NMFS declared this stock overfished in 1999 and the Council developed a rebuilding plan. In 2005, abundance increased to a level to support a fishery in the area west of 166^0 W. ADF&G opened both fisheries for the 2006/07 to 2008/09 crab fishing years and to the area east of 166° W. longitude only in 2009/10. In 2007, NMFS determined the stock was rebuilt because spawning biomass was above B_{MSY} for two consecutive years. The mature male biomass was, however, estimated to be below the Minimum Stock Size Threshold ($0.5B_{MSY}$) in February 2010 (the assumed time of mating), and NMFS declared the stock overfished in September 2010 and a rebuilding plan will be developed for implementation in 2012/13. New minimum size limits adopted by the Alaska Board of Fisheries will be implemented in the 2011/12 fishing season.

Data and assessment methodology

This stock is surveyed annually by the NMFS EBS trawl survey. Although a stock assessment model has been developed for the eastern portion of the stock, and a model is currently under development for the entire stock, no currently approved model exists for the stock. Area-swept estimates of biomass from the EBS trawl survey are therefore used to estimate the biomass of stock components: mature male biomass (MMB), legal male biomass (LMB), and females. The current assessment used NMFS trawl survey data with measured net width (as opposed to the fixed-width assumed in previous assessments). Fish ticket data were used for computing retained catch, and observer data from the crab and groundfish fisheries were used to estimate non-retained catch; assumed handling mortality rates for fishery components were used to estimate the discard mortality.

Stock biomass and recruitment trends
MMB and LMB showed peaks in the mid-1970s and early 1990s. MMB at the survey revealed an all-time high of 257.0 thousand t in 1975, and a second peak of 108.3 thousand t in 1991. From late-1990s through 2007, MMB has risen at a moderate rate from a low of 10.4 thousand t in 1997. Post-1997, MMB at the time of survey increased to 73.6 thousand t in 2007, but subsequently declined to MMB at the time of survey of 32.1 thousand t in 2010. The survey estimate of MMB from the 2011 survey was 41.8 thousand t, an increase of 30.2% from 2010, but this estimate is not used in the Tier 4 assessment given the way this assessment is applied. The MMB projected for February 2012 (26.06 thousand t) is less than the MMB in February 2011 (26.73 thousand t) if the total catch for 2011/12 equals the OFL. The 2011 survey estimated a high abundance of small (25-35 mm CW) animals.

Tier determination/Plan Team discussion and resulting OFL and ABC determination
The team recommends the OFL for this stock be based on the Tier 4 control rule because no stock assessment model has been adopted. Based on the estimated biomass at 15 February 2011, the stock is at stock status level b. The team recommends that $B_{\mathrm{MSY\ proxy}}$ be based on the average MMB for the years 1974-80, discounted by fishery removals (retained and non-retained mortalities) and natural mortality between the time of survey and the time of mating. This time period is thought to represent the reproductive potential of the stock. The range of years on which B_{MSY} is based differs from that used for the 2010 assessment because the range of years was shortened from 1969-80 to 1974-80 following the February 2011 assessment workshop recommendation that survey estimates for 1969-73 not be used for assessments owing to data quality issues. The $B_{\mathrm{MSY\ proxy}}$ for the 2011 assessment is 83.33 thousand t MMB at mating. The 2010/11 estimate of MMB at mating is 26.73 thousand t, or 32% of $B_{\mathrm{MSY\ proxy}}$. Hence, the stock is estimated to have been in overfished condition. The team recommends that γ=1.0 and M = 0.23yr^{-1}. Under the OFL Control Rule, the 2010/11 F_{OFL}=0.05, equating to a total male and female catch of 1.57 thousand t.

Given a P* of 0.49 and a within-model standard error of 0.13 on terminal biomass, the maximum permissible ABC would be 1,570 t. The author recommended a total catch OFL of 1,290t, i.e., 82% of the OFL based on an assumed additional uncertainty of 0.3. This level of uncertainty reflects several aspects not accounted for in the measure of uncertainty captured in the assessment: (a) pre-specified population dynamic parameters and life-history rates such as natural mortality, size-weight, and maturity; (b) the assumption $F_{\mathrm{MSY}}=M$; and (c) the assumption that B_{MSY} is the average biomass over 1974-80. However, the assessment is based on a Q of 1.0 for all sizes, whereas the stock assessment model includes a prior of Q <1.0 and that selectivity is a logistic function of size. The team recommended that the ABC be set equal to the maximum permissible ABC in the absence of a defensible way to specify a larger buffer, and the fact that a Q lower than 1.0 provides some buffer.

Historical status and catch specifications (kt) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL	ABC
2007/08 [b/]		68.76	2.55	0.96	3.63		
2008/09 [b/]	43.04[c/]	53.63	1.95	0.88	2.25	7.04	
2009/10	41.90[c/]	28.44	0.61[a/]	0.60	1.69	2.27	
2010/11	41.67	26.73	0.00	0.00	0.87	1.61	
2011/12		26.06[c/]				1.57	1.57

Historical status and catch specifications (millions lb) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL	ABC
2007/08 [b/]		151.59	5.62	2.12	8.00		
2008/09 [b/]	94.89	118.23	4.30	1.94	4.96	15.52	
2009/10	92.37	62.70	1.34[a/]	1.32	3.73	5.00	
2010/11	91.87	58.93	0.00	0.00	1.92	3.55	
2011/12		57.45[c/]				3.48	3.48

a/ Only the area east of 166 deg. W opened in 2009/10; TAC was 1.85 million lb.
b/ Biomass and threshold definitions based on survey estimates derived using 50ft net width area-swept calculations
c/ Projected 2011/12 MMB at time of mating after extraction of the estimated total catch OFL.

EBS Tanner crab MMB was below MSST at the time of mating in mid-February 2011 and is still in an overfished state. Overfishing did not occur during the 2010/11 fishing year because total catch losses (0.87 thousand t) did not exceed the total catch OFL (1.61 thousand t). The stock is projected to remain below MSST in February 2012, under a catch equal to the OFL.

Additional Plan Team comments

A catch of 42.77 thousand t (94.29 million lb) in the snow crab fishery is predicted to lead to a level of bycatch of EBS Tanner crab which, when added to predicted catch in the red king crab and groundfish fisheries, equals to the OFL of 1.57 thousand t. Thus, a TAC for the snow crab fishery of more than 42.77 thousand t is predicted to lead to overfishing for EBS Tanner crab.

4 Pribilof Islands red king crab

Fishery information relative to OFL setting

The ADF&G has not published harvest regulations for the Pribilof Islands red king crab fishery. The fishery began in 1973 as bycatch during the blue king crab fishery. The directed red king crab fishery opened with a specified GHL for the first time in September 1993. Beginning in 1995, combined Pribilof Islands red and blue king crab GHLs were established. Declines in crab abundance of both king crab stocks from 1996 to 1998 resulted in poor fishery performance during those seasons with annual harvest levels below the GHLs. The Pribilof red king crab fishery was closed from 1999 through 2010/1 due to uncertainty in estimated red king crab survey abundance and concerns for incidental catch and mortality of Pribilof blue king crab which was an overfished and severely depressed stock. Prior to the closure, the 1998/99 harvest was 246.9 t (0.544 million lb). The non-retained catches, with application of bycatch mortality rates, from pot and groundfish bycatch estimates of red king crab ranged from 2.8 t (0.001

million lb) to 192.1 t (0.424 million lb) during 1991/92 to 2010/11.

Data and assessment methodology

Although a catch survey analysis which incorporated data from the trawl survey, commercial catch, pot survey and at-sea observer data has been used for assessing the stock in the past, the 2011/12 assessment is based on trends in male mature biomass (MMB) at the time of mating inferred from NMFS bottom trawl survey from 1975-2011 and commercial catch and observer data from 1973/74 to 2010/11. The revised time-series of historical NMFS trawl survey abundance estimates were used in this assessment. The 2010/11 assessments of non-retained catch from all non-directed pot and groundfish fisheries were included in the SAFE report. Groundfish catches of red king crab are reported for all crab combined by federal reporting areas. Catches from observed fisheries were used to estimate total annual catch. An F_{OFL} for 2011/12 was determined using a mean MMB at the time of mating, the default γ value of 1.0 and an M of 0.18yr^{-1}. As recommended by the CPT (May 2011) and SSC (June 2011), the annual index of MMB for this stock was derived as the 3-yr running average of the current year MMB and estimates of MMB in the previous two years. The $B_{MSY\ proxy}$ was estimated as the mean MMB over the period 1991-2011 in which each yearly MMB index is the 3-yr running average as described. The resultant F_{OFL} from the control rule was applied to the projected legal male biomass at the time of the fishery to determine the total male catch OFL. Exploitation rates on legal male biomass and on mature male biomass are estimated as the sum of total retained plus non-retained stock losses as a fraction of legal male biomass and on mature male biomass, respectively, at the time of the fishery.

Stock biomass and recruitment trends

The stock exhibited widely varying mature male and female abundances during 1975-2011. The average MMB estimatedfor 2011 was 3,834 t (8.45 million lb). Recruitment is not well understood for Pribilof red king crab. Retained catches have not occurred since the 1998/99 season. Non-directed discard losses in the pot fisheries decreased in recent years, and there are no discard losses in the current year. Mature stock biomass declined in 2008/09 and 2009/10 followed by increases in MMB in 2010/11 and 2011/12. The estimated biomass of pre-recruit size crab remained relatively constant over the past decade although pre-recruit sized crab may not be well sampled by the NMFS survey. Bycatch losses resulting from the fixed gear groundfish fleet declined slightly from 2009/10 to 2010/11, while losses resulting from discards in the groundfish trawl fleet increased from 2,450 t (5.40 million lb) to 3,870 t (8.53 million lb) between 2009/10 to 2010/11. In 2011, estimates of survey mature female biomass, legal male biomass and mature male biomass all increased substantially relative to 2010. The 2011 length frequency distributions reveal an increase in the proportion of old shell and very old shell males in the stock relative that seen in the 2009 and 2010 survey, and most notably in the legal component of the stock in 2011.

Pribilof Islands red king crabs have been historically harvested with blue king crabs and are currently the dominant of the two species in this area. Total catch losses of male and female red king crab in 2010/11 from all fisheries was 4,200 t (9.19 million lb) which increased from 2,800 t (6.13 million lb) in 2009/10. The 2011/12 stock is not overfished and overfishing did not occur in the 2010/11.

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

This stock is in Tier 4b and γ is set to 1.0. The time period for estimating the proxy for B_{MSY} was selected to be representative of the stock being fished at an average rate approximating F_{MSY} resulting in biomass fluctuating around B_{MSY}. In this assessment, the $B_{MSY\ Proxy}$ was estimated as the mean MMB at mating from 1991 to 2011, resulting in $B_{MSY\ Proxy}$=5,143 t (11.34 million lb) and MSST=2,572 t (5.67 million lb). The estimated 2010/11 MMB at mating was estimated at 2,577 t (5.68 million lb) which represents 0.501$B_{MSY\ Proxy}$. For the 2011/12 fisheries, the F_{OFL} estimated from the control rule (0.08) was applied to the projected legal male biomass at the time of the fishery to determine the total male catch OFL.

The author recommended an ABC less than the maximum permissible as calculated by the maxABC control rule. The estimated 2011/12 maxABC was 340 t (0.75 million lb). The CPT concurred with the author's recommendation to set the ABC below the maximum permissible. Sources of additional uncertainty outside the assessment resulted from the generally insufficient or imprecise data on this stock: the high survey coefficients of variation on survey estimates of mature biomass, the pre-specification of survey catchability (Q) and natural mortality rate (M); that F_{MSY} is assumed equal to the product of γM in which are both unknown; and that B_{MSY} is represented as the running 3-yr average survey MMB.

The CPT recommended an ABC which incorporates additional uncertainty (σ_b) in addition to the within assessment uncertainty (σ_w). In this calculation, σ_w=0.645, σ_b=0.40 and σ_{total}=0.759. This resulted in a multiplier of 0.78, and a recommended ABC for the 2011/12 fisheries of 307 t (0.68 million lb).

Historical status and catch specifications (kt) of Pribilof Islands red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	1.96	6.66	0	0	0.007		
2008/09	1.99	5.02[A]	0	0	0.010	1.51	NA
2009/10	1.91	2.02[B]	0	0	0.003	0.23	NA
2010/11	2.57	2.75[C]	0	0	0.004	0.35	NA
2011/12		2.58[D]				0.39	0.31

Historical status and catch specifications (million lb) of Pribilof Islands red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	4.33	14.69	0	0	0.015		
2008/09	4.39	11.06[A]	0	0	0.021	3.32	NA
2009/10	4.22	4.46[B]	0	0	0.006	0.50	NA
2010/11	5.67	5.44[C]	0	0	0.009	0.77	NA
2011/12		5.62[D]				0.87	0.68

A – Based on survey data available to the Crab Plan Team in September 2008 and updated with 2008/2009 catches
B – Based on survey data available to the Crab Plan Team in September 2009 and updated with 2009/2010 catches
C – Based on survey data available to the Crab Plan Team in September 2010
D – Based on 3-yr average of 2009, 2010 and 2011 MMB estimates

Overfishing did not occur during 2010/11. The 2010/11 MMB was 2,577 t (5.68 million lb) which was above MSST (2,572 t; 5.67 million lb) but below $B_{MSY\ Proxy}$ (5,143 t; 11.34 million lb). Therefore, the stock was assigned to Tier 4b for the 2011/12 OFL calculation.

$B_{MSY\ Proxy}$=5,143 t (11.34 million lb) and MSST=2,572 t (5.67 million lb). The estimated 2010/11 MMB at mating was estimated at 2,577 t (5.68 million lb) which represents $0.501B_{MSY\ Proxy}$.

5 Pribilof Islands blue king crab

Fishery information relative to OFL setting.

The Pribilof blue king crab fishery began in 1973, with peak landings of 11.0 million lb during the 1980/81 season. A steep decline in landings occurred after the 1980/81 season. Directed fishery harvest from 1984/85 until 1987/88 was annually less than 1.0 million lb with low CPUE. The fishery was closed from 1988 until 1995. The fishery reopened from 1995 to 1998. Fishery harvests during this period ranged from 1.3 to 2.5 million lb. The fishery closed again in 1999 due to declining stock abundance and has remained closed through the 2010/11 season. The stock was declared overfished in 2002.

Data and assessment methodology

The NMFS conducts an annual trawl survey that is used to produce area-swept abundance estimates. The CPT discussed the history of the fishery and the rapid decline in landings. It is clear that the stock has collapsed, although the annual area-swept abundance estimates are imprecise.

Stock biomass and recruitment trends

The survey biomass time series was recalculated in 2011 to include actual measured net widths. Based on 2011 NMFS bottom-trawl survey, the estimated total mature-male biomass increased to 461 t from 322 t in 2010. The 2011/12 MMB at mating is projected to be 365 t (average of the last three years)(0.80 million lb) which is about 4% of B_{MSYproxy}. The Pribilof blue king crab stock biomass continues to be low. From recent surveys there is no indication of recruitment. Station by station survey data for red king crab and blue king crab show they occupy similar areas, indicating red king are not displacing blue king crab.

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

This stock is recommended for placement into Tier 4. B_{MSY} was estimated using the time period 1975/76 - 1984/85 plus 1990/1991-1997/1998, i.e. excluding the period 1985/1986-1989/1990. This range was chosen because it eliminates periods of extremely low abundance that may not be representative of the production potential of the stock. B_{MSY} is estimated at 8,839 t (19.49 million pounds).

The retained catch OFL is 0 because the 2010/11 estimate of MMB is less than 25% B_{MSY}. Due to the Tier level and stock status an F_{OFL} must be determined for the non-directed catch. Ideally this should be based on the rebuilding strategy. However the current rebuilding plan needs to be revised due to inadequate progress towards rebuilding.

The OFL for 2011/12 was estimated at 1.16 t (0.003 million lb), reduced from 2010/11 OFL of 1.81 t (0.004 million lb). The OFL is estimated from the average groundfish bycatch between 1999/00 and 2005/06, which was recalculated in 2011, resulting in the drop in the average catch.

The CPT concurred with the author's recommendation to set ABC less than the maximum permissible by employing a 10% buffer consistent with a Tier 5 average catch calculation. The ABC was estimated at 1.04 t (0.002 million lb.).

Historical status and catch specifications (t.) of Pribilof blue king crab in recent years.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		300	closed	0	2.3		
2008/09	2,105	110	closed	0	0.5	1.81	
2009/10	2,105	510	closed	0	0.5	1.81	
2010/11	4,420	286	closed	0	0.18	1.81	
2011/12		365*				1.16	1.04

*- 3- year average survey biomass

Historical status and catch specifications (million lb.) of Pribilof blue king crab in recent years.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		0.66	closed	0	0.005		
2008/09	4.64	0.25	closed	0	0.001	0.004	
2009/10	4.64	1.13	closed	0	0.001	0.004	
2010/11	9.74	0.63	closed	0	0.0004	0.004	
2011/12		0.80*				0.003	0.002

*- 3- year average survey biomass

The total catch for 2010/11 (0.18 t, 0.0004 million lb) was less than the 2010/11 OFL (1.81 t, 0.004 million lb) so overfishing did not occur during 2010/11. The 2011/12 projected MMB estimate of 365 t (0.80 million lb) is below the proxy for MSST (MMB/Bmsy = 0.04) so the stock continues to be in an overfished condition.

Additional Plan Team comments

A revised rebuilding plan is under development. Final action on this analysis will occur at the October 2011 Council meeting.

6 Saint Matthew blue king crab

Fishery information relative to OFL setting

The fishery was prosecuted as a directed fishery from 1977 to 1998. The fishery developed when 10 U.S. vessels harvested 1.202 million pounds during 1977/78. Harvests peaked in 1983/84 when 9.454-million pounds were landed. The fishery was fairly stable from 1986/87 to 1990/91, with a mean annual harvest of 1.252-million pounds. The mean catch increased to 3.297-million pounds during the period from 1991/92 to 1998/99.

This fishery was declared overfished and closed in 1999 when the stock size estimate was below the MSST. In November of 2000, Amendment 15 to the FMP was approved to implement a rebuilding plan for the St. Matthew Island blue king crab stock. The rebuilding plan included a harvest strategy established in regulation by the Alaska Board of Fisheries and an area closure to control bycatch as well as gear modifications. In 2008/09 and 2009/10, the MMB was above B_{MSY} for two years and was declared rebuilt in 2009.

The fishery re-opened in 2009/10 with a TAC of 1.167 million pounds and 0.461 million pounds of retained catch were harvested. The 2010/11 TAC was 1.6 million pounds and the fishery reported a retained catch of 1.264 million pounds Commercial crab fisheries near St. Matthew Island were scheduled in the fall and early winter to reduce the potential for bycatch from handling mortalities due to molting and mating crabs. Some bycatch has been observed of non-retained St. Matthew blue king crab in the St. Matthew blue king crab fishery, the eastern Bering Sea snow crab fishery, and groundfish fisheries. Based on limited observer data, bycatch of sublegal male and female crabs from the directed blue king crab fishery off St. Matthew Island was relatively high when the fishery was prosecuted in the 1990s, and total bycatch (in terms of number of crabs captured) was often twice as high or higher than total catch of legal crabs. The 2009/10 fishery had lower observed bycatch in the directed fishery than historical estimates. Observed bycatch in 2010/11 more than doubled from 2009/10, but was still below historical estimates.

Data and assessment methodology

A three-stage catch-survey analysis (CSA) is used to assess the male component of the stock. The CSA incorporates the following data: (1) commercial catch data from 1978 to 2010/11; (2) annual trawl survey data from 1978 to 2011; (3) triennial pot survey data from 1995 to 2010; (4) bycatch data in the groundfish trawl fishery from 1989 to 2006 and in the groundfish fixed-gear fishery from 1996 to 2008; and (5) ADF&G crab-observer data for the years 1990/91-1998/99, 2009/10, and 2010/11. Fishery effort and catch data are the vessel numbers, potlifts, catch number and weight, and CPUE for the directed pot fishery; total annual retained catches (including deadloss) were used in the catch-survey analysis. Trawl survey data are from summer trawl survey for stations within the St. Matthew Section. Trawl survey data provided estimates of density (number/nm^2) at each station for males in four size and shell-condition categories that were used in the assessment: 105–119 mm carapace length (CL); 90–104 mm CL; new-shell 120–133 mm CL; and old-shell ≥120 mm CL and new-shell ≥134 mm CL) males.

Pot survey data are from the July–August 1995, 1998, 2001, 2004, 2007, and 2010 ADF&G triennial pot surveys for Saint Matthew Island blue king crab. The pot survey samples areas of important habitat for blue king crab, particularly females, that the NMFS trawl survey cannot sample. Data used are from only the 96 stations fished in common during each of the five surveys. The CPUE (catch per pot lift) indices from those 96 stations for the male sex and shell-condition categories listed above were used in the assessment.

NMFS observer data were used to estimate groundfish trawl and fixed-gear bycatch. Bycatch composition data were not available so total biomass caught as bycatch was estimated by summing blue king crab biomass from federal reporting areas 524 and 521 according to gear type.

Stock biomass and recruitment trends

The stock is estimated to have been above B_{MSY} during 2008/09 through 2010/11 and is projected to be above B_{MSY} in 2011/12. MMB has fluctuated substantially over three periods. MMB increased during the first period (1978 to 1981) from 7.6 to over 17.6 million lb, followed by a steady decrease to 2.9 million lb. in 1985. The second period had a steady increase from the low in 1985 to 13.3 million lb. in 1997 followed by a rapid decrease to 2.8 million lb. in 1999. The third period had a steady increase in all size classes from the low in 1999 to the present high of over 15.8 million lb. in 2011/2012.

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

The CPT and SSC recommends that the stock be in Tier 4, with gamma (γ)=1 used for calculating F_{OFL}, and stock status level a. The CPT concurs with the use of the author recommended survey-based assessment while the model is undergoing revisions. The B_{MSYproxy} varies as a function of years used to calculate average MMB. The time period for estimating B_{MSYproxy} is 1989/90 to 2009/10 because the stock was harvested at extremely high rates before 1986 and this time period incorporates stock abundance during rebuilding. The B_{MSYproxy} during this time period is 6.865 million lb. The OFL is a total male OFL, as recommended by the team. The maxABC is based on cv = 0.5 and P*=0.49, which is 3.6 million pounds. However, to do the nature of the scientific uncertainty in the OFL, the team recommended a 10% buffer for an ABC of 3.4 million lb (1,530 t). Unaccounted for scientific uncertainty for this stock relates to the estimate of natural mortality, and that the survey does not cover the stock distribution (catchability) or the location of fishery. The trawl survey is a poor indication of abundance and may underestimate abundance. However, how the abundance index in the survey relates to the crab caught in the fishery or the total population is uncertain. The team discussed how to use this uncertainty to calculate an ABC because there is no expectation for information or analyses to resolve these uncertainties in the near future.

Historical status and catch specifications (kt) of St. Matthew blue king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		4.39	closed	closed	0.16		
2008/09	1.81	4.87	closed	closed	0.09	0.74 [retained]	
2009/10	1.52	5.79	0.53	0.20	0.25	0.78	
2010/2011	1.52	6.7	0.73	0.57	0.64	1.04	
2011/2012		7.17*				1.7	1.5

* Forecast based on survey data available in the 2011 assessment under the assumption that the 2010/11 catch is equal to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Historical status and catch specifications (millions lb.) of St. Matthew blue king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		9.7	closed	closed	0.35		
2008/09	4.0	10.74	closed	closed	0.20	1.63 [retained]	
2009/10	3.4	12.76	1.17	0.46	0.53	1.72	
2010/2011	3.4	14.77	1.6	1.26	1.4	2.29	
2011/2012		15.8*				3.74	3.4

The total catch for 2010/11 (1.4 million lb) was less than the 2010/11 OFL (2.29 million lb) so overfishing did not occur during 2010/11. Likewise, the 2010/2011 MMB (14.77 million pounds) is above the MSST (3.4 million lb.) so the stock is not overfished.

Additional Plan Team recommendations

The team made additional recommendations for the stock assessment model for the 2012 assessment cycle. These recommendations are contained in the September 2012 Crab Plan Team report.

7 Norton Sound red king crab

Fishery information relative to OFL setting

This stock supports three main fisheries: summer commercial, winter commercial, and winter subsistence. The summer commercial fishery, which accounts for the majority of the catch, reached a peak in the late 1970s at a little over 2.9 million pounds retained catch. Retained catches since 1982 have been below 0.5 million pounds, averaging 275,000 pounds, including several low years in the 1990s. Retained catches in the past three years have been about 400,000 pounds.

Data and assessment methodology

Four types of surveys have been conducted periodically during the last three decades: summer trawl, summer pot, winter pot, and preseason summer pot, but none of these surveys were conducted every year. To improve abundance estimates, a length-based stock synthesis model of male crab abundance was previously developed that combines multiple sources of survey, catch, and mark-recovery data from 1976 to 1996. A maximum likelihood approach was used to estimate abundance, recruitment, and catchabilities of the commercial pot gear. The model has been updated with data from 2010/11 and estimated population abundance in 2011. The current model assumes $M=0.18yr^{-1}$ for all length classes, except

M=0.288 yr^{-1} for the largest (> 123 mm CL) length group.

Stock biomass and recruitment trends

Mature male biomass was estimated to be on an upward trend following a recent low in 1997 and an historic low in 1982 following a crash from the peak biomass in 1977. Estimated recruitment was weak during the late 1970s and high during the early 1980s with a slight downward trend from 1983 to 1993. Estimated recruitment has been highly variable but on an increasing trend in recent years. Uncertainty in biomass is driven in part by temporal (every 3 to 5 years) and spatial variability in trawl survey coverage.

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

The team recommended Tier 4 stock status for Norton Sound red king crab. The model was the same as that recommended by the Team for the 2010 assessment. This model estimates bycatch mortality in the directed fishery, assumes M to 0.288 yr^{-1} for the largest length bin and 0.18 yr^{-1} for other length bins, and assumes flat selectivity for the summer fishery. The estimated abundance and biomass in 2011 are:

Legal males: 1.471 million crabs with a standard deviation of 0.199 million crabs.
Mature male biomass: 4.699 million lb with a standard deviation of 0.644 million lb.

Average of mature male biomasses during 1983-2011 was used as the B_{MSY} proxy and the CPT chose gamma =1.0 to derive the F_{MSY} proxy.
Estimated B_{MSY} proxy, F_{MSY} proxy and retained catch limit in 2010 are:

- B_{MSY} proxy = 2.490 million lb,
- F_{MSY} proxy = 0.18

The maximum permissible ABC would be 0.65 million lb. A retrospective analysis in the assessment showed that each time new data are added, estimates of historic abundance become lower, i.e. the assessment tends to over-estimate abundance, particularly in the most recent year. Regressing the predicting legal abundance one year beyond the end of the assessment against the corresponding estimates from 2011 indicates that hindcast legal abundance is 59.2% of the estimate. Applying a 59.2% adjustment as a bias correction to the OFL results in a recommended ABC of 0.388 million lb.

In June 2011, the SSC recommended an ABC of 0.59 mill lb. The rationale for the SSC recommendation is provided in their minutes (SSC minutes June 2011).

Status and catch specifications (kt)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2007/08		2.00	0.15	0.14	0.18		
2008/09	0.81[A]	2.38[A]	0.19	0.18	0.21	0.31[A]	
2009/10	0.70[B]	2.64[B]	0.17	0.18	0.22	0.32[B]	
2010/11	0.71[C]	2.47[C]	0.18	0.19	0.22	0.33[C]	
2011/12	0.56[D]	2.13[D]	0.16	0.18		0.30[D]	0.27

A-Calculated from the assessment reviewed by the Crab Plan Team in May 2008
B-Calculated from the assessment reviewed by the Crab Plan Team in May 2009
C-Calculated from the assessment reviewed by the Crab Plan Team in May 2010
D- Calculated from the assessment reviewed by the Crab Plan Team in May 2011

Status and catch specifications (millions lb.)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2007/08		4.40	0.32	0.31	0.36		
2008/09	1.78[A]	5.24[A]	0.41	0.39	0.43	0.68 [A]	
2009/10	1.54[B]	5.83[B]	0.38	0.40	0.43	0.71 [B]	
2010/11	1.56[C]	5.44[C]	0.40	0.42	0.46	0.73 [C]	
2011/12	1.25[D]	4.70[D]	0.36	0.40		0.66 [D]	0.59

A – Calculated from the assessment reviewed by the Crab Plan Team in May 2008
B – Calculated from the assessment reviewed by the Crab Plan Team in May 2009
C – Calculated from the assessment reviewed by the Crab Plan Team in May 2010
D - Calculated from the assessment reviewed by the Crab Plan Team in May 2011

Total catch in 2010/11 did not exceed the OFL for this stock thus overfishing is not occurring. . Stock biomass is above MSST; thus, the stock is not overfished.

Additional Plan Team recommendations

The CPT agrees with the authors that systematic declines in the retrospective estimates of abundance points to a model mis-specification that needs to be resolved.

The retrospective analysis shows a strong influence of the periodic trawl survey data. The CPT recommends conducting a retrospective analysis in which profiles are provided for other parameters. The 2011 assessment included only a likelihood profile for M based on the full time series.
Other requested changes and modification for the next assessment include:

- Provide greater consideration of selectivity as applied to the fisheries and surveys.
- Model notations used for equations need to be clarified.

This stock would be a good candidate for the subject of a modeling workshop.

8 Aleutian Island golden king crab

Fishery information relative to OFL setting

The directed fishery has been prosecuted annually since the 1981/82 season. Retained catch peaked during the 1986/87 season at 14.7 million lb , but average harvests dropped sharply from the 1989/90 to 1990/91 season to an average harvest of 6.9 million lb. for the period 1990/91–1995/96. Management based on a formally established GHL began with the 1996/97 season. The 5.9 million lb GHL, based on the previous five-year average catch, was subsequently reduced to 5.7- million lb beginning with the 1998/99 season. The GHL (or TAC, since the 2005/06 season) remained at 5.7 million lb through the 2007/08 season. Average retained catch for the period 1996/97–2007/08 was 5.6 million lb. In March 2008, the Alaska Board of Fisheries increased the TAC for this stock in regulation, to 5.985 million lb. Average retained catch for the period 2008/09–2009/10 was 5.8 million lb. This fishery is rationalized under the Crab Rationalization Program.

Data and assessment methodology

An assessment model is currently being developed for this stock. Available data are from ADF&G fish tickets (retained catch numbers, retained catch weight, and pot lifts by ADF&G statistical area and landing date), size-frequencies from samples of landed crabs, at-sea observations from pot lifts sampled during the fishery (date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc), triennial pot surveys in the Yunaska-Amukta Island area of the Aleutian Islands (approximately 171° W longitude), tag recoveries from crabs released during the triennial pot surveys, and bycatch from the groundfish fisheries. These data are available through the 2009/10 season and the 2006 triennial pot survey. Most of the available data were obtained from the fishery which targets legal-size (≥6-inch CW) males and trends in the data can be affected by changes in both fishery practices and the stock. The triennial survey is too limited in geographic scope and too infrequent to provide a reliable index of abundance for the Aleutian Islands area. A triennial survey was scheduled for 2009, but was cancelled.

Stock biomass and recruitment trends

Although a stock assessment is in development, it has not yet been accepted for use in management. There are consequently no estimates of stock biomass. Estimates of recruitment trends and current levels relative to virgin or historic levels are also not available.

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

The CPT recommends that this stock be managed as a Tier 5 stock in 2011/12. B_{MSY} and MSST are not estimated for this stock. Observer data on bycatch from the directed fishery and groundfish fisheries provides the estimate of total bycatch mortality. Bycatch data from the directed fishery for years after the 1990/91 season (excluding 1993/94 and 1994/95 seasons due to insufficient data) and from the groundfish fisheries since the 1993/94 season were used. For other time periods under consideration there are no directed fishery observer data prior to the 1988/89 season and observer data are lacking or confidential for four seasons in at least one management area in the Aleutian Islands during 1988/89–1994/95.

Thus, the CPT concurred with the author's recommended approach for establishing the OFL. This method is as follows:

OFLTOT = (1+RATE90/91-08/09)•OFLRET(85/86-95/96) + BM_{GF} 93/94-08/09 = 11.40 million lb

where:

RATE90/91-08/09 = mean annual rate = (bycatch mortality in crab fisheries)/(retained catch) over the period 1990/91-2008/09.

OFLRET85/86-95/96 = mean annual retained catch over the period 1985/86-1995/96, and

BM_{GF}93/94-08/09 = mean of annual bycatch mortality in groundfish fisheries over the period 1993/94-2008/09.

The recommended OFL is set following the June 2010 recommendation of the SSC, but uses additional historical data on bycatch that was not available for review in 2010.

The team concurred with the author's recommendation to set the ABC based on the maximum permissible from the ABC control rule which specifies an ABC based on a 10% buffer on the OFL. The recommended ABC is 10.26 million lb.

Historical status and catch specifications (millions lb.) of Aleutian Islands golden king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	5.70	5.51	6.25		
2008/09	NA	NA	5.99	5.68	6.31	9.18[A]	
2009/10	NA	NA	5.99	5.91	6.51	9.18[A]	
2010/11	NA	NA	5.99	5.97	6.56	11.06	
2011/12	NA	NA	5.99			11.40	10.26

A – retained catch

Historical status and catch specifications (kt) of Aleutian Islands golden king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	2.59	2.50	2.83		
2008/09	NA	NA	2.72	2.58	2.86	4.16[A]	
2009/10	NA	NA	2.72	2.68	2.95	4.16[A]	
2010/11	NA	NA	2.72	2.71	2.98	5.02	
2011/12	NA	NA	2.72			5.17	4.66

A – retained catch

No overfished determination is possible for this stock given the lack of biomass information. Total catch in 2010/11 was below the retained catch OFL thus overfishing did not occur.

Additional Plan Team recommendations

In May 2011, the plan team reviewed a developing stock assessment model for Aleutian Islands golden king crab. Use of an assessment model could allow for this stock to be moved out of Tier 5 and would provide focus for establishing research and data collection priorities. The team recommended incorporation of plan team comments into the model for the September 2011 plan team meeting but did not recommend adopting the model for OFL determination in this year. The team subsequently reviewed the modeified stock assessment model at the September 2011 CPT meeting. Specific model recommendations are contained in the September 2011 Crab Plan Team report. This stock was identified for inclusion in the 2012 Crab Modeling workshop to assist the author in further development of this model.

9 Pribilof Island golden king crab

Fishery information relative to OFL setting

The Pribilof District fishery for male golden king crab ≥ 5.5 in carapace width (≥ 124 mm carapace length) developed in the 1981/82 season. The directed fishery mainly occurs in Pribilof Canyon of the continental slope. Peak directed harvest is 856-thousand lb during the 1983/84 season. Historical fishery participation has been sporadic and retained catches variable. The current fishing season is based on a calendar year. Since 2000, the fishery was managed for a guideline harvest level (GHL) of 150-thousandlb. Non-retained bycatch occurs in the directed fishery as well as Bering Sea snow crab, Bering

Sea grooved Tanner crab, and Bering Sea groundfish fisheries. Estimated total fishing mortality in crab fisheries averages 78-thousand lb (2001-2010). Crab mortality in groundfish fisheries (July 1–June 30, 1991/92–2009/10) averages 6-thousand lb. There was no participation in the directed fishery from 2006-2009; one vessel participated in 2010. Pribilof District golden king crab is not included in the Crab Rationalization Program.

Data and assessment methodology

Total golden king crab biomass has been estimated during NMFS upper-continental-slope trawl surveys in 2002, 2004, and 2008. There is no assessment model for this stock. Fish ticket and observer data are available (including retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date), size-frequency data from samples of landed crabs, and pot lifts sampled during the fishery (including date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc), and from the groundfish fisheries. Much of the directed fishery data is confidential due to low number of participants.

Stock biomass and recruitment trends

Estimates of stock biomass (all sizes, both sexes) were provided for Pribilof Canyon. The 2008 Pribilof Canyon area-swept estimate of golden king crab biomass from the triennial slope survey was 2.026 million lb (CV=38%). This estimate is not being used for estimating stock biomass because it does not represent the whole distribution of the stock.

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

The Team recommends this stock be managed under Tier 5 in 2012.

The assessment author presented three alternatives for establishing the OFL. The Team concurs with the author's recommendation for an OFL based on Alternative 1 for 2012 of 0.2 million lb and the maximum permissible ABC of 0.18 million lb. The ABC was derived by applying the Tier 5 control rule a 10% buffer of the OFL, ABC = 0.9 * OFL. The OFL was derived based on the following data:

$$OFL_{TOT,2012} = (1+R_{2001\text{-}2010}) * RET_{1993\text{-}1998} + BM_{NC,1994\text{-}1998} + BM_{GF,92/93\text{-}98/99}$$

- R2001–2010 is the average of the estimated average annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010.
- RET1993-1998 is the average annual retained catch in the directed crab fishery during 1993–1998 (period of unconstrained catch).
- BMNC,1994-1998 is the estimated average annual bycatch mortality in non-directed crab fisheries during 1994–1998.
- BMGF,1992/93–1998/99 is the estimated average annual bycatch mortality in groundfish fisheries during 1992/93–1998/99.

The average of the estimated annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010 is used to estimate bycatch mortality in the directed fishery during 1993–1998 because, whereas there are no data on bycatch for the directed fishery during 1993–1998, there are such data from the directed fishery during 2001–2010 (excluding 2006–2009, when there was no fishery effort).

The estimated average annual bycatch mortality in non-directed fisheries during 1994–1998 is used to estimate the average annual bycatch mortality in non-directed fisheries during 1993–1998 because there is no bycatch data available for the non-directed fisheries during 1993.

The estimated average annual bycatch mortality in groundfish fisheries during 1992/93–1998/99 is used to estimate the average annual bycatch mortality in groundfish fisheries during 1993-1998 because

1992/93–1998/99 is the shortest time period of crab fishery years that encompasses calendar years 1993–1998.

Status and catch specifications (t)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2008	N/A	N/A	68	0	0.0		
2009	N/A	N/A	68	0	0.5	77.1[A]	
2010	N/A	N/A	68	Conf.	Conf.	77.1[A]	
2011	N/A	N/A	68			81.6	
2012	N/A	N/A				90.7	81.6

A= Retained-catch OFL
Conf. = confidential

Status and catch specifications (millions lb)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2008	N/A	N/A	0.15	0	0.000		
2009	N/A	N/A	0.15	0	0.001	0.17[A]	
2010	N/A	N/A	0.15	Conf.	Conf.	0.17[A]	
2011	N/A	N/A	0.15			0.18	
2012	N/A	N/A				0.20	0.18

A= Retained-catch OFL
Conf. = confidential

No overfished determination is possible for this stock given the lack of mature biomass information. Although catch information is confidential under Alaska statute (AS 16.05.815) the assessment author indicated that the retained catch did not exceed the retained catch OFL of 0.17 million lb therefore overfishing did not occur. The 2011 fishery is ongoing until the GHL is achieved or until December 31.

10 Adak red king crab

Fishery information relative to OFL and ABC setting

The domestic fishery has been prosecuted since 1960/61 and was opened every season through the 1995/96 season. Since 1995/96, the fishery was opened only in 1998/99, and from 2000/01-2003/04. Peak harvest occurred during the 1964/65 season with a retained catch of 21.193 million lb. During the early years of the fishery through the late 1970s, most or all of the retained catch was harvested in the area between 172° W longitude and 179° 15' W longitude. As the annual retained catch decreased into the mid-1970s and the early-1980s, a large portion of the retained catch came from the area west of 179° 15' W longitude.

Retained catch during the 10-year period, 1985/86 through 1994/95, averaged 0.943 million lb, but the retained catch during the 1995/96 season was low, only 0.039 million lb. There was an exploratory fishery with a low guideline harvest level (GHL) in 1998/99; three Commissioner's permit fisheries in limited areas during 2000/01 and 2002/03 to allow for ADF&G-Industry surveys, and two commercial fisheries with a GHL of 0.5 million lb. during the 2002/03 and 2003/04 seasons. Most of the catch since the 1990/91 season was harvested in the Petrel Bank area (between 179° W longitude and 179° E longitude) and the last two commercial fishery seasons (2002/03 and 2003/04) were opened only in the

Petrel Bank area. Retained catches in those two seasons were 0.506 million lb (2002/03) and 0.479 million lb (2003/04). The fishery has been closed since the end of the 2003/04 season.

Non-retained catch of red king crabs occurs in both the directed red king crab fishery (when prosecuted), in the Aleutian Islands golden king crab fishery, and in groundfish fisheries. Estimated bycatch mortality during the 1995/96-2009/10 seasons averaged 0.003 million lb in crab fisheries and 0.022 million lb in groundfish fisheries. Estimated annual total fishing mortality (in terms of total crab removal) during 1995/96-2009/10 averaged 0.109 million lb. The average retained catch during that period was 0.084 million lb. This fishery is rationalized under the Crab Rationalization Program only for the area west of 179° W longitude.

Data and assessment methodology

The 1960/61-2007/08 time series of retained catch (number and pounds of crabs), effort (vessels, landings and pot lifts), average weight and average carapace length of landed crabs, and catch-per-unit effort (number of crabs per pot lift) are available. Bycatch from crab fisheries during 1995/96-2009/10 and from groundfish fisheries during 1993/94-2009/10 are available. There is no assessment model in use for this stock. The standardized surveys of the Petrel Bank area conducted by ADF&G in 2006 and 2009 and the ADF&G-Industry Petrel Bank surveys conducted in 2001 have been too limited in geographic scope and too infrequent for reliable estimation of abundance for the entire western Aleutian Islands area.

Stock biomass and recruitment trends

Estimates of stock biomass are not available for this stock. Estimates of recruitment trends and current levels relative to virgin or historic levels are not available. The fishery has been closed since the end of 2003/04 season due to apparent poor recruitment. An ADF&G-Industry survey was conducted as a commissioner's permit fishery in the Adak-Atka-Amlia Islands area in November 2002 and provided no evidence of recruitment sufficient to support a commercial fishery. A pot survey conducted by ADF&G in the Petrol Bank area in 2006 provided no evidence of strong recruitment. A 2009 survey conducted by ADF&G in the Petrol Bank area encountered a smaller, ageing population with the catch of legal male crab occurring in a more limited area and at lower densities than were found in the 2006 survey and provided no expectations for recruitment. A test fishery conducted by a commercial vessel during October-December 2009 in the area west of Petrel Bank yielded only one legal male red king crab.

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

The CPT recommends that this stock be managed under Tier 5 for the 2011/12 season. The CPT concurs with the assessment author's recommendation of an OFL based on the 1995/96–2007/08 average total catch. The CPT recommends a total catch OFL for 2010/11 of 0.12 million lb, following the recommendation of the SSC in June 2010 to freeze the time period for computing the total-catch OFL at 1995/96–2007/08.

The team recommends that the directed fishery remain closed given concerns of stock status. The team struggled to establish an ABC which would account solely for bycatch in other fisheries. Groundfish bycatch in recent years has accounted for the majority of the catch of this stock. The maximum permissible ABC is 0.111 million lb based on the Tier 5 control rule of a 10% buffer on the OFL. However, the CPT recommends an ABC of 0.074 million lb based on the maximum annual groundfish and crab fishery bycatch during the period 1995/96–2009/10.. Based on the limited information available on this stock, the team struggled to adequately quantify the uncertainty in order to develop an ABC below the maximum permissible. The team recognizes that the stock is distributed over a wide area, making an appropriate recommendation for an ABC difficult.

The SSC recommended an ABC of 0.03 in June 2011, their rationale for this choice is reflected in their minutes from that meeting (SSC minutes June 2011).

Status and catch specifications (t) of Adak RKC.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	Closed	0	4.99		
2008/09	NA	NA	Closed	0	6.35	208.7^{A}	
2009/10	NA	NA	Closed	0	5.44	226.8^{A}	
2010/11	NA	NA	Closed	0		54.43^{B}	
2011/12	NA	NA				54.43^{B}	12

A-Retained catch OFL based on 1984/85-2007/08 mean retained catch
B-Total catch OFL of 54.43 t based on the average for 1995/96-2007/08.

Status and catch specifications (millions of lb) of Adak RKC.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	Closed	0	0.011		
2008/09	NA	NA	Closed	0	0.014	0.46^{A}	
2009/10	NA	NA	Closed	0	0.012	0.50^{A}	
2010/11	NA	NA	Closed	0	0.004	0.12^{B}	
2011/12	NA	NA				0.12^{B}	0.03

A-Retained catch OFL based on 1984/85-2007/08 mean retained catch
B-Total catch OFL of 0.12 million lb based on the average for 1995/96-2007/08.

No overfished determination is possible for this stock given the lack of biomass information. Total catch was below the OFL in 2010/11 therefore overfishing did not occur.

Table 3 Crab Plan Team recommendations for September 2011 (stocks 1-6). Note that recommendations for stocks 7-10 represent those final values recommended by the SSC in June 2011. Note diagonal fill indicates parameters are not applicable for that tier level. Values in metric tons (t)

Chapter	Stock	Tier	Status (a,b,c)	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	Years[1] (biomass or catch)	2011/12[2] [3] MMB	2011 MMB / MMB_{MSY}	γ	Mortality (M)	2011/12 OFL	2011/12 ABC
1	EBS snow crab	3	b	1.42	147.48	1979-current [recruitment]	133.8	0.91		0.23(females) 0.319 (imm) 0.299 (mat males)	73.50	<maxABC
2	BB red king crab	3	a	0.32	27.3	1984-2011	29.76	1.05		0.18default Estimated[4]	8.80	7.19
3	EBS Tanner crab	4	b	0.05	83.33	1974-1980	26.06	0.31	1.0	0.23	1.57	1.57
4	Pribilof Islands red king crab	4	b	0.08	5.13	1991/92-2010/11	2.58	0.50	1.0	0.18	0.393	0.307
5	Pribilof Islands blue king crab	4	c	0	8.84	1975/76-1984/85 1990/91/-1997/98	0.37	0.04	1.0	0.18	0.01	.0104
6	St. Matthew Island blue king crab	4	a	0.18	6.87	1989/90-2009/10	7.17	1.04	1.0	0.18	1.7	1.5 [total male catch]
7	Norton Sound red king crab	4	a	0.18	1.13	1983-current [model estimate]	2.13	1.9	1.0	0.18	0.30	0.27
8	AI golden king crab	5				See intro chapter					5.17	4.66
9	Pribilof Island golden king crab	5				See intro chapter					0.09	0.08
10	Adak red king crab	5				1995/96–2007/08					.054	0.014

1 For Tiers 3 and 4 where B_{MSY} or $B_{MSYproxy}$ is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years upon which the catch average for OFL is obtained.

2 MMB as projected for 2/15/2012 at time of mating.

3 Model mature biomass on 7/1/2011

4 Additional mortality males: two periods-1980-1985; 1968-1979 and 1986-2008. Females three periods: 1980-1984; 1976-1979; 1985 to 1993 and 1968-1975; 1994-2008. See assessment for mortality rates associated with these time periods.

Table 4 Maximum permissible ABCs for 2011/12 and Crab Plan Team recommended ABCs for those stocks where the Plan Team recommendation is below the maximum permissible ABC as defined by Amendment 38 to the Crab FMP. Note that the rationale is provided in the individual introduction chapters for recommending an ABC less than the maximum permissible for these stocks. Values are in 1000 t. Note that recommendations for Norton Sound red king crab and Adak red king crab represent those final values recommended by the SSC in June 2011.

Stock	Tier	2011/12 *Max*ABC	2011/12 ABC
EBS snow crab	3a	73.4	<maxABC
Bristol Bay red king crab	3a	8.78	7.19
Pribilof Islands red king crab	4b	0.390	0.307
Pribilof Islands blue king crab	4c	NA	0.0104
Saint Matthew blue king crab	4a	1.63	1.50
Norton Sound red king crab	4a	0.29	0.27
Adak red king crab	5	0.05	0.014

Table 5. Stock status in relation to status determination criteria 2010/11
(Note diagonal fill indicates parameters not applicable for that tier level)

Chapter	Stock	Tier	MSST	B_{MSY} or $B_{MSYproxy}$	2010/11[4] MMB	2010/11 MMB / MMB_{MSY}	2010/11 OFL 1000 t	2010/11 Total catch
1	EBS snow crab	3	73.7	147.5	196.6	1.33	44.4	26.7
2	BB red king crab	3	13.63	27.26	32.64	1.19	10.67	7.71
3	EBS Tanner crab	4	41.67	83.34	26.73	0.32	1.61	0.87
4	Pribilof Islands red king crab	4	2.57	5.14	2.75	0.54	0.35	0.004
5	Pribilof Islands blue king crab	4	4.42	8.84	0.29	0.033	1.81	0.18
6	St. Matthew Island blue king crab	4	1.52	3.04	6.70	2.20	1.04 [total male catch]	0.64 [total male catch]
7	Norton Sound red king crab	4	0.71	1.42	2.47	1.74	0.33	0.22
8	AI golden king crab	5					5.02	2.98
9	Pribilof Island golden king crab	5					0.08	Conf.
10	Adak red king crab	5					0.05	0.02

4 MMB as estimated during this assessment for 2009/10 as of 2/15/2010.

Crab Plan Team report

The North Pacific Fishery Management Council's Crab Plan Team (CPT) met September 19-22, 2011 at the Alaska Fisheries Science Center in Seattle, WA.

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)***
Gretchen Harrington	***(NOAA Fisheries – 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 for all or part of the meeting included: Jack Tagart, Brett Reasor, Lori Swanson, Dave Boisseau, Mike Woodley, Rob Rogers, Steve Hughes, Kevin Kaldestad, Anne Vanderhoeven, Pat Livingston, Guy Fleischer, Ray Nomura, Jie Zheng, Bill Prout, Linda Kozak, Scott Goodman, Hunter Burns, Gary Stauffer, Glenn Merrill, Clayton Jernigan and Tom Casey.

The attached agenda was approved for the meeting.

Administration

The team welcomes new member Dr. Steve Martell of UBC.

Agenda: Changes to the agenda include the following: add a discussion of survey catch in assessments (per total catch accounting under ACL amendments) and add 30 minutes each morning to review minutes from the previous day. Thus, each agenda item listed will start 30 minutes later than originally scheduled. *Meetings:* Timing of upcoming meetings and locations are as follows: January NPFMC crab modeling workshop (AFSC) January 9-13, 2012; May CPT meeting (Anchorage) May 7-11; September CPT meeting (AFSC) September 17-21. Further discussion will occur this week regarding stocks to be discussed at the modeling workshop, as well as workshop format.

SAFE report timing: Diana reminded the team and assessment authors of the compressed meeting timing relative to SSC review on Monday. Existing have already been distributed to the SSC, so no changes to assessment are possible during this meeting. However, errors in assessments may be updated for the final SAFE version to be posted on the Council's website in October.

BBRKC EFH update: The CPT was updated on the current status of a discussion paper on the EFH associated with Bristol Bay red king crab. To address the question about defining EFH associated with larval hatching locations AFSC scientists are seeking funding to conduct research in Bristol Bay. To address the validity of existing closure areas and their relative importance as EFH, NMFS scientists are working with industry representatives in groundfish and crab fisheries to mine existing data on crab and catch distributions. An update on this analysis will be available in 2012.

Survey overview

Bob Foy (AFSC) summarized preliminary results from 2011 NMFS survey. The standard 376 survey stations were sampled beginning June 5 in Bristol Bay and ending on July 25 in the western Bering Sea. Resampling occurred in 20 Bristol Bay stations through July 31 due to effects of cold water temperatures on the red king crab reproductive cycle. Additional data collection occurred for nine special projects including: nearshore sampling in Bristol Bay; Tanner diets; pathology; *Chionoecetes* spp. reproductive potential; hemolymph collections for monitoring of bitter crab syndrome and to study the effects of cold temperatures on hormones; genetic sampling for blue king crab stock structure and Tanner/snow crab hybridization; and finally live red king crab were collected for several ocean acidification experiments in the lab (maternal condition/reproductive success and larval condition/survival).

The cold pool did not extend as far to the southwest this year. Compared to 2010, warmer bottom temperatures were present in the southwest, at the nearshore stations along the Alaska Peninsula, and in the shallow waters around Nunivak Island. The 20 stations resampled in Bristol Bay warmed from 2-3°C in early June to 4-7°C in late July.

Abundance estimates and spatial distributions by sex and size were briefly summarized and new maps were presented which showed the percent frequency that individual stations contributed to the overall abundance estimates for each stock. The new maps were well received and a CPT member suggested that it may also be useful to see these changes over time. An additional request was made to update the centroid plots developed by Billy Ernst and to show variance in the proportion of the total survey catch in each grid cell in addition to the most recent value.

Total catch accounting

The team discussed the necessity of including survey catch into assessments for total catch accounting purposes as needed under the revised MSA. The CPT discussed how to incorporate survey or EFP catch data into the ABC process. All future assessments should include removals of historical survey catches. The team discussed how to accomplish this for the EBS trawl survey as well as ADF&G pot surveys. These removals must also account for handling mortality. Trawl survey catch is currently estimated with 100% mortality and pot survey catch was suggested to have a mortality rate of 10 – 20%. The team discussed that GOA data on that pot survey could help inform values for handling mortality for the BSAI pot survey. Bob Foy and Doug Pengilly will work to assess appropriate handling mortality rates for respective surveys and provide this information as well as survey data to authors for incorporation into the subsequent assessments.

Team members noted that these removals could be significant for some stocks (e.g. PIBKC). There are two primary surveys that need to be accounted for: the EBS trawl survey, and the ADF&G pot surveys. Some of the issues to consider are appropriate length-to-weight relationships, estimating historical time series, and a central access point for compiling these data to facilitate access by assessment authors. The team questioned to what extent additional consideration will be necessary for research permits for additional surveys or the need to tie the State permitting process tied to total catch accounting as well as what component of the catch accrues towards this. The team discussed that catch should be accounting for however the OFL is currently defined in for consistency by stock.

The team noted that it will be necessary to continue to have discussions of how best to ensure that all survey catches are included in the assessment and total catch accounting towards the OFL. It will also be important to ensure that catch is in same year as the year assumed when including the survey in the model, for example, 2010/11 survey would be included in the 2011/12 catch model year. Guidance will be sent out this winter in terms of the process for accounting for these catches in the next assessment cycle.

Stock Assessment Review

EBS Tanner crab: Assessment and OFL / ABC recommendations

Dr. Lou Rugolo presented the 2011 assessment for EBS Tanner crab. Although a model for this stock is in development, it has not yet been approved for use in providing management advice. The methodology on which the 2011 assessment is based is therefore essentially the same as that used for the 2010 assessment. However, the B_{MSY} proxy (B_{REF}) is based on the years 1974-80 rather than 1969-80, reflecting a recommendation from the February 2011 stock assessment workshop. The estimate of mature male biomass for 1974-75 is based on recalculated estimates of abundance rather than values from INPFC reports as was the case last year. Stock status is based on the calculated MMB on 15 February 2011 given the availability of catches and discards for 2010/11. The assessment also provided a projection of MMB to 15 February 2012 under a catch equal to the OFL. The author provided estimates of the breakdown of the OFL into catches of mature males, females, as well as the retained catch in the directed fishery for various levels of catch in (and hence bycatch by) the opilio fishery.

The analyst provided OFLs based on three B_{MSY} proxies: (a) 1974-80, (b) 1974-80 where the mature male biomasses are adjusted for catches under the F_{MSY} proxy rather than the actual catches, and (c) 1974-2010. The team agreed to base the 2010/11 OFL on a B_{MSY} proxy defined in terms of the years 1974-80 without the adjustment ("no bias correction" in the assessment report). In relation to the selection of a range of years to set B_{MSY}, the team recommends use of the *status-quo* (1974-80) because there was insufficient information provided in the assessment report to change the range of years recommended at the February 2011 stock assessment workshop. The team **recommends** that the analyst provide all of the information which the team identified in May 2011 related to the selection of years to define B_{MSY}, and rank each B_{MSY} alternative against each source of information. The team identified trends in recruitment as a key source of information which could inform the selection of a range of years to define B_{REF}. Recruitment estimates are not available for Tier 4 stocks, but an index of recruitment could be based on survey catch-rates for pre-recruit size-classes.

The OFL in the summary table (pg. 3 of the assessment report) does not include catches of females. An additional loss of 110t (243 thousand lbs) of females projected under assumptions for female bycatch and discard leads to a total-catch OFL of 1.57 thousand t (3.46 million lbs). The team based its recommendation for an OFL on the highest possible catch in the opilio fishery (42.77 thousand t), although the OFL was virtually unchanged if a lower catch in this fishery is assumed. The retained catch in the directed fishery depends critically on the size of the opilio fishery. The analyst reported that a bycatch in an opilio fishery with a catch of 42.77 thousand t would lead to the entire OFL being taken as bycatch given projected catches in the red king crab and groundfish fisheries. The OFL calculations are based on a predicted catch in the groundfish fisheries (both sexes) of 360t. This value reflects a declining trend in bycatch in the groundfish fisheries. Public comment to the team indicated that the reduced level of bycatch was appropriate for projection purposes owing to changes caused by rationalization of the groundfish fishery as well as shifts in Pacific cod fishery.

1. Future assessment reports should fully describe the process used to infer bycatch of females and the level of catch in the opilio fishery which corresponds to a zero catch by the directed fishery.

2. Future assessments should consider a survey time series which excludes "hot spot" re-samples throughout the time-series for consistency with how the 2011 survey was conducted.
3. Rather than sampling with replacement from the years used to calculate the B_{MSY} proxy, the uncertainty associated with this proxy should be quantified by sampling from the distributions from the survey estimates for each of the years on which the B_{MSY} proxy is based.

EBS Tanner crab: Stock assessment model

Drs Lou Rugolo and Jack Turnock presented the latest version of the TCSAM to the team. Model development started in 2010 and preliminary versions of the model were reviewed by the team and SSC three times during 2011. The authors reviewed and revised the data used in the model, extended the model to implement the suggestions by the team, the SSC and other reviewers, and provided results for several model variants. The team welcomed the new model and results, and noted that the fits to the data were markedly improved compared to those from earlier versions of the model. However, some of the implications of the assessment, specifically the very high fishing mortality rates in some years (>$2yr^{-1}$) and the marked changes in selectivity over time and among the sexes seemed unrealistic. The team **recommended** that revisions to the model should be further reviewed at the January methodology meeting. It made several **recommendations** for further model development:

1. exclude the 1995 retained length-composition data;
2. do not downweight the 1991 female discard length-composition data;
3. quantify the change in mean recruitment between the two "regimes"[1950-1973; 1974-current];
4. consider a scenario in which the β parameter of the growth model is estimated, subject to a prior based on the data for the GOA;
5. document how fishing mortalities are set for bycatch in the opilio and red king crab fisheries before discard catch biomass data are available - ideally move to an approach for specifying these bycatch levels based on the fishing mortality rate estimates for these stocks from their respective assessments;
6. include a table of correlations among the parameters;
7. consider a variant of model 2 in which survey catchability changes as a time-series, but female catchability is a multiple of that for males (37 instead of 72 parameters);
8. examine the sensitivity of the results to uncertainty in the foreign catches (and discards in the foreign fisheries);
9. fully document the priors for M;
10. include a likelihood profile for male survey Q in the last period in the assessment, show results for analyses with different values for male survey Q in the last period, and apply the model with the prior on male survey Q in the last period;
11. Include any new information on handling mortality rates from on-going studies by NMFS in groundfish and directed snow crab fisheries;
12. conduct runs in which a) recruitment before 1973 is constant, and b) in which it is selected so that the 1974-80 mean biomass is 30-35% of the unfished biomass – these runs will help the team select a series of years for defining the average recruitment used when computing $B_{35\%}$; and
13. conduct retrospective analyses for the various model configurations.

EBS Tanner crab: Rebuilding analyses

While the stock assessment is not yet capable of providing the basis for projections and hence a rebuilding analysis, the basic structure of the model is appropriate for this purpose. The team noted that catches in the directed fishery are computed east and west of 166^0W given the minimum sizes in these two areas. The current approach is based on different selection patterns east and west of 166^0W and the assumption that future fishing mortality will occur in proportion to the amount of survey biomass east and west of 166^{0}W. The approach should be modified so that the catches rather than fishing mortality rates match the assumed split.

In relation to the alternatives for rebuilding, the team noted that current results suggest that the stock should be able to recover to the proxy for B_{MSY} within 10 years with current rates of bycatch in the groundfish and red king crab fisheries (but this needs to be confirmed by the final version of the model). The team **recommends** that further management measures to constrain bycatch in the groundfish fisheries and in the Bristol bay red king crab fishery are not necessary in conjunction with the rebuilding alternatives. The impact of these fisheries bycatch on rebuilding time frames is marginal in comparison to bycatch from the snow crab and directed Tanner crab fisheries. The team **recommends** that the alternatives should be crafted around different years, T_{target}, for recovery to the B_{MSY} proxy and, given a T_{target}, the split of the removals between the opilio and directed Tanner crab fisheries. One of the alternatives should consider the maximum possible catch in the opilio fishery by assuming that future opilio catches are the lower of the maximum permissible ABC and the output of the ADF&G control rules.

The team **recommends** that an analysis of spatial bycatch rates of Tanner crab in the opilio fishery be undertaken with the possibility of alternatives which include spatial closures to reduce Tanner crab bycatch rates in the opilio fishery.

A key component of any rebuilding analysis will be the B_{MSY} proxy. Model output, e.g. the time series of recruitment estimates and estimates of recruits per spawner from the model should provide information needed to set this proxy.

Bering Sea snow crab

Jack Turnock presented results of the eastern Bering Sea snow crab assessment. This model is currently used for setting OFL using the Tier 3 OFL control rule. The assessment includes responses to recommendations from the May 2011 CPT meeting and the June 2011 SSC meeting. Thirteen alternative assessment scenarios relative to a base (Model 0, the Sept 2010 Model) scenario were presented. Alternative scenarios explored various treatments of BSFRF survey data, natural mortality for immature male and female crabs, and natural mortality for mature male crabs. Models 8-10 included new, but not fully reviewed, information on male crab growth.

Changes to data included: (1) side by side tows from the 2010 experimental study; (2) 2011 survey biomass and length frequency; and (3) 2010/11 fisheries catch, bycatch and discard and the associate length frequency data.

Information on snow crab growth was reviewed. The CPT commented on the growth increment data from the Kodiak holding studies of crabs captured in the Bering Sea; although these are assumed to be male only data, the study indicates that both male and sexually immature crab were included.

Assessment results primarily focused on Model 7, where M was fixed at 0.23 yr^{-1} in the model. Model selection was based on the fact that the author does not believe that M can be estimated within the model and that, in cases where M was estimated, the results are not credible based on the data available for longevity. There was some disagreement among CPT members as to how the estimate of natural mortality was derived. The CPT **recommends** that additional investigations are necessary to develop a better prior for natural mortality and the assessment should better specify the derivation of the estimated longevity. For example, simulation studies should be examined to determine if M could be jointly estimated, reliably. Team members commented that it could also be possible that M is higher than $0.23yr^{-1}$. Based on the model results, there is some confounding between catchability *Q* and *M*, therefore, a prior on *M* implies a prior on *Q* (Table 8; Figure 119 of the assessment report)

The model uses the average recruitment over the entire time series to estimate B_{35}. Model 7 ranks 7th in terms of AIC among the seven model configurations that estimate growth, but the effective number of parameters and the appropriate metric for model selection are unclear. The CPT **recommends** that a retrospective analysis be employed for help with model selection.

Fits to the NMFS trawl survey data are best for model 6, and worst for model 7. Models 8-10, are new, and the CPT has not had an opportunity to examine the new growth information that was used to fix the growth parameters within the assessment model. All of the assessments are robust with respect to estimates of trends in MMB relative to $B_{35\%}$; i.e., the stock is robustly estimated to be above $B_{35\%}$. This indicates that the stock is rebuilt.

The team endorsed the use of model 6 for stock status determination and OFL specification. This model: 1) estimated M; 2) smoothed the BSFRF data; and 3) better fit the NMFS trawl survey data.

Recommendations for next assessment:

1) add parameter bounds to Table 13;
2) add a table of parameter correlations;
3) include a plot overlaying the MMB trajectories for each of the scenarios for easier comparison (similar to Figure 87 but with all the runs);
4) the model description for the likelihood functions for the experimental data is incomplete and needs to be elaborated;
5) fix caption (legend) for Figure 24;
6) develop a more formal and reasonable model selection criterion based on statistical descriptions of the model fit to the data rather than having a zero prior for all models that don't have an M = $0.23yr^{-1}$;
7) provide retrospective estimates of Q and $B_{35\%}$; and
8) conduct further work on estimating M and the associated confounding of M, and growth with Q.

ABC deliberations:

The Team **recommends** an ABC less than the maximum permissible. This is due to multiple sources of uncertainty in the OFL that are not reflected in the model-based estimate of within-model uncertainty, σ_w, employed in the maxABC control rule. These uncertainties include: estimating M, the implications of the yet-to-be-reviewed new growth data, and structural uncertainty. These sources have not been fully considered in the calculation of maxABC. The team also expressed concern that the uncertainty in recruitment, as well as the declining trend in recruitment (indicating that biomass is likely to drop below B_{MSY} in the short-term), provides additional rationale for an ABC < maxABC.

The Team had difficulty in determining the buffer between the OFL and the ABC that appropriately addresses uncertainty. The Team considered many options for an ABC <maxABC permissible including the following options:

1) a default 10% buffer from the OFL;
2) use of the OFL from model 7 as an ABC;

3) using the recommended total uncertainty (i.e., σ_w and σ_b from the EA for amendment 38) to estimate a buffer using a P* of 0.49; and
4) using the ratios of OFL from model scenarios (e.g., use ratios between different model scenarios) to define a range of values to be used as a multiplier (buffer) for the ABC.

Despite extensive discussion of these items, the CPT was unable to recommend a specific ABC but wishes to identify the following information on uncertainty that should be captured in an ABC: a) using *M* fixed at prior value would have led to a lower OFL value; and b) use of the new growth data (which has not yet been reviewed in much detail) would have resulted in a lower value. However, the Team recognized that given the uncertainty noted, risk tolerance is required to choose an appropriate buffer based on the model results presented.

St. Matthew blue king crab

Bill Gaeuman presented the St. Matthew blue king crab stock assessment. He explained the methods used in the survey-based assessment. The estimate of biomass is high relative to historic abundance and may be at peak abundance. The team noted that the new assessment now includes all sources of fishery mortality. The assessment indicates that groundfish bycatch mortality is largely inconsequential (Figure 9). The author noted that approximately 48% of trawl survey catch occurred in one station, and that the ADF&G survey, fishery, and groundfish bycatch all occur in spatially different areas.

The author clarified that the OFL in the assessment was calculated for mature males only. The team discussed calculating the OFL in this manner and how to reconcile this with evaluating whether overfishing occurred. The team requested that the author recalculate the OFL to apply to total males. The OFL is not a total catch OFL because the OFL estimate does not include females.

The team discussed the years used to calculate $B_{\mathrm{MSY_{proxy}}}$ and the author recommended the period from 1989/90 to 2009/10. The team **recommends** that the assessment provide further justification for this choice of this period at the May 2012 meeting.

The author recommended an ABC below maxABC, but did not provide a recommended ABC amount. Unaccounted for scientific uncertainty for this stock relates to the estimate of natural mortality, and that the survey does not cover the stock distribution (catchability) or the location of fishery. The trawl survey is a poor indication of abundance andmay underestimate abundance. However, how the abundance index in the survey relates to the crab caught in the fishery or the total population is uncertain. The team discussed how to use this uncertainty to calculate an ABC because there is no expectation for information or analyses to resolve these uncertainties in the near future. As a result, the team **recommends** a 10% buffer for the ABC.

St. Matthew model discussion: Bill Gaeuman presented the recent developments in the stock assessment model for St. Matthew blue king crab and requested the team's input on the next steps. The team noted that the model description is very clear and well written which makes review easier. The team discussed the equations and requested clarification on a few of the parameters. The author noted that, after the work in reconstructing the model, the new model results and formulation are similar to the original model which provides confidence in the historical use of the model for specifications purposes

The author explained the changes in the model from the version the team reviewed in May 2011, including removing shell condition and decreasing the weight of the pot survey data relative to trawl survey data. The team discussed the weighing of the different data sources; pot survey, trawl survey, and observer data (Table 5). The author notes that one (or both) of the trawl and pot surveys may not be representative of the population.

The team made **recommendations** to adopt a standardized weighting procedure based on CVs for indices and catch biomass, to provide several model configurations [along with an author-preferred model] for evaluation by the team, and to provide diagnostics to evaluate the choices. The issues of effective sample size and survey representation should be evaluated. The team noted that the report from the team's modeling workshop in 2009 (and annual SAFE guidelines) provide additional guidance for addressing these issues.

The team discussed whether or not this model should be reviewed at the January modeling workshop or at the May 2012 CPT meeting. The team intends to review the model in May for possible use in stock status determination in the 2012/13 assessment cycle.

Bristol Bay red king crab

Jie Zheng presented the stock assessment for Bristol Bay red king crab. Major changes to the assessment from September 2010, aside from the updating with data from the 2010/11 fishery year and the summer 2011 trawl survey, involve the use of assessment model Scenario 7ac, which is the Scenario 1 model from September 2010 with incorporated recommendations from the CPT in September 2010 and May 2011. Model Scenario 7ac assumes 3 levels of molting probabilities, incorporates the BSFRF biomass data, estimates effective sample sizes, estimates proportions in initial years, and (with respect to the "Bristol Bay retow data") uses only the standard survey data for males and only retow data for females for stations where retows took place. Only results for Scenario 7ac were presented.

This model also assumes that natural mortality is $M=0.18yr^{-1}$ for both sexes, regardless of size and shell condition, over the 1968–2011 period that is modeled, except that it also estimates additional naturalmortality for 1980–1984 for males, 1980−1984 for females, and 1976−1979 plus 1985−1993 for females. Additional natural mortality for males during the 1976−1979 plus 1985−1993 period was not estimated because previous model runs suggested that male natural mortality was not higher during this period. As in previous assessment reviews, the CPT asked if those periods of increased natural mortality could be related to some physical or biological mechanism or were only chosen to improve the fit because there is concern that estimable parameters are added to the model to fit the available data, without supporting evidence from outside the model. The CPT felt that the authors' response to the May 2011 comment raising this question was speculative; the authors suggested that increased mortality during those periods could be due to unknown fishing mortality or to increased predation, but offered no supporting evidence. The CPT **recommends** that the authors summarize available data on predation/mortality for the May 2012 meeting so that the CPT can assess the justification for invoking increased predation during the periods concerned.

Questions and comments concerning the use of the retow data and the standard survey data in the retow area were made by the CPT and the audience. The possibility of using the retow data as a separate survey series was raised. Zheng said that, given that the retows are performed only in unusual years (mainly unusually cold years), they are not a survey in same was as the standard survey, and hence do not represent a time-series. There were also questions on changes in densities between standard survey and retows in the resurvey area. Densities of females were markedly higher in the retow stations. There had been speculations that the increase in female densities was due to a large-scale redistribution of females from nearshore areas outside of the surveyed area into the resurveyed area. A nearshore survey performed early during the 2011 survey provided no evidence that females were aggregated in the nearshore area until after the standard survey (a report on the nearshore survey will be given later in the meeting). Rugolo suggested that the difference in female densities between standard and resurvey tows was due to a small-scale patchy, distribution of females with the survey area and noted that females in pre-molt and pre-mating become highly aggregated (mounding), which would result in a low probability of encounter of females by the widely-spaced tows during the standard survey; after molting/mating, the females spread out and encounter probabilities for the survey become higher. Following discussion of the mechanism for effecting the observed increase in female densities in the retow survey, the CPT **recommends** that in May 2012 the assessment authors and CPT settle on the proper use of the standard and retow survey data for males (i.e., use only standard tows, an average of the standard tows and retows, or only retows) and provide a justification for the choice.

Zheng reviewed the trend in the 2011 survey data. The area-swept estimates for mature females and, especially, for mature males declined from 2010, as would be expected given the poor recruitment inferred from recent surveys; the decline for mature males is larger than for mature females and is more than expected. A large catch of juvenile males and females in eastern Bristol Bay is a hopeful sign. However, that large catch is due to only one tow, so has high uncertainty.

Zheng reviewed the results of the current estimates from the model Scenario 7ac. Differences between the 2010 assessment and current scenario 7ac were noted: Lower total biomass, mature male biomass, and mature female biomass peaks for scenario 7ac than in the 2010 assessment in the peak years of late 1970s/early 80s.

The model fit to the survey size frequency distributions was reviewed. The "bubble plots" for the size frequency distribution residuals looks adequate for males, but there is a problem for the fit of the female size distribution at larger sizes in early survey years. There was a question about the 1984 survey size distributions for males and females; there is a marked discrepancy between the model fit and the peak in the lower end of observed size distribution. Zheng explained that the peak in the observed size frequency distribution was due to a single hotspot tow. The model also fits the retained catch and directed fishery bycatch size frequencies well for males. The model doesn't fit the bycatch size frequencies for females well, however; a result attributed by Zheng to the hit or miss nature of the female bycatch.

Zheng noted a slight negative trend through time in the standardized residuals of total biomass.

Zheng presented a retrospective analysis of the Scenario 7ac estimates of MMB and noted the clear and evident downward bias (sequentially adding each terminal year results in a lower biomass estimate for recent years). The CPT emphasized the importance of this trend, particularly when judging the uncertainty in the estimate of recent years' MMB; i.e., from this trend, it would be reasonable to expect that next year, should the declining survey trend continue, the model will estimate the 2011 MMB to be lower than it is presently estimated.

Zheng provided a review of information relevant to choosing the reference period for recruitment used to estimate $B_{35\%}$. Much of what was presented by Zheng was not in the assessment report that was available for review. Zheng stated that if we believe that the 1976/77 regime shift had a strong effect on the stock's productivity, estimates of recruitment and productivity from after 1983 (from within the period the 1984–2011) should be used; if not, the 1969–1983 period should be used as, or be included in, the reference period. The choice is important: the stock would be considered overfished and at a level necessitating closure of the fishery if 1969–1983 is used as the reference period, whereas the stock would be estimated to be above the proxy for B_{MSY} if 1984–2011 or 1995–2011 is used. Zheng showed that the estimates for annual recruitment during 1969–1983 were much higher than the mean recruitment during 1984–2011 (a t-test is significant). Likewise, the mean of annual productivity (R/MMB, appropriately lagged) was much higher for 1969–1983 than for 1984–2011 (statistically significant). Finally, Zheng showed that the stock-recruit relationship shows a difference between the pre-1984 and post-1983 recruitments. Zheng then proceeded with a presentation (also not in the assessment report) that showed that the differences in pre-1984 and post-1983 recruitment/productivity align well with effects that can be attributed to the 1976/77 regime shift: differences align well with the time series of bottom temperatures and PDO. The differences in recruitment also align with a distribution change in mature females from between the 1970s to the 1980s-through-present, which would have an effect on recruitment (the earlier distribution of mature females would favor larval drift to the "RKC nursery area" whereas the larvae may be carried away from the nursery area with the present distribution of mature females and warmer years. Finally, the differences align well with the time series of biomass of predators (cod and yellowfin sole) and with the possible effects of the regime shift on the prey availability to red king crab larvae. In summary, the effects of the 1976/77 regime shift – spring bloom composition and timing, shift in geographic distribution of mature females, predation on juveniles – support the use of a post-1983 recruitment when computing $B_{35\%}$.

The CPT commended the authors on the presentation pertaining to choice of reference period; it is exactly the sort of information that the CPT had requested as background for choosing reference periods. However, the CPT noted that this information – which is key for choosing the reference period – was not in the assessment report that was reviewed by the CPT and distributed to the SSC for their review. This information should be seen by the SSC; accordingly, the CPT decided that the key written information from Zheng's presentation pertaining to the regime shift and recruitment period will be provided as supplemental information to the SSC for their review next week. The CPT also questioned why, given what was presented, the assessment used 1995–2011 as the reference period rather than 1984–2011. Although average recruitment during 1995–2011 is extremely close to that during 1984–2011, the later period is more justified on the basis of what Zheng presented. Moreover, being as the stock is estimated to be close to $B_{35\%}$ small changes in the reference period become important for stock status determination, so the best, most-justifiable period should be used. The CPT **recommends** that 1984–2011 be used as the reference period in the 2011 assessment, rather than 1995–2011, necessitating some changes to the stock status tables. Additionally, the CPT **recommends** that a more detailed analysis of the choice of the reference period that includes the effects presented relative to assumed time lag until recruitment be prepared for the May 2012 CPT meeting for review given the stock is estimated to be close to B_{MSY}.
Zheng ended with some projections showing that we should expect declines in catch through 2015. Beyond that, an increase after 2015 may occur, contingent on whether the high catch of juveniles in the 2011 survey reappears in future surveys.

The CPT noted that the estimates of recruitment may be confounded with the assumed periods of higher natural mortality in model Scenario 7ac, which may, in turn, have an effect on the estimated trend in productivity that is used for determination of the reference period and estimation of B_{MSY}. The CPT cannot predict at this time what, if any, the variable-M assumption has on the estimates and estimated trend in recruitment and productivity. The CPT **recommends** that an analysis be prepared for May 2012 that includes a constant-M model (i.e., no periods of increased natural mortality) so that the effect of the Scenario 7ac mortality estimates on the estimates of and trends in recruitment and R/MMB can be assessed; overall, it is **recommended** that a constant-M always be included as one of the scenarios in assessments for this stock so that the effects of, and need for, the variable-M models on the stock assessment can be assessed.

Finally, the CPT noted that the total catch column in Table 1 doesn't add up with the columns to the left; the CPT **"recommends"** that this be corrected.

ABC determination

Zheng presented the estimated probability distribution for the OFL estimate and the maximum ABC computed according to the "P* =0.49" ABC control rule. The maximum ABC (19.35 million pounds, or 8.78 thousand t) is essentially equal to the OFL (19.39 million pounds, or 8.80 thousand t). The CPT was uncomfortable with recommending the maximum ABC because it believes that the estimate of within-model variance is unrealistically low and does not capture the full extent of the uncertainty in estimate of OFL. Specifically, the assessment is based on pre-specified values for survey Q and, for several years, natural mortality. Further estimates of recruitment may be confounded with the assumed periods of higher natural mortality in model Scenario 7ac, which may, in turn, have an effect on the estimated trend in productivity that is used for determination of the reference period and estimation of B_{MSY}.

The downward bias revealed by the model 7ac retrospective analysis suggests uncertainty in the present estimate of MMB. If the unexpectedly sharp downward trend in the survey results for MMB in 2011 is real (and not due to survey error in 2011) and the retrospective pattern in MMB estimates persists, it is reasonable to expect that next year's estimate of the 2011 MMB will be lower than the current estimate. To address this uncertainty, the CPT **recommends** that the ABC for 2011 be set by using the average percent bias (2011 assessment estimate versus terminal year assessment) in the MMB estimate over the last five years. The average percent bias estimated by linear regression (estimated slope for regression of terminal year estimate on 2011 assessment estimate = 0.817) resulted in an 18.3% buffer on the OFL. Hence, the CPT's recommended ABC is,

ABC = 0.817xOFL = 0.817*19.39-million pound = 15.84-million pounds, or 7.19-thousand t.

PIRKC assessment

Bob Foy presented the 2011 PIRKC SAFE. The team discussed the recommended change in years used in the calculation of the $B_{MSY\ Proxy}$ from the status quo (1991-2011) to a revised period, 2000-2011. The team reviewed results of various analyses conducted by the author following the recommendations of the CPT (May 2011) in establishing criteria to be used in estimating a $B_{MSY\ Proxy}$. No evidence was no found in the analysis to support a regime shift as the basis of truncating the MMB history to 2000-2011 to estimate $B_{MSY\ Proxy}$, nor to demonstrate a change in the reproductive potential of the stock between the 1991-2011 and 2000-2011 periods. The brief exploitation history of this stock makes it difficult to identify a period in the MMB history that could meet the criteria of the CPT in estimating the $B_{MSY\ Proxy}$. The team recommended maintaining the status quo time period of 1991-2011 in the calculation of $B_{MSY\ Proxy}$.

The team discussed the use of the 3-yr running average in calculating the $B_{MSY\ Proxy}$. It was suggested that the 3-yr average be used in estimating MMB at mating in any year t, but that the actual observed MMBs in each year over the reference period should be used to calculate the $B_{MSY\ Proxy}$. This 2011/12 assessment will use the 3-yr average in estimating the MMB at mating in 2011/12 as well as the 1991-2011 average of the 3-yr running average MMBs in the calculation of the $B_{MSY\ Proxy}$. This issue will be considered in more detail by the team in May 2012.

The team discussed that the simple 3-yr average used in this assessment is problematic since it does not consider the precision in the annual MMB estimates. As calculated, the 3-yr average equally weights each of the three MMB estimates regardless of its level of its level of precision. For example, if one estimate of MMB used in the average is highly imprecise, then three consecutive indices of MMB based on the 3-yr average will be contaminated until this highly imprecise estimate drops out of the calculation. In the case of a declining stock, the 3-yr running average would be biased high and underestimate the magnitude and rate of decline.

The running 3-yr average MMBs calculated in this assessment was based on the current year and the previous two years. The team recommended that the 3-yr average should be calculated based on the current year, the previous year and the following year, not the current year plus the preceding two years. These calculations will be corrected for the next assessment. The team also discussed alternative methods for deriving a 3-yr average index of MMB – e.g., an average weighted by the inverse of the coefficients of variation of each annual MMB, a lowess smoothed index, and a weighted index in which the weights reflected the relative importance of the years in the average. This issue will be considered in more detail by the team in May 2012.

The team agreed with the author's ABC calculation, and the rationale provided in the assessment for recommending an OFL multiplier of 0.78(based upon the Status quo $B_{MSYproxy}$ years). The general issue of uncertainty in this assessment was discussed. It is unlikely that we'll have better estimates of parameters in this assessment given the data quality. The team concurred with the author on the recommendation for an ABC less than the maximum permissible.

PIBKC assessment

The author presented information relative to criteria for determining the time period for estimating the B_{MSY} proxy discussed at the May 2011 CPT meeting. Exploitation history, surplus production and ln(recruits/MMB) were examined. The author recommended the period 1975/76 – 1979/80 for estimation of the B_{MSY} proxy (recalculated during the meeting as 20,138 t). The B_{MSY} proxy in the September 2010 assessment (4,210 t) was estimated using the time period 1980/81 -1984/85 plus 1990/1991-1997/1998, i.e. excluding the period 1985/1986-1989/1990.

Based on the information presented by the author there was no evidence of a change in reproductive potential of stock. The highest exploitation rates and declines in the stock occurred in the 1980/81-1984/85 period, which was included in period used to specify the B_{MSY} proxy at the September 2010. Since there are no catch or biomass data before 1975, the higher biomass estimates in 1975-1979 are difficult to interpret relative to what true B_{MSY} might be. After much discussion the CPT recommended adding the 1975-1979 biomass data to the time series for estimation of the B_{MSY} proxy. The recommended B_{MSY} was estimated at 4,493 t using the time period 1975/76-1984/85, plus 1990/91-1997/98.

Groundfish bycatch occurs mostly in the Pacific cod fishery, followed by the yellowfin and flathead sole fisheries. Most bycatch results from pot fisheries. Currently bycatch from area 513 is included. In future, groundfish bycatch will be available by ADFG statistical areas.

Current MMB is estimated using the 3 year average survey MMB (2009, 2010 and 2011). The CPT recommends examining different methods of estimating the average MMB using a weighted average of the last three years or a smoother that accounts for variances of the individual years. The team notes that the author calculated the average MMB using a running mean rather than a mean which is centered on the year for which an estimate is needed. This should be rectified for the May 2012 assessment but the results and conclusions of the current assessment are robust to changing how the average is computed.
The groundfish bycatch time series has been re-estimated to account for 'unidentified crab" during the time period 1999-2005. This issue was highlighted to the Team in 2009 and bycatch estimates re-estimated at that time. However the assessment author did not provide historical re-estimated catch estimates in the previous assessment. The result of these re-estimated catches result in lower bycatch estimates in these years than previously reported. As a result the average catch calculation over the same time frame for the OFL calculation in previous years results in a lower average. The team noted that groundfish bycatch (0.18 t in 2010/11) has been low compared to the recommended OFL (1.16 t).

The team concurred with the author's recommendation to set the ABC below the maximum permissible Tier 4 maxABC by using a 10% buffer from the OFL consistent with the Tier 5 calculation for this OFL for this stock based on its stock status.

Aleutian Island Golden King Crab Model Based Assessment

Siddeek updated the CPT on model development to move this stock out of Tier 5 average catch management. The model has been re-formulated and cleaned-up observer data were included. The author reviewed responses to CPT and SSC comments. One aspect of note was the author's implementation of asymptotic selectivity. The CPT **recommends** that dome-shaped selectivity should also be examined for the January 2012 model draft.

When asked about inconsistencies in the time series of observed retained data, Pengilly clarified that observed retained represents dockside samples whereas observed discarded represent at sea observations (a shorter time series). In addition, at-sea observers don't always sample slightly undersized crab that may be subsequently delivered. An observer effect may also be indicated in bubble plots of residuals (e.g., Fig 14). The observer and retained data should be treated similar to the EBS Tanner assessment, namely, the model is fit to the catch length-compositions for the retained catch (from dockside sampling) and to the length-compositions for the total catch (from observers) as this eliminates effects of observers assigned animals as discarded when they are actually landed. Fishery retained and bycatch CPUE were standardized by separating CPUE into two time periods and ignoring soak times longer than the 95th percentile (≥456-hr before for 1985–2004 and ≥936 hr for 2005–2010). The public expressed concern about long soak times skewing the assessment owing to reduced catch from bio-twine degradation. Given the need for the bait to be effective, it was further noted that survey data was limited to soak times of 30–140 hrs. The authors could examine model sensitivity to further restrictions on long soak times.

The author discussed optimization scenarios and weighting factors for the EAG (Table 2) and WAG (Table 9). The CPT **recommends** the listing of sigmas instead of absolute weights as being more informative for factors such as L_{50} and β. Also, the team **recommends** specifying weights for the penalties on L_{50} and β from the standard errors from the analysis on which the estimates for these parameters were based. Three scenarios were examined, differing by weighting applied to pot survey CPUE, mean CPUE ratio, molt L_{50}, and β components of the negative log likelihood functions. The CPT discussed some of the model likelihood components. In particular, there may be an excessive number of penalty functions for aspects that might not be justified. An example is the mean CPUE penalty ratio (Eq. 37) for the pot fishery; because pot fishery CPUE is already incorporated into the model (Eq. 12), the CPUE penalty ratio represents additional inclusion of the same data. There was also substantial discussion about the QQ parameters. Many lambdas are listed in formulas, but their values are not presented in tables. The authors should be fitting the model to the data and not using lambdas to simply improve model fit. For example, Eq. 18 estimates catch, but another likelihood function treats catch data as being without error. The CPT was concerned by the very high weight (effectively a CV of 0.05 assigned to the estimates of legal male biomass). If such estimates (or preferably the associated exploitation rates) are to be included in the assessment, they should be weighted by their estimation variance. Also, care should be taken to ensure that the estimates pertain to the whole stock and not just a subset of the population. In examining parameter estimates, the CPT noted many estimates appear to be constrained, or nearly so, by bounds, particularly for the EAG (Table 4 and negative Hessian gradients in Table 7); the author noted that many bounds had been expanded. The CPT **suggested** expanding bounds or reducing weighting factors.

The CPT also noted:

1. large confidence intervals in early time series discarded CPUE data (Fig. 4b, perhaps due to small number of potlifts);
2. poor fit to fishery CPUE trend in post-rationalized years (Figs. 4a and 26);
3. poor fit to pot survey CPUE (Fig. 4c);
4. extremely good fit to retained catch length frequencies (Fig. 5);and
5. poor fit to groundfish discards for small crab sizes (Fig. 7).

There was insufficient time to provide a full discussion of the WAG. The CPT **requested** the model be updated and brought to the January 2012 workshop, with a preliminary distribution to André and Steve.

Crab B_{MSY}

André Punt presented his current NPRB project: "Evaluating methods for determining overfishing levels for Bering Sea and Aleutian Islands crab (BSAI) stocks". The project will run from September 2011 to February 2013, with the following three objectives: (a) develop and evaluate proxies for estimating the productivity of crab stocks (i.e. F_{MSY}), (b) assess how well simple assessment methods can estimate time-series of mature male biomass and hence proxies for F_{MSY}, and (c) develop and evaluate methods for estimating the reference biomass B_{ref}

For objective a, André evaluated two methods for estimating B_{MSY} and F_{MSY} based on estimated surplus production using simulated data. He then applied one of the candidate methods to actual data from Bristol Bay red king crab, EBS snow crab, and EBS Tanner crabs. He will be applying the surplus production model to all surveyed crab stocks with abundance data (in addition to the above three stocks, Pribilof red and blue king, St. Mathew blue king, and Norton Sound red king crab).

Regarding objective b, André Punt is fitting a simple five-size-class model to male-only data and estimating all management parameters as well as producing a number of diagnostic statistics. The candidate stocks are: Bristol Bay red king, EBS snow, EBS Tanner, Pribilof red king, Pribilof blue king, St. Mathews blue king, Aleutian Islands golden king, and Norton Sound red king crabs. Andre plans to compute $F_{35\%}$ and compare biomass projections under $F_{35\%}$, M, and the current B_{MSY} proxy (γM) for Tier 4 stocks. The final outcome of this project is to address the question whether $F_{35\%}$, M, or a multiple of M((γM) is a good proxy for F_{MSY} for these crab stocks. André plans to complete the simulation evaluation by February – March 2012 and present initial final results for all objectives at the May 2012 CPT meeting.

Ecosystem Considerations

Liz Chilton provided an overview of changes to the Ecosystem chapter for the SAFE. These changes primarily include supporting documentation on the ecosystem indicators section of the document. The CPT complimented the authors on the document and are enthusiastic about the possibilities for ecosystem information can be included in crab management. Information requested by the team to be added to the May 2012 Ecosystem chapter includes the following.

- Include historical information on sea surface and/or air temperature information throughout the Bering Sea (previous to the M2 mooring) that go back as far as possible, ideally to 1969.
- Include information from Aydin's group on stomach content analysis with regards to crab. Encourage Aydin's group to examine stomach contents from observers to get data from other seasons.
- Provide a time series of PDO, sea ice, benthic production, and other environmental indices, for as long a time period as possible, in a format that can be available for stock assessment authors to correlate these indices with crab population dynamics.
- Refine information on benthic productivity to develop an indicator of benthic productivity, including spatial variation.
- Consider spatial information on ecosystem indicators.
- Discuss and justify time lags used in this document.

In the future the final Ecosystem chapter will be produced in May so that stock assessment authors can include this information in stock assessments and analysis for September.

Bristol Bay Nearshore Survey

Scott Goodman (BSFRF) and Liz Childers (NMFS) provided an overview of the joint NMFS-BSFRF Bristol Bay RKC nearshore trawl survey research results from Summer, 2011. Liz reviewed the sampling design and study implementation, noting that the survey employed standard survey and sampling protocols, differing principally from typical surveys by extending the sampling area with additional nearshore stations to investigate whether the standard survey is missing large concentrations of crab in nearshore areas. Scott discussed survey results and presented figures depicting survey catch densities spatially and with respect to sea temperature measurements, noting that the survey did not find higher densities in south of survey area, contrary to expectations, and did not catch many mature females. Scott also noted the relatively high sea temperatures during the survey time period, which limited the utility of the survey in identifying an association between RKC movement nearshore in response to sea temperature.

The CPT discussed use of the survey results in the BBRKC stock assessment. The particularly high incidence of small (<65mm) juvenile females associated with a single tow was discussed, and it was noted that the BBRKC stock assessment had not incorporated the survey data for crab in that size range. Jack questioned whether the survey results were affected by net performance in nearshore benthic conditions and recommended investigating potentially systematic differences in female catch incidence, e.g., in leg 3. Bob appealed to CPT members for recommendations regarding the utility of replicating or modifying the survey in the future, noting that two research questions suggested/left unanswered by the study findings were 1. what is going on during the regular survey with respect to juvenile female, and 2: are there crab nearshore in cold water years? No additional recommendations were made by the CPT.

Economic SAFE

Brian Garber-Yonts provided a brief summary of economic status of fisheries and a walk-through of the economic section of the SAFE. Currently the economic chapter focus is on summarization of fishery economics (employment, labor income, and wholesale and ex-vessel values) over the past five years and not based on research findings or projections, though there is effort for future reports to include economic projections. Catch and earnings data are taken from fish ticket and COAR data. Author clarified that revenue is based on FOB (Alaska) from COAR data. The CPT recommends adding evaluation of expenses, such as product shipping and vessel fuel costs. The author has been working on obtaining this information, however such data is difficult to obtain and hopefully will be more accessible in the future. The CPT recommends that a balance between a brief summary of economic trends as well as a detailed discussion should be provided.

Increased prices in recent years have somewhat offset the economic effects of lower harvests. The CPT noted that the prices in 2010 went up for Bristol Bay red king crab but decreased for Bering Sea snow crab. Data is presented by calendar year, not fishery year. COAR data is released on a calendar year basis and is not available until well after the calendar year is over. The CPT recommends an estimate be provided from available data from the most recent fisheries that can be updated later; the CPT is more interested in economic trends than exact values.

Wholesale values are more variable than ex-vessel values; author noted this is because the processing section involves varying markets and products. Snow crab values are more based on Canadian snow crab then Bering Sea snow crab because of Canadian production is vastly higher than Alaskan snow crab production. CPT noted that Aleutian Islands golden king crab values are more varied than in other fisheries, author stated that this is likely more volatile because it is a relatively small fishery. Author noted the difficulty of reporting catcher-processor vessel values due to confidentiality issues involved with there being only five catcher-processors in the Bering Sea-Aleutian Islands crab fleet, and is working on ways to pool the catcher-processor data with other sectors, however permission may be needed from catcher-processors to disseminate some confidential information.

A future workshop is planned that will address improving data presented to be most useful. A potential SAFE document containing economic statuses of all Alaska fisheries will also be discussed at the workshop. The author noted that work is being done to streamline production of the economic SAFE chapter to provide for an earlier distribution date.

The CPT appreciated receiving the report and recommended attaching the summary provided as an appendix to the CPT report rather than including in the SAFE introduction at this time as it was not received in advance such that that team could fully review and discuss the material prior to including in the SAFE report. The team intends to include this type of information in the introduction to next year's SAFE report.

New Business

Model workshop

The Council has scheduled a crab modeling workshop for January 9-13, 2012 at the AFSC. This workshop will involve participation from crab and groundfish stock assessment authors, CPT members, SSC members and other invited participants. It will be hosted by the Council and open to the public. Steve Martell will chair the workshop and work with Council staff to produce the recommendations report from the workshop.

The team identified the two highest priority stocks for consideration at the workshop as Tanner crab and AIGKC. The format of the assessment review is intended to be a split-format review of both models. Model documentation and code must be provided at least 2 weeks in advance of the meeting (week of December 12th), with the authors expected to come to the meeting with a series of scenarios and questions for consideration at the workshop. Models are intended to be run real-time during the meeting to best facilitate feedback and problem-solving during the workshop week.

The workshop will also include a half-day meeting and discussion of the OFL pdf workgroup to establish a set of guidelines for estimating the pdf of the OFL for purposes of setting the maxABC according to the Council's maxABC control rule. Diana will coordinate with the 'pdf workgroup' previously identified to prepare for the workshop discussion.

Steve and Diana will work together to lay out a description of the overall modeling workshop objectives and draft agenda to circulate to the participants and to post on the Council's website.

Total catch OFL white paper

The team requested that Doug Pengilly provide a document to the CPT in May regarding the issues in establishing Tier 4 total catch OFLs and the allocative versus policy implications of doing so. Doug will work with stock assessment authors to compile the relevant issues, referencing the work done in the EA for amendment 24 which provides the rationale for the current use of a total catch OFL for all stocks. This paper will be distributed to the CPT prior to the May meeting as well as to the SSC for their consideration.

May meeting documentation and expectations for models

Full assessment reports will be provided in May for the AIGKC and 3 Tier 5 stocks. Note that the AIGKC assessment will include both the proposed model-based assessment as well as the current Tier 5 formulation. White papers describing developing models are to be prepared for the following stocks: Tanner crab and SMBKC. A white paper describing alternative methodologies for weighted averaging for the surveyed stocks such as the Pribilofs will be prepared for discussion and recommendations on the approach for the 2012 assessments at the May meeting. Any other major changes in assessment models or methodologies should be discussed at the May meeting with discussion papers prepared in advance of the meeting.

Other issues

Pribilof Island red king crab stock: The author highlighted that the current MMB/B_{MSY} ratio is 0.501. The team discussed the potential that the estimated survey-based MMB for this stock next year could drop it below MSST based on one survey data point. The team discussed the need for careful consideration of the year sets for these survey-based stocks given the potential ramifications of the time frames on the perception of stock status. This will be discussed further at the May 2012 meeting in conjunction with updated documentation and discussion of the B_{MSY} criteria.

Membership: The team discussed membership of the plan team and the role of economic participation on the plan team. The team would benefit from increased involvement of the team economists in discussions and appreciates the input provided by them at the plan team meetings. The team encourages all members to prioritize their scheduling such that they are able to participate in the entire plan team meeting, while understanding that work-related conflicts may preclude participation at times.

The meeting adjourned at 5pm Thursday September 22.

North Pacific Fishery Management Council Crab Plan Team Meeting

September 19-22, 2011

AFSC, Seattle WA

DRAFT AGENDA 8/17/2011 vers

Monday, Sept 19		**Traynor Room**
9:00	**Administration**	• Introductions, approve agenda, SAFE assignments, update on model workshop January 2012, review scheduling for May/September 2012 meetings, BBRKC EFH update
9:30	**Survey overview**	• Results of 2011 summer survey
	Break 10:30-10:45	
10:45	**Tanner crab**	• Final assessment, OFL and ABC recommendation, update on model progress, discussion of rebuilding plan alternatives and time frame for analysis
Noon		Lunch
1:00	**Tanner crab (cont).** Break 3:00 – 3:15	
3:15	**Snow crab**	• Final assessment, OFL and ABC recommendation
Tuesday, Sept 20		
9:00	**Snow crab (cont as necessary)** Break 10-10:15	• Final assessment, OFL and ABC recommendation (cont)
10:15	**BBRKC**	• Final assessment, OFL and ABC recommendation (cont)
Noon		Lunch
1:00	**St Matthew BKC**	• Final assessment, OFL and ABC recommendation; model description review
	Break 3:00-3:15	•
3:15	**St Matthew BKC (cont)**	• Final assessment, OFL and ABC recommendation; model description review
4:00	**PIRKC**	• Final assessment, OFL and ABC recommendation
4:45	**PIBKC**	• Final assessment, OFL and ABC recommendation
Wednesday, Sept 21		
9:00	**PIBKC (cont as necessary)**	• Final assessment, OFL and ABC recommendation (cont)
9:45	**Ecosystem Considerations** Break 10:15-10:30	• Review ecosystem indicators, finalize introduction section
10:30	**Economic SAFE**	• Review chapter, review/revise summary document (for inclusion in SAFE)

11:15	**AIGKC**	• Model review
Noon		Lunch
1:00	**AIGKC (cont as necessary)**	• Model review
2:00	**Crab B_{MSY}** Break 2:45-3:00	• Update on UW crab project; broader discussion of Bmsy proxy criteria and time frames based on results of current assessments and guidelines for upcoming assessment cycle
4:00	**BB nearshore survey**	• NMFS/BSRFR nearshore Bristol Bay survey overview

Thursday, Sept 22

9:00	**New business**	• Model workshop (January 9-13 AFSC): selection of stocks for review, format of workshop, other items for discussion (pdf of OFL)
9:30	**SAFE report**	• Finalize introduction sections
Noon		Lunch
1:00	**SAFE report (cont) /CPT minutes**	• Finalize introduction sections • Finalize minutes by section
5:00	Break 3:00 – 3:15 Adjourn	

Attachment: **Economic Status of the Fishery: Summary of economic conditions in the FMP crab fisheries**

The BSAI crab fisheries managed under the NPFMC's crab FMP are currently prosecuted by a fleet of approximately 100 catcher vessels and five catcher processors, and landed principally at 18-20 processing facilities throughout the region. Across all fisheries managed under the NPFMC's crab FMP, the total sold, retained catch during calendar year 2010 was approximately 70 million pounds (32×10^3 *t*), with an ex-vessel value of over $170 million (Table X1). Total finished pounds reported by processors in 2010 across all FMP crab species and product forms was approximately 45 million pounds (20.5×10^3 *t*), with an estimated first wholesale value of over $270 million (F.O.B Alaska). Total ex-vessel production for 2010 was reduced in volume relative to the previous year by 14 percent, corresponding to reductions in the TAC in the 2009/2010 snow crab and 2010/2011 Bristol Bay red king crab fisheries. Due to an upturn in first wholesale and ex-vessel prices in the red king crab and golden king crab markets, the reduced TAC's were somewhat offset, resulting in an overall 7.75 percent decrease in economic value accruing to the harvest sector relative to 2009. Total catch was approximately 3 percent above the average for 2005-2009, and aggregate gross revenue was decreased by 5.5 percent relative to the same period.

Reported data for finished production indicates that output in 2010 was reduced relative to 2009 by 11.3 percent. Estimated sales value of total production in 2010 increased by approximately 6 percent. Both first wholesale volume and sales value in 2010 were above the average for the previous five years (by 2 percent and 7 percent, respectively). Data for individual fisheries for 2005-2010 is presented in Table X1. The relative trends in production volume and revenue across the four largest crab fisheries in the harvest and processing sector are illustrated in Figure X1 below. Unweighted mean ex-vessel and first wholesale prices are displayed in Figure X2. Error bars (one standard deviation) in the figures depict the range of cross-sectional variation in prices over time, with the greater variation in wholesale prices reflective of both the effect of greater volatility of world market prices as well as the broader range of products, markets, and sales conditions observed in processed crab sales.

The most recent employment data available for crab fisheries is for the 2009 calendar year fisheries managed under the rationalization program, as reported in the BSAI Crab Economic Data Report program. Data for crew participation and payment by fishery is presented in Table X2. In 2009, approximately 715 unique individuals were employed as fishing crew (including deckhands, vessel captains, and other positions requiring commercial fishing crew or other form of licensure) on 88 fishing vessels prosecuting the IFQ and CDQ crab fisheries. Participation as crew members in individual crab fisheries is indicated by counts of share recipients by fishery, with individual crew members participating in multiple fisheries. In 2009, EDR records indicate 1,130 share recipients aggregated over crab fisheries. Based on average crew size reported in eLandings, the total number of crew positions on active crab vessels in

Total crew and captain payment amount is reported annually for rationalized fisheries in the crab EDR. Total share payments to crab vessel crews totaled approximately $25.5 million in 2009, with an additional payment to vessel captains of $11.4 million (noting that reported values for captain pay may to some degree reflect payments associated with vessel ownership and/or IFQ royalties as well as in-season labor contribution). Somewhat fewer vessels operated in 2009 that 2008, which combined with a reduction in average payment per vessel of approximately four percent resulted in a reduction of over 20 percent in total crew and captain share payments relative to 2008.

Table X3 presents data on crab processing labor employed in the crab fishery. It is estimated that nearly 830 thousand hours of processing labor was expended on crab production in 2009, generating $10.5 million in labor income. Most processing facilities that receive crab landings do not exclusively process crab, however, and it may difficult to attribute crab processing labor to specific employment effects. The high degree of variance in the measure of crab processing labor hours likely reflects variation in ability to track labor input by species for reporting compliance, as well as variation in use of processing labor.

Additional detail on economic conditions in the fishery is provided in the 2011 Economic Status Report (AFSC, forthcoming). Statistics on harvesting and processing activity, revenue, labor employment, labor compensation, operational costs, and quota usage and disposition among participants in the fisheries are provided in the report. Additionally, this report provides a summary of BSAI crab-related research being undertaken by the Economic and Social Sciences Research Program (ESSRP) at the Alaska Fisheries Science Center.

Table X1: Harvest and Processing Sector Production, Gross Revenue, and Average Prices, FMP Crab Fisheries, 2005-2010[1]

	Harvest Sector Gross Ex-vessel				Processing Sector Gross 1st Wholesale			
	Vessels	Landed volume million pounds (10^3 mt)	Total revenue $ million	Weighted average $/pound	Plants	Finished production million lbs (10^3mt)	Total revenue $ million	Weighted average $/pound
Aleutian Islands Golden King - Eastern and Western								
2005	9	4.44 (2.01)	$14.88	$3.36	6	3.03 (1.37)	$21.51	$7.10
2006	7	5.24 (2.38)	$11.20	$2.14	6	3.13 (1.42)	$15.50	$4.95
2007	6	5.44 (2.47)	$11.60	$2.13	6	3.42 (1.55)	$21.12	$6.17
2008	5	5.73 (2.6)	$18.07	$3.15	6	3.41 (1.55)	$25.05	$7.34
2009	5	5.51 (2.5)	$13.70	$2.48	8	3.3 (1.5)	$19.07	$5.78
2010	5	6.09 (2.76)	$17.42	$2.86	8	3.74 (1.7)	$28.99	$7.76
Bristol Bay Red King								
2005	89	18.14 (8.23)	$98.05	$5.41	16	12.3 (5.58)	$127.12	$10.33
2006	81	15.55 (7.05)	$65.02	$4.18	14	9.17 (4.16)	$78.99	$8.62
2007	73	20.17 (9.15)	$98.23	$4.87	17	13.09 (5.94)	$125.04	$9.55
2008	79	20.13 (9.13)	$107.68	$5.35	15	13.31 (6.04)	$138.33	$10.39
2009	70	15.78 (7.16)	$78.45	$4.97	15	10.4 (4.72)	$97.85	$9.41
2010	65	14.73 (6.68)	$92.58	$6.28	15	9.8 (4.45)	$132.17	$13.48
Eastern Bering Sea Snow								
2005	167	24.86 (11.28)	$55.08	$2.22	20	17.71 (8.03)	$83.22	$4.70
2006	78	38.02 (17.25)	$50.20	$1.32	13	24.92 (11.3)	$82.37	$3.31

1 Source: BSAI Crab Economic Data Reports database, CFEC Commercial Operators Annual Report database, and ADF&G eLandings database. Landed volume is calculated from commercial (sold) pounds recorded on fish tickets. Ex vessel revenue is the calculated using CFEC-adjusted landed values on commercial crab landings and average price is the weighted average value per pound calculated over individual fish ticket entries. EDR data provides the only stock-specific source of data for finished production volume and value. For years/stocks for which EDR data is unavailable (NSR; 2010, pre-2005), processed volume by stock is estimated by applying average product recovery rate to ex-vessel pounds recorded by processor in fish tickets. Weighted and unweighted wholesale prices are estimated by species from COAR data on FOB Alaska first wholesale price. Total wholesale value is estimated by applying weighted average wholesale price by species to estimated volume.

	Harvest Sector				Processing Sector			
	Gross Ex-vessel				Gross 1st Wholesale			
	Vessels	Landed volume million pounds (10^3 mt)	Total revenue $ million	Weighted average $/pound	Plants	Finished production million lbs (10^3mt)	Total revenue $ million	Weighted average $/pound
2007	68	34.76 (15.77)	$62.58	$1.80	16	22.66 (10.28)	$99.66	$4.40
2008	78	62.23 (28.23)	$112.84	$1.81	16	41.02 (18.61)	$176.80	$4.31
2009	77	57.69 (26.17)	$87.46	$1.52	16	35.97 (16.31)	$133.50	$3.71
2010	68	47.84 (21.7)	$54.05	$1.13	12	30.68 (13.91)	$100.19	$3.27
Eastern Bering Sea Tanner								
2005	4	0.26 (0.12)	$0.51	$2.00	4	0.18 (0.08)	$0.86	$4.81
2006	45	0.99 (0.45)	$1.63	$1.64	9	0.72 (0.33)	$2.89	$4.01
2007	29	2.25 (1.02)	$4.08	$1.82	8	1.46 (0.66)	$6.90	$4.73
2008	30	2.33 (1.06)	$4.24	$1.81	10	1.34 (0.61)	$6.06	$4.54
2009	18	2.14 (0.97)	$3.67	$1.72	10	1.39 (0.63)	$5.63	$4.06
2010	4	0.37 (0.17)	$0.55	$1.47	6	0.24 (0.11)	$0.98	$4.04
Norton Sound Red King								
2005	31	0.4 (0.18)	$1.67	$4.19				
2006	29	0.44 (0.2)	$1.29	$2.91				
2007	31	0.32 (0.14)	$1.00	$3.18				
2008	9	0.03 (0.01)	$0.07	$2.39				
2009	10	0.03 (0.01)	$0.14	$4.63				
2010	16	0.32 (0.15)	$1.37	$4.28				

	Harvest Sector				Processing Sector			
	Gross Ex-vessel				Gross 1st Wholesale			
	Vessels	Landed volume million pounds (10^3 mt)	Total revenue $ million	Weighted average $/pound	Plants	Finished production million lbs (10^3mt)	Total revenue $ million	Weighted average $/pound
Pribilof Island Golden King								
2005	4	--	--	--	--	--	--	--
2010	1	--	--	--	--	--	--	--
Saint Matthews Blue								
2009	7	0.45 (0.2)	$1.07	$2.38	3	--	--	--
2010	11	1.25 (0.57)	$5.16	$4.12	6	0.82 (0.37)	$9.49	$11.50
Total – All FMP Crab Fisheries								
2005		48.1 (21.82)	$170.20			33.23 (15.07)	$232.71	
2006		60.24 (27.33)	$129.33			37.94 (17.21)	$179.75	
2007		62.94 (28.55)	$177.50			40.63 (18.43)	$252.72	
2008		90.82 (41.2)	$244.35			59.07 (26.79)	$346.24	
2009		81.97 (37.18)	$185.72			51.06 (23.16)	$256.05	
2010		70.7 (32.07)	$171.33			45.28 (20.54)	$271.81	

Table X2: Crab vessel crew participation and share payment income[2]

		Crew participants		Deck crew positions		Crew share payment $ millions		Captain share payment $ millions	
Fishery	Obs	Total	Vessel mean (sd)	Total	Vessel mean (sd)	Total payment	Vessel mean (sd)	Total payment	Vessel mean(sd)
Aleutian Islands Golden King - Eastern and Western									
2005	10	72	7.2 (2.58)	58	5.8 (1.14)	$1.87	$0.17 (0.13)	$1.01	$0.09 (0.07)
2006	6	48	7.92 (2.58)	38	6.33 (0.52)	$0.87	$0.12 (0.09)	$0.48	$0.07 (0.04)
2007	6	40	6.67 (1.21)	38	6.33 (0.52)	$1.14	$0.19 (0.15)	$0.56	$0.09 (0.07)
2008	4	--	--	--	--	$1.83	$0.37 --	$0.77	$0.15 --
2009	5	43	8.6 --	31	6.2 --	$1.93	$0.39 --	$1.13	$0.23 --
Bristol Bay Red King									
2005	84	493	5.87 (1.04)	472	5.61 (0.82)	$12.39	$0.15 (0.09)	$6.51	$0.08 (0.05)
2006	79	465	5.89 (1.06)	445	5.63 (0.83)	$8.77	$0.11 (0.06)	$4.45	$0.06 (0.03)
2007	70	419	5.99 (0.86)	407	5.81 (0.79)	$11.92	$0.17 (0.08)	$5.94	$0.08 (0.04)
2008	76	473	6.22 (1.11)	454	5.97 (0.94)	$14.14	$0.19 (0.13)	$6.39	$0.09 (0.04)
2009	70	435	6.21 (1.01)	424	6.06 (0.98)	$9.66	$0.14 (0.06)	$4.57	$0.07 (0.03)
Eastern Bering Sea Snow									
2005	150	857	5.71 (0.73)	N/C	N/C	$11.10	$0.07 (0.03)	$5.71	$0.04 (0.02)
2006	74	448	6.05 (1.19)	418	5.65 (0.78)	$6.08	$0.08 (0.05)	$3.04	$0.04 (0.02)
2007	65	400	6.15 (1.08)	377	5.79 (0.79)	$9.01	$0.14 (0.09)	$4.28	$0.07 (0.03)
2008	74	489	6.61 (1.41)	450	6.07 (0.95)	$16.05	$0.22 (0.13)	$7.64	$0.1 (0.05)
2009	77	522	6.78 (1.82)	492	6.39 (1.66)	$13.17	$0.17 (0.1)	$5.83	$0.08 (0.04)

2 *Source: NOAA Fisheries, Alaska Fisheries Science Center. BSAI Crab Economic Data.*
Crew and captain payments reflect amounts paid for harvesting labor. Where applicable, these figures include post-season adjustments, bonuses, and deductions made to labor payments for shared expenses such as fuel, bait, and food and provisions. Payments to harvest crew and captains for IFQ are excluded. 2009 data is summarized over all harvesting sectors (CVCP) to preserve confidentiality. Cells displaying "—" are suppressed for confidentiality purposes, and N/C indicates that data was not collected for the fishery. Data reported in aggregate over all crab fisheries in Table X2 omits missing values where there are indicated. As a result, direct comparison of values over time is limited in instances where missing values are present.

Eastern Bering Sea Tanner									
2005	4	–	–	–	–	–	–	–	–
2006	25	143	5.72 (1.02)	140	5.6 (1)	$0.23	$0.01 (0.01)	$0.13	$0.01 (0.01)
2007	22	131	5.95 (0.84)	118	5.36 (0.66)	$0.62	$0.03 (0.02)	$0.32	$0.02 (0.01)
2008	26	162	6.23 (1.31)	149	5.73 (1.12)	$0.52	$0.02 (0.03)	$0.30	$0.01 (0.02)
2009	14	96	6.86 (2.54)	87	6.21 (1.48)	$0.55	$0.04 (0.05)	$0.34	$0.02 (0.03)
Saint Matthews Blue									
2009	7	40	5.71 (0.76)	39	5.57 (0.79)	$0.16	$0.02 (0.02)	$0.07	$0.01 –
All Crab Fisheries									
2005		1422		529		$25.36		$13.23	
2006		1104		1041		$15.95		$8.09	
2007		990		940		$22.69		$11.11	
2008		1124		1053		$32.54		$15.10	
2009		1136		1073		$25.46		$11.94	

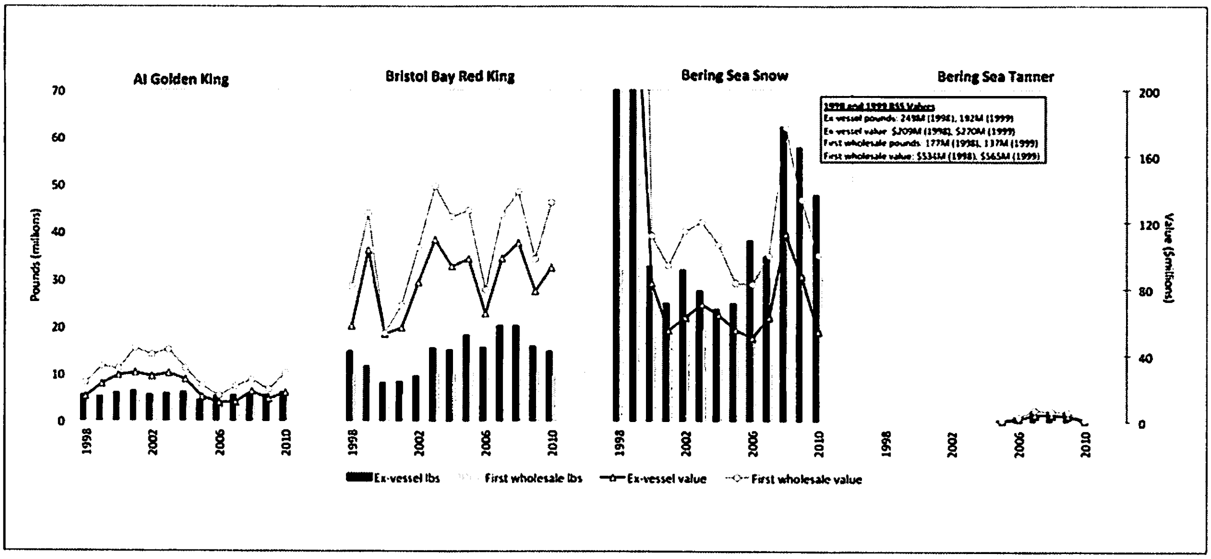
Table X3: Crab Processing Labor and Income[3]

Crab Processing Labor					
Fishery	Obs	Total Man-hours (1000)	Average per plant mean (sd) (1000)	Total Labor payment ($1000)	Pay per hour
Aleutian Islands Golden King - Eastern and Western					
2005	4	–	–	–	–
2006	6	47.15	7.86 (11.58)	$510.99	12.66
2007	5	71.97	14.39 –	$770.34	13.25
2008	6	37.85	6.31 (6.35)	$554.19	12.13
2009	4	–	–	–	–
Bristol Bay Red King					
2005	11	201.82	18.35 (17.02)	$2,386.11	13.47
2006	11	180.16	16.38 (15.38)	$2,065.67	11.87
2007	11	260.51	23.68 (20.39)	$2,868.82	13.24
2008	11	244.92	22.27 (21.06)	$2,809.21	10.19
2009	10	198.90	19.89 (17.01)	$2,281.84	10.88
Eastern Bering Sea Snow					
2005	13	301.98	23.23 (16.62)	$3,805.65	11.65
2006	10	445.35	44.54 (34.78)	$4,749.05	11.45
2007	10	442.21	44.22 (37.81)	$5,170.08	11.18
2008	12	712.38	59.37 (77.49)	$8,936.86	10.26

3 *Source: NOAA Fisheries, Alaska Fisheries Science Center. BSAI Crab Economic Data.*
Processing labor payments exclude payments to salaried workers employed by processors. Where applicable, these figures include bonuses and deductions to labor payments for shared expenses such as food and provisions. Benefits and indirect expenses paid on behalf of processing workers are excluded. Note that observations for pro-rata statistics (pay per plant, worker, and finished pounds) may differ from the number of observations for total labor payments due to observations that are missing data for the denominator variable (average number of processing positions, processing man-hours, finished production lbs) in the fishery-year of interest. Outlier observations in the 2008 data have been excluded for pay per worker and pay per hour statistics. Data for EAG and WAG fisheries are summarized together as the 'AIG' fishery. Where a submitter reported separate labor payments and processing positions in the two fisheries, we use the maximum reported number of processing positions, rather than the sum of processing positions over the two fisheries, to calculate pay per worker statistics. All other variables used in pro-rata statistics for the AIG fisheries are treated cumulatively. 2009 data is summarized over all processing sectors (SFCP) due to confidentiality.

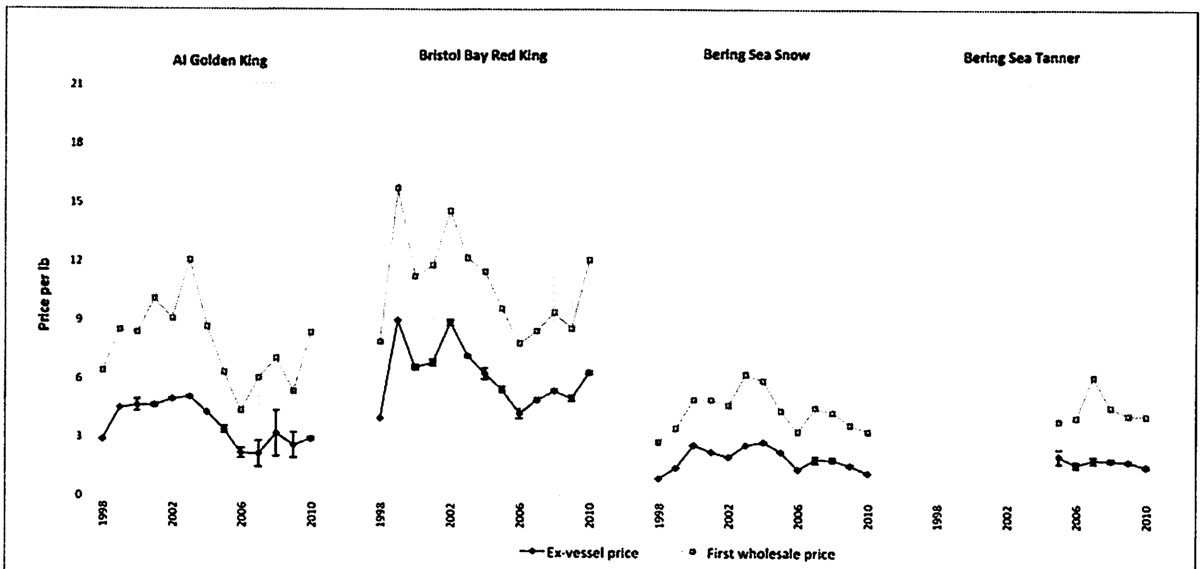
2009	10	600.07	60.01 (50.91)	$7,014.28	10.79
Eastern Bering Sea Tanner					
2005	7	8.34	1.19 (1.53)	$92.37	11.29
2006	8	14.00	1.75 (1.67)	$148.68	10.74
2007	7	34.90	4.99 (3.31)	$365.99	10.73
2008	8	27.02	3.38 (3.01)	$439.62	10.73
2009	7	29.32	4.19 (2.26)	$297.54	10.44
Pribilof Island Golden King					
2009		--	--	--	--
All Rationalized Crab Fisheries					
2005		512.14		$6,284.13	
2006		686.66		$7,474.40	
2007		809.59		$9,175.23	
2008		1022.17		$12,739.87	
2009		828.29		$10,483.59	

Figure X1: Ex-vessel and first wholesale production and value, BSAI crab, 1998-2010



Source: CFEC Commercial Operators Annual Report database and ADF&G eLandings database.

Figure X2: Ex-vessel and first wholesale production and value, BSAI crab, 1998-2010



Source: CFEC Commercial Operators Annual Report database and ADF&G eLandings database

2011 Stock Assessment and Fishery Evaluation Report for the King and Tanner Crab Fisheries in the Bering Sea and Aleutian Islands

Introduction

The annual stock assessment and fishery evaluation (SAFE) report is a requirement of the North Pacific Fishery Management Council's *Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (FMP)*, and a federal requirement [50 CFR Section 602.12(e)]. The SAFE report summarizes the current biological and economic status of fisheries, total allowable catch (TAC) or Guideline Harvest Level (GHL), and analytical information used for management decisions. Additional information on Bering Sea/Aleutian Islands (BSAI) king and Tanner crab is available on the NMFS web page at http://www.fakr.noaa.gov and the Alaska Department of Fish and Game (ADF&G) Westward Region Shellfish web page at: http://www.cf.adfg.state.ak.us/region4/shellfsh/shelhom4.php.

This FMP applies to 10 crab stocks in the BSAI: 4 red king crab, *Paralithodes camtschaticus*, stocks (Bristol Bay, Pribilof Islands, Norton Sound and Adak), 2 blue king crab, *Paralithodes platypus,* stocks (Pribilof District and St Matthew Island), 2 golden (or brown) king crab, *Lithodes aequispinus,* stocks (Aleutian Island and Pribilof Islands), EBS Tanner crab *Chionoecetes bairdi*, and EBS snow crab *Chionoecetes opilio*. All other BSAI crab stocks are exclusively managed by the State of Alaska.

The Crab Plan Team (CPT) annually assembles the SAFE report with contributions from ADF&G and the National Marine Fisheries Service (NMFS). This SAFE report is presented to the North Pacific Fishery Management Council (NPFMC) and is available to the public on the NPFMC web page at: http://fakr.noaa.gov/npfmc/membership/plan_teams/CRAB_team.htm. Under a process approved in 2008 for revised overfishing level (OFL) determinations, and new ACL requirements in 2011, the Crab Plan Team reviews four assessments in May to provide recommendations on OFL, ABC and stock status specifications for review by the Council's Science and Statistical Committee (SSC) in June. In September, the CPT reviews the remaining assessments and provides final OFL and ABC recommendations and stock status determinations. Additional information on the OFL and ABC determination process is contained in this report.

The Crab Plan Team met from September 19-22, 2011 in Seattle, WA to review the final stock assessments as well as additional related issues, in order to provide the recommendations and status determinations contained in this SAFE report. This final 2011 Crab SAFE report contains all recommendations for all 10 stocks including those whose OFL and ABC were determined in June 2011. This SAFE report will be presented to the Council in October for their annual review of the status of BSAI Crab stocks. Members of the team who participated in this review include the following: Bob (Chair), Ginny Eckert (Vice-Chair), Wayne Donaldson, Bill Bechtol, Karla Bush, Heather Fitch, Brian Garber-Yonts, Gretchen Harrington, Steve Martell, Doug Pengilly André Punt, Lou Rugolo, Shareef Siddeek, Diana Stram and Jack Turnock.

Stock Status Definitions

The FMP (incorporating all changes made following adoption of Amendment 24) contains the following stock status definitions:

Acceptable biological catch (ABC) is a level of annual catch of a stock that accounts for the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty and is set to prevent, with a greater than 50 percent probability, the OFL from being exceeded. The ABC is set below the OFL.

ABC Control Rule is the specified approach in the five-tier system for setting the maximum permissible ABC for each stock as a function of the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty.

Annual catch limit (ACL) is the level of annual catch of a stock that serves as the basis for invoking accountability measures. For crab stocks, the ACL will be set at the ABC.

Total allowable catch (TAC) is the annual catch target for the directed fishery for a stock, set to prevent exceeding the ACL for that stock and in accordance with section 8.2.2 of the FMP.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions. MSY is estimated from the best information available.

F_{MSY} control rule means a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY.

B_{MSY} stock size is the biomass that results from fishing at constant F_{MSY} and is the minimum standard for a rebuilding target when a rebuilding plan is required.

Maximum fishing mortality threshold (MFMT) is defined by the F_{OFL} control rule, and is expressed as the fishing mortality rate.

Minimum stock size threshold (MSST) is one half the B_{MSY} stock size.

Overfished is determined by comparing annual biomass estimates to the established MSST. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished.

Overfishing is defined as any amount of catch in excess of the overfishing level (OFL). The OFL is calculated by applying the F_{OFL} control rule annually estimated using the tier system in Chapter 6.0 to abundance estimates.

Status Determination Criteria

The FMP defines the following status determination criteria and the process by which these are defined following adoption of amendment 24 and 38.

Status determination criteria for crab stocks are annually calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criteria and acceptable biological catch (ABC) levels are annually formulated. The annual catch limit (ACL) for each stock equals the ABC for that stock. Each crab stock is annually assessed to determine its status and whether (1) overfishing is occurring or the rate or level of fishing mortality for the stock is approaching overfishing, (2) the stock is overfished or the stock is approaching an overfished condition, and (3) the catch has exceeded the ACL.

For crab stocks, the overfishing level (OFL) equals maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Overfishing is determined by comparing the OFL with the catch estimates for that crab fishing year. For the previous crab fishing year, NMFS will determine whether overfishing occurred by comparing the previous year's OFL with the catch from the previous crab fishing year. For the previous crab fishing year, NMFS will also determine whether the ACL was exceeded by comparing the ACL with the catch estimates for that crab fishing year. Catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL and ACL will be set for and compared to the retained catch.

NMFS will determine whether a stock is in an overfished condition by comparing annual biomass estimates to the established MSST, defined as ½ B_{MSY}. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. MSSTs or proxies are set for stocks in Tiers 1-4. For Tier 5 stocks, it is not possible to set an MSST because there are no reliable estimates of biomass.

If overfishing occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the Council to immediately end overfishing and rebuild affected stocks.

The Magnuson-Stevens Act requires that FMPs include accountability measures to prevent ACLs from being exceeded and to correct overages of the ACL if they do occur. Accountability measures to prevent TACs and GHLs from being exceeded have been used under this FMP for the management of the BSAI crab fisheries and will continue to be used to prevent ACLs from being exceeded. These include: individual fishing quotas and the measures to ensure that individual fishing quotas are not exceeded, measures to minimize crab bycatch in directed crab fisheries, and monitoring and catch accounting measures. Accountability measures in the harvest specification process include downward adjustments to the ACL and TAC in the fishing year after an ACL has been exceeded.

Annually, the Council, Scientific and Statistical Committee, and Crab Plan Team will review (1) the stock assessment documents, (2) the OFLs and ABCs, and total allowable catches or guideline harvest levels, (3) NMFS's determination of whether overfishing occurred in the previous crab fishing year, (4) NMFS's determination of whether any stocks are overfished and (5) NMFS's determination of whether catch exceeded the ACL in the previous crab fishing year.

Optimum yield is defined in the FMP Chapter 4. Information pertaining to economic, social and ecological factors relevant to the determination of optimum yield is provided in several sections of the FMP, including sections 7.2 (Management Objectives), Chapter 11, Appendix D (Biological and Environmental Characteristics of the Resource), and Appendix H (Community Profiles).

For each crab fishery, the optimum yield range is 0 to < OFL catch. For crab stocks, the OFL is the annualized maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Recognizing the relatively volatile reproductive potential of crab stocks, the cooperative management structure of the FMP, and the past practice of restricting or even prohibiting directed harvests of some stocks out of ecological considerations, this optimum yield range is intended to facilitate the achievement of the biological objectives and economic and social objectives of the FMP (see sections 7.2.1 and 7.2.2) under a variety of future biological and ecological conditions. It enables the State to determine the appropriate TAC levels below the OFL to prevent overfishing or address other biological concerns that may affect the reproductive potential of a stock but that are not reflected in the OFL itself. Under FMP section 8.2.2, the State establishes TACs at levels that maximize harvests, and associated economic and social benefits, when biological and ecological conditions warrant doing so.

Five-Tier System

The OFL and ABC for each stock are annually estimated for the upcoming crab fishing year using the five-tier system, detailed in Table 6-1 and 6-2. First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the Crab Plan Team process to the Council's Scientific and Statistical Committee. The Council's Scientific and Statistical Committee recommends tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the proposed OFLs and ABCs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the determination of stock status level is based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the F_{OFL}. Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 6-1). The F_{MSY} control rule reduces the F_{OFL} as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the B_{MSY}. For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β).

In stock status level "c," the ratio of current biomass to B_{MSY} (or a proxy for B_{MSY}) is below β. At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the MSST.

For Tiers 1 through 3, the coefficient α is set at a default value of 0.1, and β set at a default value of 0.25, with the understanding that the Scientific and Statistical Committee may recommend different values for a specific stock or stock complex as merited by the best available scientific information.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}.

In Tier 5, the OFL is specified in terms of an average catch value over an historical time period, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

Second, the assessment author prepares the stock assessment and calculates the proposed OFLs by applying the F_{OFL} and using the most recent abundance estimates. The assessment authors calculate the proposed ABCs by applying the ABC control rule to the proposed OFL.

Stock assessment documents shall:

- use risk-neutral assumptions;
- specify how the probability distribution of the OFL used in the ABC control rule is calculated for each stock; and
- specify the factors influencing scientific uncertainty that are accounted for in calculation of the probability distribution of the OFL.

Second, the Crab Plan Team annually reviews stock assessment documents, the most recent abundance estimates, the proposed OFLs and ABCs, and complies the Stock Assessment and Fishery Evaluation Report. The Crab Plan Team then makes recommendations to the Scientific and Statistical Committee on the OFLs, ABCs, and any other issues related to the crab stocks.

Third, the Scientific and Statistical Committee annually reviews the Stock Assessment and Fishery Evaluation Report, including the stock assessment documents, recommendations from the Crab Plan Team, and the methods to address scientific uncertainty.

In reviewing the Stock Assessment and Fishery Evaluation Report, the Crab Plan Team and the Scientific and Statistical Committee shall evaluate and make recommendations, as necessary, on:

- the assumptions made for stock assessment models and estimation of OFLs;
- the specifications of the probability distribution of the OFL;
- the methods to appropriately quantify uncertainty in the ABC control rule; and
- the factors influencing scientific uncertainty that the State has accounted for and will account for on an annual basis in TAC setting.

The Scientific and Statistical Committee will then set the final OFLs and ABCs for the upcoming crab fishing year. The Scientific and Statistical Committee may set an ABC lower than the result of the ABC control rule, but it must provide an explanation for setting the ABC less that the maximum ABC.

As an accountability measure, the total catch estimate used in the stock assessment will include any amount of harvest that may have exceeded the ACL in the previous fishing season. For stocks managed under Tiers 1 through 4, this would result in a lower maximum ABC in the subsequent year, all else being equal, because maximum ABC varies directly with biomass. For Tier 5 stocks, the information used to establish the ABC is insufficient to reliably estimate abundance or discern the existence or extent of biological consequences caused by an overage in the preceding year. Consequently, the subsequent year's maximum ABC will not automatically decrease. However, when the ACL for a Tier 5 stock has been exceeded, the Scientific and Statistical Committee may decrease the ABC for the subsequent fishing season as an accountability measure.

Tiers 1 through 3

For Tiers 1 through 3, reliable estimates of B, B_{MSY}, and F_{MSY}, or their respective proxy values, are available. Tiers 1 and 2 are for stocks with a reliable estimate of the spawner/recruit relationship, thereby enabling the estimation of the limit reference points B_{MSY} and F_{MSY}.

- Tier 1 is for stocks with assessment models in which the probability density function (pdf) of F_{MSY} is estimated.
- Tier 2 is for stocks with assessment models in which a reliable point estimate, but not the pdf, of F_{MSY} is made.
- Tier 3 is for stocks where reliable estimates of the spawner/recruit relationship are not available, but proxies for F_{MSY} and B_{MSY} can be estimated.

For Tier 3 stocks, maturity and other essential life-history information are available to estimate proxy limit reference points. For Tier 3, a designation of the form "F_X" refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or its proxy such as mature male biomass at mating) per recruit equal to X% of the equilibrium level in the absence of any fishing.

The OFL and ABC calculation accounts for all losses to the stock not attributable to natural mortality. The OFL and ACL are total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, the handling mortality rate is multiplied by bycatch discards in each fishery. Overfishing would occur if, in any year, the sum of all three catch components exceeds the OFL.

Tier 4

Tier 4 is for stocks where essential life-history, recruitment information, and understanding are insufficient to achieve Tier 3. Therefore, it is not possible to estimate the spawner-recruit relationship. However, there is sufficient information for simulation modeling that captures the essential population dynamics of the stock as well as the performance of the fisheries. The simulation modeling approach employed in the derivation of the annual OFLs captures the historical performance of the fisheries as seen in observer data from the early 1990s to present and thus borrows information from other stocks as necessary to estimate biological parameters such as γ.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}. Explicit to Tier 4 are reliable estimates of current survey biomass and the instantaneous M. The proxy B_{MSY} is the average biomass over a specified time period, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information. A scalar, γ, is multiplied by M to estimate the F_{OFL} for stocks at status levels "a" and "b," and γ is allowed to be less than or greater than unity. Use of the scalar γ is intended to allow adjustments in the overfishing definitions to account for differences in biomass measures. A default value of γ is set at 1.0, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information.

If the information necessary to determine total catch OFLs and ACLs is available for a Tier 4 stock, then the OFL and ACL will be total catch limits comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. If the information necessary to determine total catch OFLs and ACLs is not available for a Tier 4 stock, then the OFL and ACL are determined for retained catch. In the future, as information improves, data would be available for some stocks to allow the formulation and use of selectivity curves for the discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models. The resulting OFL and ACL from this approach, therefore, would be the total catch OFL and ACL.

Tier 5

Tier 5 stocks have no reliable estimates of biomass and only historical catch data is available. For Tier 5 stocks, the OFL is set equal to the average catch from a time period determined to be representative of the production potential of the stock, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information. The ABC control rule sets the maximum ABC at less than or equal to 90 percent of the OFL and the ACL equals the ABC.

For Tier 5 stocks where only retained catch information is available, the OFL and ACL will be set for the retained catch portion only, with the corresponding limits applying to the retained catch only. For Tier 5 stocks where information on bycatch mortality is available, the OFL and ACL calculations could include discard losses, at which point the OFL and ACL would be applied to the retained catch plus the discard losses from directed and non-directed fisheries.

Figure 1. **Overfishing control rule for Tiers 1 through 4. Directed fishing mortality is 0 below β.**

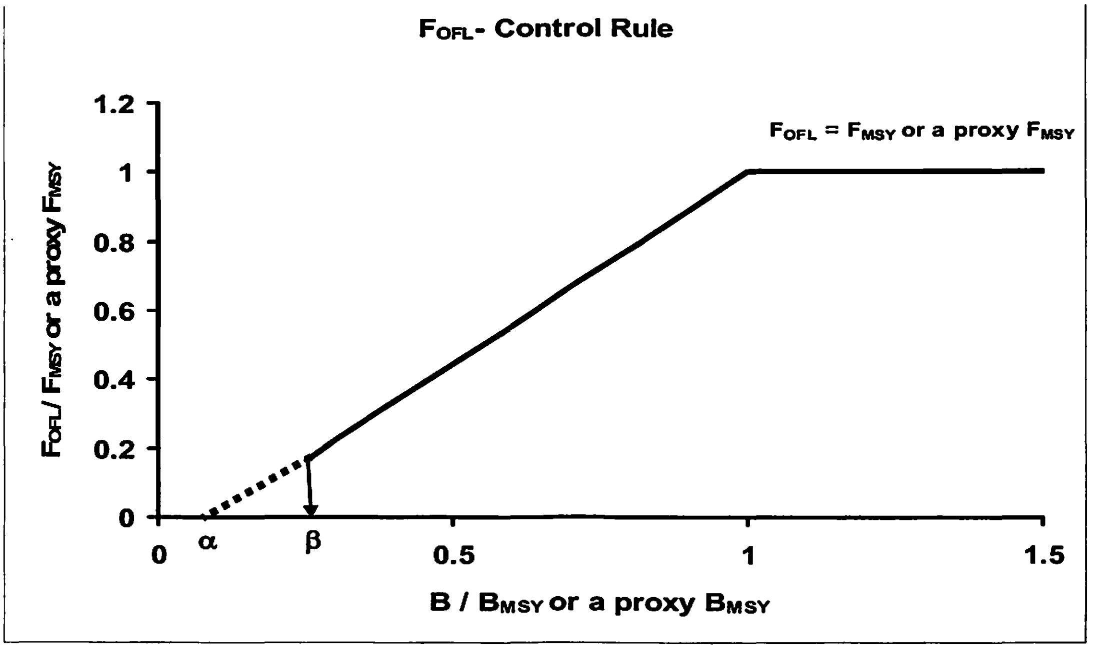


Table 1 **Five-Tier System for setting overfishing limits (OFLs) and Acceptable Biological Catches (ABCs) for crab stocks. The tiers are listed in descending order of information availability. Table 2 contains a guide for understanding the five-tier system.**

Information available	Tier	Stock status level	F_{OFL}	ABC control rule
B, B_{MSY}, F_{MSY}, and pdf of F_{MSY}	1	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ =arithmetic mean of the pdf	
		b. $\beta < \frac{B}{B_{msy}} \le 1$	$F_{OFL} = \mu_A \frac{B/B_{msy} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, B_{MSY}, F_{MSY}	2	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$	
		b. $\beta < \frac{B}{B_{msy}} \le 1$	$F_{OFL} = F_{msy} \frac{B/B_{msy} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, $F_{35\%}^*$, $B_{35\%}^*$	3	a. $\frac{B}{B_{35\%^*}} > 1$	$F_{OFL} = F_{35\%}{}^*$	
		b. $\beta < \frac{B}{B_{35\%}{}^*} \le 1$	$F_{OFL} = F^*_{35\%} \frac{\frac{B}{B^*_{35\%}} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{35\%}{}^*} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
B, M, $B_{msy^{prox}}$	4	a. $\frac{B}{B_{msy^{prox}}} > 1$	$F_{OFL} = \gamma M$	
		b. $\beta < \frac{B}{B_{msy^{prox}}} \le 1$	$F_{OFL} = \gamma M \frac{B/B_{msy^{prox}} - \alpha}{1-\alpha}$	ABC≤(1-b_y) * OFL
		c. $\frac{B}{B_{msy^{prox}}} \le \beta$	*Directed fishery F = 0* $F_{OFL} \le F_{MSY}$†	
Stocks with no reliable estimates of biomass or M.	5		OFL = average catch from a time period to be determined, unless the SSC recommends an alternative value based on the best available scientific information.	ABC≤0.90 * OFL

*35% is the default value unless the SSC recommends a different value based on the best available scientific information.
† An $F_{OFL} \le F_{MSY}$ will be determined in the development of the rebuilding plan for an overfished stock.

Table 2 A guide for understanding the five-tier system.

- F_{OFL} — the instantaneous fishing mortality (F) from the directed fishery that is used in the calculation of the overfishing limit (OFL). F_{OFL} is determined as a function of:
  - F_{MSY} — the instantaneous F that will produce MSY at the MSY-producing biomass
    - A proxy of F_{MSY} may be used; e.g., $F_{x\%}$, the instantaneous F that results in x% of the equilibrium spawning per recruit relative to the unfished value
  - B — a measure of the productive capacity of the stock, such as spawning biomass or fertilized egg production.
    - A proxy of B may be used; e.g., mature male biomass
  - B_{MSY} — the value of B at the MSY-producing level
    - A proxy of B_{MSY} may be used; e.g., mature male biomass at the MSY-producing level
  - β — a parameter with restriction that $0 \leq \beta < 1$.
  - α — a parameter with restriction that $0 \leq \alpha \leq \beta$.
- The maximum value of F_{OFL} is F_{MSY}. $F_{OFL} = F_{MSY}$ when $B > B_{MSY}$.
- F_{OFL} decreases linearly from F_{MSY} to $F_{MSY}\cdot(\beta-\alpha)/(1-\alpha)$ as B decreases from B_{MSY} to $\beta\cdot B_{MSY}$
- When $B \leq \beta\cdot B_{MSY}$, F = 0 for the directed fishery and $F_{OFL} \leq F_{MSY}$ for the non-directed fisheries, which will be determined in the development of the rebuilding plan.
- The parameter, β, determines the threshold level of B at or below which directed fishing is prohibited.
- The parameter, α, determines the value of F_{OFL} when B decreases to $\beta\cdot B_{MSY}$ and the rate at which F_{OFL} decreases with decreasing values of B when $\beta\cdot B_{MSY} < B \leq B_{MSY}$.
  - Larger values of α result in a smaller value of F_{OFL} when B decreases to $\beta\cdot B_{MSY}$.
  - Larger values of α result in F_{OFL} decreasing at a higher rate with decreasing values of B when $\beta\cdot B_{MSY} < B \leq B_{MSY}$.
- The parameter, b_y, is the value for the annual buffer calculated from a P* of 0.49 and a probability distribution for the OFL that accounts for scientific uncertainty in the estimate of OFL.
- P* is the probability that the estimate of ABC, which is calculated from the estimate of OFL, exceeds the "true" OFL (noted as OFL') (P(ABC>OFL').

Crab Plan Team Recommendations

Table 3 lists the team's recommendations for 2011/2012 on Tier assignments, model parameterizations, time periods for reference biomass estimation or appropriate catch averages, OFLs and ABCs. The team recommends two stocks be placed in Tier 3 (EBS snow crab and Bristol Bay red king crab), five stocks in Tier 4 (EBS Tanner crab, St. Matthew blue king crab, Pribilof Island blue king crab, Pribilof Island red king crab and Norton Sound red king crab) and three stocks in Tier 5 (AI golden king crab, Pribilof Island golden king crab and Adak red king crab). Table 4 lists those stocks for which the team recommends an ABC less than the maximum permissible ABC for 2011/12. Stock status in relation to status determination criteria are shown in Table 5.

The team has general recommendations for all assessments and specific comments related to individual assessments. All recommendations are for consideration for the 2012 assessment. The general comments are listed below while the comments related to individual assessments are contained within the summary of plan team deliberations and recommendations contained in the stock specific summary section. Additional details regarding recommendations are contained in the Crab Plan Team Report (September 2011 CPT Report).

General recommendations for all assessments

1. In relation to whether mature male biomasses should be reduced by the actual catches or the projected catches using an F_{MSY} strategy when computing the B_{MSY} proxy for Tier 4 stocks, the team recommended that the analysts provide a more complete and general analysis supporting the possible application of "bias" corrections for the May 2012 meeting.
2. The team had a further discussion of the relative merits of male-catch-only versus total-catch OFLs. While the team has striven to calculate total-catch OFLs in recent years, there are good reasons why a male-catch-only OFL may better satisfy the aims of OFL setting, including: (a) the formulae used to calculate OFLs are generally based on data for males, with females as an 'add on', and (b) if the OFL is calculated including females, the entire OFL could be males without the conclusion that overfishing occurred. The team requests that the SSC reconsider whether the team can recommend male-only OFLs when the situation suggests that this is warranted, even when it is possible to calculate a total-catch OFL (e.g. EBS Tanner crab). A white paper is being developed to discuss this issue further at the May 2012 CPT meeting and will be provided to the SSC for their consideration in June 2012.
3. The team recommends that analysts provide a list of the parameters (e.g. natural mortality, Q, the appropriateness of F_{MSY} and B_{MSY} proxies), an indication of whether the estimates / assumption used to compute the OFL is likely wrong in systematic way (leading to under- or over-estimation of the OFL) and a range for the extent of error. The analysts should then calculate how the OFL would change for the extremes of the ranges. The team will discuss this approach to quantifying error further at the January modeling workshop.
4. The team recommends that all assessment authors document assumptions and simulate data under those assumptions to test the ability of the model to estimate key parameters in an unbiased manner. These simulations would be used to demonstrate precision and bias in estimated model parameters.
5. The CPT recommends the listing of sigmas instead of absolute weights as being more informative for factors such as L_{50} and β. Also, the team recommends specifying weights for the penalties on L_{50} and β from the standard errors from the analysis on which the estimates for these parameters were based.
6. The team requests that to the extent possible assessments include a listing of the tables and figures in the assessment (i.e., Table of Tables, Table of Figures).

By convention the CPT used the following conversions to include tables in both lbs and t in the status status summary sections:

- lbs to t [/2.204624]
- t to lbs [x 0.453592]

Ecosystem SAFE overview

The ecosystem chapter is composed of three main sections 1) ecosystem assessment, 2) current status of ecosystem indicators, and 3) ecosystem-based management indicators. The objectives of this chapter are to assess the BSAI ecosystem trends, identify and provide annual updates of ecosystem status indicators and research priorities for BSAI crab stocks, and to update management status indicators.

A summary of the most recent ecosystem trends affecting BSAI crab is summarized below with additional information detailed in the ecosystem consideration indicators chapter. Crab Plan Team comments and recommendations on the ecosystem chapter are contained in the September 2011 CPT report.

Recent trends in the 2011 ecosystem indicators (physical & biological trends)

- Extensive sea ice coverage in 2010 persisted into late spring, resulting in one of the largest summer cold pools in 2010.
- Analysis of sea ice extent suggests that the northern Bering Sea will remain relatively cold in the future; affecting distribution of species (crab and predators).
- Pacific cod and pollock on 2010 EBS survey distributed outside the cold pool.
- Winter 2011 was a moderately cold compared to previous five years, although winter ice cover advanced in late spring (April 2011).
- Moderate La Niña for winter 2011 may result in a transitional year in summer 2011.

2010/2011 Status of Predators

- Pacific cod biomass of 0.84 t doubled from 2009.
- Pollock biomass of 3.75 t highest since 2007.
- YFS, NRS, SRS, ATF and HAB all increasing.
- Overall predator abundance is increasing including a significant increase in age 2-3 Pacific cod.

Stock Status Summaries

1 Eastern Bering Sea Snow Crab

Fishery information relative to OFL setting

The total catch in the 2010/11 fishery was estimated at 26,720 t (including model estimated bycatch). This is below the 2010/11 OFL of 44,400 t. Since 1992 when observers were placed on the boats, estimated discard mortality from the directed pot fishery has averaged 15.5% with an assumed discard mortality rate of 50%. Retained catch in the 2010/11 fishery was 24,670 t, which is a slight increase over the 2009/10 fishery of 21,785 t. Snow crab is taken as bycatch in the trawl fishery and estimates of trawl bycatch in recent years are less than 1% of the total snow crab catch. Current estimates of stock status have been above B_{MSY}(418,150 t) for the past three years. Recent trends in mature biomass have continued to increase since 2008. Since 1999, estimates of exploitation rates on mature male biomass have been well below estimates of exploitation rates corresponding to fishing at $F_{35\%}$.

Data and assessment methodology

The stock assessment is based on a size- and sex-structured model in which crabs are categorized into immature, mature, new and old shell. The growth transition matrix is based on an exponential growth function with the transition probability based on a gamma distribution where the variance term for the growth increment is fixed. The model is fitted to abundance data from the NMFS trawl survey, total catch data from the directed fishery and the bycatch data from the trawl fishery, size frequency data by maturity status for the male crab pot fishery, female bycatch in the crab pot fishery, trawl fishery bycatch. The model is also fitted to the 2009 and 2010 BSFRF study area biomass estimates and length frequency data. Changes to the model for 2011 include: i) immature M for male and females, ii) mature male M that is either fixed or estimated depending on the model scenario, iii) reformulation of the survey selectivity in the BSFRF study areas in 2009 and 2010, iv) a nonparametric availability curve for the BSFRF study area in 2009 and 2010,, v) model scenarios with a fixed growth curve based on data from a 2011 growth study.

A total of 13 alternative model scenarios were evaluated. The base model chosen by the author was scenario 7 where natural mortality rates for all stages were fixed at 0.23 yr^{-1} and a logistic curve was used for the availability BSFRF survey data. The Crab Plan Team recommends scenario 6, where a nonparametric availability model was used and natural mortality rates were estimated in conjunction with an informative prior for adult M (see CPT minutes for discussions regarding model selection and natural mortality rates).

Stock biomass and recruitment trends

All model scenarios investigated indicated that the stock is above the B_{MSY} proxy. This indicates that under any model scenario the stock is rebuilt. Estimated trends (model 7) in mature male biomass (MMB) at mating have increased since 2002/03 to 2010/11, and 2011/12 estimates (179,000 t) are slightly less than 2010/11 (184,900 t). Observed survey mature male biomass increased from 157,310 t in summer 2010 to 167,400 t in summer 2011. Trends in recruits per mature male biomass have increased between 2001/02 and 2005/06, and the estimates of recruitment (25-50 mm size class) in the last 5 years are dominated by an above average cohort in 2009/10.

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

The CPT recommends that the EBS snow crab is a tier 3 stock so the OFL will be determined by $F_{35\%}$ control rule. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating is 147,500 t, based on average recruitment over 1979 to present, and the minimum stock size threshold is 73,700 t. The CPT recommends that the ABC be less than maxABC

The Team had difficulty in determining the buffer between the OFL and the ABC that appropriately addresses uncertainty. The Team considered many options for an ABC <maxABC permissible including the following options:

1. a default 10% buffer;
2. use of the OFL from model 7 as an ABC;
3. using the recommended total uncertainty (i.e., σw and σb from the EA for amendment 38) to estimate a buffer using a P* of 0.49; and
4. using the ratios of OFL from model scenarios (e.g., use ratios between different model scenarios) to define a range of values to be used as a multiplier (buffer) for the ABC.

Despite extensive discussion of these items, the CPT was unable to recommend a specific ABC but wishes to identify the following information on uncertainty that should be captured in an ABC: a) using M fixed at prior value would have led to a lower OFL value; and b) use of the new growth data (which has not yet been reviewed in much detail) would have resulted in a lower value. However, the Team recognized that given the uncertainty noted, risk tolerance is required to choose an appropriate buffer based on the model results presented.

Historical status and catch specifications for snow crab (kt).

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	72.1	98.9	28.6	28.6	35.0		
2008/09	74.1	109.3	26.6	26.5	31.5	35.1	
2009/10	66.6	127.7	21.8	21.8	23.9	33.1	
2010/11	73.7	196.6	24.6	24.7	26.7	44.4	
2011/12		133.8*				73.5	<maxABC

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Historical status and catch specifications for snow crab (millions of lb.).

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	159.0	218.0	63.1	63.1	77.2	NA	
2008/09	163.4	241.0	58.6	58.4	69.4	77.4	
2009/10	146.8	281.5	48.1	48.1	52.7	73.0	
2010/11	162.5	433.4	54.2	54.5	58.9	97.9	
2011/12		295.0*				162.0	<maxABC

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Additional Plan Team recommendations

See the CPT Report (September 2011) for additional recommendations on the Snow Crab assessment for

2012 specification cycle.

2 Bristol Bay red king crab

Fishery information relative to OFL setting.

The commercial harvest of Bristol Bay red king crab (BBRKC) dates to the 1930s, initially prosecuted mostly by foreign fleets but shifting to a largely domestic fishery in the early 1970s. Retained catch peaked in 1980 at 129.9 million lbs (58.9 thousand t), but harvests dropped sharply in the early 1980s, and population abundance has remained at relatively low levels over the last two decades compared to those seen in the 1970s. The fishery is managed for a total allowable catch (TAC) coupled with restrictions for size (≥ 165.1mm (6.5-in) carapace width), sex (male only), and season (no fishing during mating/molting periods). Prior to 1990, the harvest rate was based on estimated population size and prerecruit and postrecruit abundances at survey time, and varied from 20% to 60% of legal males. In 1990, the harvest strategy became 20% of the mature male (≥120-mm CL) abundance, with a maximum of 60% on legal males, and a threshold abundance of 8.4 million mature females. The current stepped harvest strategy allows a maximum harvest rate of 15% of mature males, but also incorporates a maximum harvest rate of 50% of legal males, a threshold of 14.5 million lb (6.6 thousand t) of effective spawning biomass (ESB), and a minimum GHL of 4.0 million lb (8.8 thousand t) to prosecute a fishery. The TAC increased from 15.5 million lb (34.2 thousand t) for the 2006/07 season to 20.4 million lb (45.0 thousand t) for the 2007/08 and 2008/09 seasons, and then declined through the next two seasons to 14.9 million lb (32.8 thousand t) for 2010/2011. Catch of legal males per pot lift was relatively high in the 1970s and low in the 1980s to mid-1990s. Following implementation of the crab rationalization program in 2005, CPUE increased to31 crab/pot in 2006, but fell to 18 crab/pot by 2010/11. Annual non-retained catch of female and sublegal male RKC during the fishery averaged less than 3.9 million lb (8.6 thousand t) since data collection began in 1990. Estimated fishing mortality ranged from 0.3 to 0.4 yr^{-1} following implementation of crab rationalization. Total catch (retained and bycatch mortality) increased from 17.0 million lb (7.7 thousand t) in 2010/11 to 23.4 million lb (10.6 thousand t) in 2008/09.

Data and assessment methodology

The stock assessment model is based on a length-structured population dynamics model incorporating data from the NMFS eastern Bering Sea trawl survey, commercial catch, and at-sea observer data program. Annual stock abundance is estimated for male and female crabs ≥ 65-mm carapace length during 1968/69–2010/11 to the time of the 2011 survey and mature male biomass is projected for 15 February 2012. Catch data (retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date from the fishery which targets males ≥ 165mm (6.5 in. carapace width) were obtained from ADF&G fish tickets and reports, red king crab and Tanner crab fisheries bycatch data from the ADF&G observer database, and groundfish trawl bycatch data from the NMFS trawl observer database. Catch and bycatch data were updated with data from the 2010/11 crab fishery year. The 2011 assessment was based on model scenario 7ac. Model scenario 7ac assumes three levels of molting probabilities, a constant natural mortality $M = 0.18yr^{-1}$ (but with additional natural mortality for males and females during 1980–1984 and for females during the "split period" 1976–1979 and 1985–1993), incorporates the BSFRF data, estimates effective sample sizes, estimates proportions in initial years, and (with respect to the "Bristol Bay retow data") uses only the standard survey data for males and uses the retow data for females.

Stock biomass and recruitment trends

Model estimates of total survey biomass increased from 162.5 million lb (73.7 thousand t) in 1968 to 631.1 million lb (286.3 thousand t) in 1978, fell to 77.0 million lb (34.9 thousand t) in 1985, generally increased to 201.2 million lb (91.3 thousand t) in 2007, and declined to 166.9 million lb (75.7 thousand t) in 2011. Model estimates of mature male biomass at mating (15 February) generally increased from 48.3 million lb (21.9 thousand t) in 1993/94 to 73.8 million lb (33.5 thousand t) in 2009/10 and to 72.0 million lb (32.6 thousand t) in 2010/11; the projected value for mature male biomass on 15 February 2012 is 65.6 million lb (29.8 thousand t) if the 2011/12 catch equals the OFL. Estimated recruitment was high during the 1970s and early 1980s and has been generally low since 1985. Estimated recruitment to the modeled size classes (i.e., ≥65 mm CL) from the 2007–2011 surveys has been below the average for 1984–2011. The 2011 survey produced a high catch of juvenile males and females <65 mm CL, but that catch occurred in only one survey tow and hence has high uncertainty as a predictor of future recruitment.

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

This assessment showed improvement in exploring the use of the data that are available, particularly with regard to exploring physical and biological oceanographic trends to support the choice of 1984–2011 as recruitment period to use in estimating $B_{35\%}$. The CPT supports the use of model scenario 7ac for the 2011 assessment for stock status determination.

The Plan Team recommends Bristol Bay red king crab as a Tier 3 stock. The team recommends that the proxy for B_{MSY} ($B_{35\%}$) be the mature male biomass at mating, computed as the average recruitment from 1984 to the last year of the assessment (2011) multiplied by the mature male biomass-per-recruit corresponding to $F_{35\%}$ less the mature male catch under an $F_{35\%}$ harvest strategy. Estimated $B_{35\%}$ for 2010/11 is 27.3 t (60.0 million lb). Total catch includes retained male catch and all other bycatch sources.

The team recommends that the OFL for 2011/12 be set according to the model scenario 7ac results at 19.39 million pounds (8.80 thousand t). The team recommends that the ABC for 2011/12 be set below the maximum ABC (19.35 million pounds, or 8.78 thousand t). The team identified uncertainty in the OFL estimation due to the unknown effects on the recruitment time series of the assumption of periods of additional mortality in the model. A downward bias trend in the male abundance estimates that was revealed in a retrospective analysis of model scenario 7ac was also identified as a source of uncertainty in OFL estimation. The team recommends that the ABC be set at 15.84 million lb (7.19 thousand t) to account for the uncertainty arising from that downward bias trend based on an analysis of the retrospective pattern contained in the assessment (see CPT Report for additional details on this adjustment).

Status and catch specifications (kt) of Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	20.32	37.69	9.24	9.30	10.54		
2008/09	17.06	39.83	9.24	9.22	10.48	10.98	
2009/10	15.56	40.37	7.26	7.27	8.31	10.23	
2010/11	13.63	32.64	6.73	6.76	7.71	10.66	
2011/12		29.76[D]				8.80	7.19

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Status and catch specifications (million lb.) of Bristol Bay red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	44.8	85.9	20.38	20.51	23.23		
2008/09	37.6	87.8	20.37	20.32	23.10	24.20	
2009/10	34.3	89.0	16.0	16.0	18.31	22.56	
2010/11	30.0	72.0	14.84	14.91	17.00	23.52	
2011/12		65.6*				19.39	15.84

*Model forecast based on the 2011 assessment under the assumption that the 2011/12 catch equals to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

The 2010/2011 MMB estimate exceeds the MSST for 2010/11, so the stock is not currently overfished (the 2010/11 MMB is 109% of the B_{MSY} proxy of $B_{35\%}$). The total catch for 2010/11 (17.00 million lb, or 7.71 thousand t) was less than the 2010/11 OFL (23.52 million lb, or 10.66 thousand t), so overfishing did not occur during 2010/11.

Additional Plan Team comments

See the September 2011 Crab Plan Team report for additional comments and recommendations on the assessment.

3 Eastern Bering Sea Tanner crab

Fishery information relative to OFL setting.

Eastern Bering Sea (EBS) Tanner crabs are caught as bycatch in the groundfish fisheries, scallop fisheries, in the directed Tanner crab fishery (principally as non-retained females and sublegal males), and in other crab fisheries (notably, eastern Bering Sea snow crab and to a lesser extent in the fishery for Bristol Bay red king crab). Two directed fisheries, one east and one west of 166° W. longitude, harvest EBS Tanner crab. Under the Crab Rationalization Program, ADF&G sets separate TACs and NMFS issues separate individual fishing quota (IFQ) for these two fisheries. However, one OFL is set for the EBS Tanner crab because there is no evidence that the EBS Tanner crab is not one stock. Both fisheries were closed from 1997 to 2005 due to low abundance and the fisheries were closed again for the 2010/11 crab fishery year. NMFS declared this stock overfished in 1999 and the Council developed a rebuilding plan. In 2005, abundance increased to a level to support a fishery in the area west of 166^0 W. ADF&G opened both fisheries for the 2006/07 to 2008/09 crab fishing years and to the area east of 166° W. longitude only in 2009/10. In 2007, NMFS determined the stock was rebuilt because spawning biomass was above B_{MSY} for two consecutive years. The mature male biomass was, however, estimated to be below the Minimum Stock Size Threshold ($0.5B_{MSY}$) in February 2010 (the assumed time of mating), and NMFS declared the stock overfished in September 2010 and a rebuilding plan will be developed for implementation in 2012/13. New minimum size limits adopted by the Alaska Board of Fisheries will be implemented in the 2011/12 fishing season.

Data and assessment methodology

This stock is surveyed annually by the NMFS EBS trawl survey. Although a stock assessment model has been developed for the eastern portion of the stock, and a model is currently under development for the entire stock, no currently approved model exists for the stock. Area-swept estimates of biomass from the EBS trawl survey are therefore used to estimate the biomass of stock components: mature male biomass (MMB), legal male biomass (LMB), and females. The current assessment used NMFS trawl survey data with measured net width (as opposed to the fixed-width assumed in previous assessments). Fish ticket data were used for computing retained catch, and observer data from the crab and groundfish fisheries were used to estimate non-retained catch; assumed handling mortality rates for fishery components were used to estimate the discard mortality.

Stock biomass and recruitment trends

MMB and LMB showed peaks in the mid-1970s and early 1990s. MMB at the survey revealed an all-time high of 257.0 thousand t in 1975, and a second peak of 108.3 thousand t in 1991. From late-1990s through 2007, MMB has risen at a moderate rate from a low of 10.4 thousand t in 1997. Post-1997, MMB at the time of survey increased to 73.6 thousand t in 2007, but subsequently declined to MMB at the time of survey of 32.1 thousand t in 2010. The survey estimate of MMB from the 2011 survey was 41.8 thousand t, an increase of 30.2% from 2010, but this estimate is not used in the Tier 4 assessment given the way this assessment is applied. The MMB projected for February 2012 (26.06 thousand t) is less than the MMB in February 2011 (26.73 thousand t) if the total catch for 2011/12 equals the OFL. The 2011 survey estimated a high abundance of small (25-35 mm CW) animals.

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

The team recommends the OFL for this stock be based on the Tier 4 control rule because no stock assessment model has been adopted. Based on the estimated biomass at 15 February 2011, the stock is at stock status level b. The team recommends that $B_{MSY\ proxy}$ be based on the average MMB for the years 1974-80, discounted by fishery removals (retained and non-retained mortalities) and natural mortality between the time of survey and the time of mating. This time period is thought to represent the reproductive potential of the stock. The range of years on which B_{MSY} is based differs from that used for the 2010 assessment because the range of years was shortened from 1969-80 to 1974-80 following the February 2011 assessment workshop recommendation that survey estimates for 1969-73 not be used for assessments owing to data quality issues. The $B_{MSY\ proxy}$ for the 2011 assessment is 83.33 thousand t MMB at mating. The 2010/11 estimate of MMB at mating is 26.73 thousand t, or 32% of $B_{MSY\ proxy}$. Hence, the stock is estimated to have been in overfished condition. The team recommends that γ=1.0 and M = 0.23yr^{-1}. Under the OFL Control Rule, the 2010/11 F_{OFL}=0.05, equating to a total male and female catch of 1.57 thousand t.

Given a P* of 0.49 and a within-model standard error of 0.13 on terminal biomass, the maximum permissible ABC would be 1,570 t. The author recommended a total catch OFL of 1,290t, i.e., 82% of the OFL based on an assumed additional uncertainty of 0.3. This level of uncertainty reflects several aspects not accounted for in the measure of uncertainty captured in the assessment: (a) pre-specified population dynamic parameters and life-history rates such as natural mortality, size-weight, and maturity; (b) the assumption F_{MSY}=M; and (c) the assumption that B_{MSY} is the average biomass over 1974-80. However, the assessment is based on a Q of 1.0 for all sizes, whereas the stock assessment model includes a prior of Q <1.0 and that selectivity is a logistic function of size. The team recommended that the ABC be set equal to the maximum permissible ABC in the absence of a defensible way to specify a larger buffer, and the fact that a Q lower than 1.0 provides some buffer.

Historical status and catch specifications (kt) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL	ABC
2007/08 b/		68.76	2.55	0.96	3.63		
2008/09 b/	43.04e/	53.63	1.95	0.88	2.25	7.04	
2009/10	41.90e/	28.44	0.61a/	0.60	1.69	2.27	
2010/11	41.67	26.73	0.00	0.00	0.87	1.61	
2011/12		26.06c/				1.57	1.57

Historical status and catch specifications (millions lb) for eastern Bering Sea Tanner crab

Year	MSST	Biomass (MMB)	TAC (east + west)	Retained Catch	Total Catch	OFL	ABC
2007/08 b/		151.59	5.62	2.12	8.00		
2008/09 b/	94.89	118.23	4.30	1.94	4.96	15.52	
2009/10	92.37	62.70	1.34a/	1.32	3.73	5.00	
2010/11	91.87	58.93	0.00	0.00	1.92	3.55	
2011/12		57.45c/				3.48	3.48

a/ Only the area east of 166 deg. W opened in 2009/10; TAC was 1.85 million lb.
b/ Biomass and threshold definitions based on survey estimates derived using 50ft net width area-swept calculations
c/ Projected 2011/12 MMB at time of mating after extraction of the estimated total catch OFL.

EBS Tanner crab MMB was below MSST at the time of mating in mid-February 2011 and is still in an overfished state. Overfishing did not occur during the 2010/11 fishing year because total catch losses (0.87 thousand t) did not exceed the total catch OFL (1.61 thousand t). The stock is projected to remain below MSST in February 2012, under a catch equal to the OFL.

Additional Plan Team comments

A catch of 42.77 thousand t (94.29 million lb) in the snow crab fishery is predicted to lead to a level of bycatch of EBS Tanner crab which, when added to predicted catch in the red king crab and groundfish fisheries, equals to the OFL of 1.57 thousand t. Thus, a TAC for the snow crab fishery of more than 42.77 thousand t is predicted to lead to overfishing for EBS Tanner crab.

4 Pribilof Islands red king crab

Fishery information relative to OFL setting

The ADF&G has not published harvest regulations for the Pribilof Islands red king crab fishery. The fishery began in 1973 as bycatch during the blue king crab fishery. The directed red king crab fishery opened with a specified GHL for the first time in September 1993. Beginning in 1995, combined Pribilof Islands red and blue king crab GHLs were established. Declines in crab abundance of both king crab stocks from 1996 to 1998 resulted in poor fishery performance during those seasons with annual harvest levels below the GHLs. The Pribilof red king crab fishery was closed from 1999 through 2010/1 due to uncertainty in estimated red king crab survey abundance and concerns for incidental catch and mortality of Pribilof blue king crab which was an overfished and severely depressed stock. Prior to the closure, the 1998/99 harvest was 246.9 t (0.544 million lb). The non-retained catches, with application of bycatch mortality rates, from pot and groundfish bycatch estimates of red king crab ranged from 2.8 t (0.001

million lb) to 192.1 t (0.424 million lb) during 1991/92 to 2010/11.

Data and assessment methodology

Although a catch survey analysis which incorporated data from the trawl survey, commercial catch, pot survey and at-sea observer data has been used for assessing the stock in the past, the 2011/12 assessment is based on trends in male mature biomass (MMB) at the time of mating inferred from NMFS bottom trawl survey from 1975-2011 and commercial catch and observer data from 1973/74 to 2010/11. The revised time-series of historical NMFS trawl survey abundance estimates were used in this assessment. The 2010/11 assessments of non-retained catch from all non-directed pot and groundfish fisheries were included in the SAFE report. Groundfish catches of red king crab are reported for all crab combined by federal reporting areas. Catches from observed fisheries were used to estimate total annual catch. An F_{OFL} for 2011/12 was determined using a mean MMB at the time of mating, the default γ value of 1.0 and an M of 0.18yr^{-1}. As recommended by the CPT (May 2011) and SSC (June 2011), the annual index of MMB for this stock was derived as the 3-yr running average of the current year MMB and estimates of MMB in the previous two years. The $B_{MSY\ proxy}$ was estimated as the mean MMB over the period 1991-2011 in which each yearly MMB index is the 3-yr running average as described. The resultant F_{OFL} from the control rule was applied to the projected legal male biomass at the time of the fishery to determine the total male catch OFL. Exploitation rates on legal male biomass and on mature male biomass are estimated as the sum of total retained plus non-retained stock losses as a fraction of legal male biomass and on mature male biomass, respectively, at the time of the fishery.

Stock biomass and recruitment trends

The stock exhibited widely varying mature male and female abundances during 1975-2011. The average MMB estimatedfor 2011 was 3,834 t (8.45 million lb). Recruitment is not well understood for Pribilof red king crab. Retained catches have not occurred since the 1998/99 season. Non-directed discard losses in the pot fisheries decreased in recent years, and there are no discard losses in the current year. Mature stock biomass declined in 2008/09 and 2009/10 followed by increases in MMB in 2010/11 and 2011/12. The estimated biomass of pre-recruit size crab remained relatively constant over the past decade although pre-recruit sized crab may not be well sampled by the NMFS survey. Bycatch losses resulting from the fixed gear groundfish fleet declined slightly from 2009/10 to 2010/11, while losses resulting from discards in the groundfish trawl fleet increased from 2,450 t (5.40 million lb) to 3,870 t (8.53 million lb) between 2009/10 to 2010/11. In 2011, estimates of survey mature female biomass, legal male biomass and mature male biomass all increased substantially relative to 2010. The 2011 length frequency distributions reveal an increase in the proportion of old shell and very old shell males in the stock relative that seen in the 2009 and 2010 survey, and most notably in the legal component of the stock in 2011.

Pribilof Islands red king crabs have been historically harvested with blue king crabs and are currently the dominant of the two species in this area. Total catch losses of male and female red king crab in 2010/11 from all fisheries was 4,200 t (9.19 million lb) which increased from 2,800 t (6.13 million lb) in 2009/10. The 2011/12 stock is not overfished and overfishing did not occur in the 2010/11.

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

This stock is in Tier 4b and γ is set to 1.0. The time period for estimating the proxy for B_{MSY} was selected to be representative of the stock being fished at an average rate approximating F_{MSY} resulting in biomass fluctuating around B_{MSY}. In this assessment, the $B_{MSY\ Proxy}$ was estimated as the mean MMB at mating from 1991 to 2011, resulting in $B_{MSY\ Proxy}$=5,143 t (11.34 million lb) and MSST=2,572 t (5.67 million lb). The estimated 2010/11 MMB at mating was estimated at 2,577 t (5.68 million lb) which represents 0.501$B_{MSY\ Proxy}$. For the 2011/12 fisheries, the F_{OFL} estimated from the control rule (0.08) was applied to the projected legal male biomass at the time of the fishery to determine the total male catch OFL.

The author recommended an ABC less than the maximum permissible as calculated by the maxABC control rule. The estimated 2011/12 maxABC was 340 t (0.75 million lb). The CPT concurred with the author's recommendation to set the ABC below the maximum permissible. Sources of additional uncertainty outside the assessment resulted from the generally insufficient or imprecise data on this stock: the high survey coefficients of variation on survey estimates of mature biomass, the pre-specification of survey catchability (*Q*) and natural mortality rate (*M*); that F_{MSY} is assumed equal to the product of γM in which are both unknown; and that B_{MSY} is represented as the running 3-yr average survey MMB.

The CPT recommended an ABC which incorporates additional uncertainty (σ_b) in addition to the within assessment uncertainty (σ_w). In this calculation, σ_w=0.645, σ_b=0.40 and σ_{total}=0.759. This resulted in a multiplier of 0.78, and a recommended ABC for the 2011/12 fisheries of 307 t (0.68 million lb).

Historical status and catch specifications (kt) of Pribilof Islands red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	1.96	6.66	0	0	0.007		
2008/09	1.99	5.02[A]	0	0	0.010	1.51	NA
2009/10	1.91	2.02[B]	0	0	0.003	0.23	NA
2010/11	2.57	2.75[C]	0	0	0.004	0.35	NA
2011/12		2.58[D]				0.39	0.31

Historical status and catch specifications (million lb) of Pribilof Islands red king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	4.33	14.69	0	0	0.015		
2008/09	4.39	11.06[A]	0	0	0.021	3.32	NA
2009/10	4.22	4.46[B]	0	0	0.006	0.50	NA
2010/11	5.67	5.44[C]	0	0	0.009	0.77	NA
2011/12		5.62[D]				0.87	0.68

A – Based on survey data available to the Crab Plan Team in September 2008 and updated with 2008/2009 catches
B – Based on survey data available to the Crab Plan Team in September 2009 and updated with 2009/2010 catches
C – Based on survey data available to the Crab Plan Team in September 2010
D – Based on 3-yr average of 2009, 2010 and 2011 MMB estimates

Overfishing did not occur during 2010/11. The 2010/11 MMB was 2,577 t (5.68 million lb) which was above MSST (2,572 t; 5.67 million lb) but below $B_{MSY\ Proxy}$ (5,143 t; 11.34 million lb). Therefore, the stock was assigned to Tier 4b for the 2011/12 OFL calculation.

$B_{MSY\ Proxy}$=5,143 t (11.34 million lb) and MSST=2,572 t (5.67 million lb). The estimated 2010/11 MMB at mating was estimated at 2,577 t (5.68 million lb) which represents $0.501B_{MSY\ Proxy}$.

5 Pribilof Islands blue king crab

Fishery information relative to OFL setting.

The Pribilof blue king crab fishery began in 1973, with peak landings of 11.0 million lb during the 1980/81 season. A steep decline in landings occurred after the 1980/81 season. Directed fishery harvest from 1984/85 until 1987/88 was annually less than 1.0 million lb with low CPUE. The fishery was closed from 1988 until 1995. The fishery reopened from 1995 to 1998. Fishery harvests during this period ranged from 1.3 to 2.5 million lb. The fishery closed again in 1999 due to declining stock abundance and has remained closed through the 2010/11 season. The stock was declared overfished in 2002.

Data and assessment methodology

The NMFS conducts an annual trawl survey that is used to produce area-swept abundance estimates. The CPT discussed the history of the fishery and the rapid decline in landings. It is clear that the stock has collapsed, although the annual area-swept abundance estimates are imprecise.

Stock biomass and recruitment trends

The survey biomass time series was recalculated in 2011 to include actual measured net widths. Based on 2011 NMFS bottom-trawl survey, the estimated total mature-male biomass increased to 461 t from 322 t in 2010. The 2011/12 MMB at mating is projected to be 365 t (average of the last three years)(0.80 million lb) which is about 4% of $B_{MSY_{proxy}}$. The Pribilof blue king crab stock biomass continues to be low. From recent surveys there is no indication of recruitment. Station by station survey data for red king crab and blue king crab show they occupy similar areas, indicating red king are not displacing blue king crab.

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

This stock is recommended for placement into Tier 4. B_{MSY} was estimated using the time period 1975/76 - 1984/85 plus 1990/1991-1997/1998, i.e. excluding the period 1985/1986-1989/1990. This range was chosen because it eliminates periods of extremely low abundance that may not be representative of the production potential of the stock. B_{MSY} is estimated at 8,839 t (19.49 million pounds).

The retained catch OFL is 0 because the 2010/11 estimate of MMB is less than 25% B_{MSY}. Due to the Tier level and stock status an F_{OFL} must be determined for the non-directed catch. Ideally this should be based on the rebuilding strategy. However the current rebuilding plan needs to be revised due to inadequate progress towards rebuilding.

The OFL for 2011/12 was estimated at 1.16 t (0.003 million lb), reduced from 2010/11 OFL of 1.81 t (0.004 million lb). The OFL is estimated from the average groundfish bycatch between 1999/00 and 2005/06, which was recalculated in 2011, resulting in the drop in the average catch.

The CPT concurred with the author's recommendation to set ABC less than the maximum permissible by employing a 10% buffer consistent with a Tier 5 average catch calculation. The ABC was estimated at 1.04 t (0.002 million lb.).

Historical status and catch specifications (t.) of Pribilof blue king crab in recent years.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		300	closed	0	2.3		
2008/09	2,105	110	closed	0	0.5	1.81	
2009/10	2,105	510	closed	0	0.5	1.81	
2010/11	4,420	286	closed	0	0.18	1.81	
2011/12		365*				1.16	1.04

*- 3- year average survey biomass

Historical status and catch specifications (million lb.) of Pribilof blue king crab in recent years.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		0.66	closed	0	0.005		
2008/09	4.64	0.25	closed	0	0.001	0.004	
2009/10	4.64	1.13	closed	0	0.001	0.004	
2010/11	9.74	0.63	closed	0	0.0004	0.004	
2011/12		0.80*				0.003	0.002

*- 3- year average survey biomass

The total catch for 2010/11 (0.18 t, 0.0004 million lb) was less than the 2010/11 OFL (1.81 t, 0.004 million lb) so overfishing did not occur during 2010/11. The 2011/12 projected MMB estimate of 365 t (0.80 million lb) is below the proxy for MSST (MMB/Bmsy = 0.04) so the stock continues to be in an overfished condition.

Additional Plan Team comments

A revised rebuilding plan is under development. Final action on this analysis will occur at the October 2011 Council meeting.

6 Saint Matthew blue king crab

Fishery information relative to OFL setting

The fishery was prosecuted as a directed fishery from 1977 to 1998. The fishery developed when 10 U.S. vessels harvested 1.202 million pounds during 1977/78. Harvests peaked in 1983/84 when 9.454-million pounds were landed. The fishery was fairly stable from 1986/87 to 1990/91, with a mean annual harvest of 1.252-million pounds. The mean catch increased to 3.297-million pounds during the period from 1991/92 to 1998/99.

This fishery was declared overfished and closed in 1999 when the stock size estimate was below the MSST. In November of 2000, Amendment 15 to the FMP was approved to implement a rebuilding plan for the St. Matthew Island blue king crab stock. The rebuilding plan included a harvest strategy established in regulation by the Alaska Board of Fisheries and an area closure to control bycatch as well as gear modifications. In 2008/09 and 2009/10, the MMB was above B_{MSY} for two years and was declared rebuilt in 2009.

The fishery re-opened in 2009/10 with a TAC of 1.167 million pounds and 0.461 million pounds of retained catch were harvested. The 2010/11 TAC was 1.6 million pounds and the fishery reported a retained catch of 1.264 million pounds Commercial crab fisheries near St. Matthew Island were scheduled in the fall and early winter to reduce the potential for bycatch from handling mortalities due to molting and mating crabs. Some bycatch has been observed of non-retained St. Matthew blue king crab in the St. Matthew blue king crab fishery, the eastern Bering Sea snow crab fishery, and groundfish fisheries. Based on limited observer data, bycatch of sublegal male and female crabs from the directed blue king crab fishery off St. Matthew Island was relatively high when the fishery was prosecuted in the 1990s, and total bycatch (in terms of number of crabs captured) was often twice as high or higher than total catch of legal crabs. The 2009/10 fishery had lower observed bycatch in the directed fishery than historical estimates. Observed bycatch in 2010/11 more than doubled from 2009/10, but was still below historical estimates.

Data and assessment methodology

A three-stage catch-survey analysis (CSA) is used to assess the male component of the stock. The CSA incorporates the following data: (1) commercial catch data from 1978 to 2010/11; (2) annual trawl survey data from 1978 to 2011; (3) triennial pot survey data from 1995 to 2010; (4) bycatch data in the groundfish trawl fishery from 1989 to 2006 and in the groundfish fixed-gear fishery from 1996 to 2008; and (5) ADF&G crab-observer data for the years 1990/91-1998/99, 2009/10, and 2010/11. Fishery effort and catch data are the vessel numbers, potlifts, catch number and weight, and CPUE for the directed pot fishery; total annual retained catches (including deadloss) were used in the catch-survey analysis. Trawl survey data are from summer trawl survey for stations within the St. Matthew Section. Trawl survey data provided estimates of density (number/nm^2) at each station for males in four size and shell-condition categories that were used in the assessment: 105–119 mm carapace length (CL); 90–104 mm CL; new-shell 120–133 mm CL; and old-shell ≥120 mm CL and new-shell ≥134 mm CL) males.

Pot survey data are from the July–August 1995, 1998, 2001, 2004, 2007, and 2010 ADF&G triennial pot surveys for Saint Matthew Island blue king crab. The pot survey samples areas of important habitat for blue king crab, particularly females, that the NMFS trawl survey cannot sample. Data used are from only the 96 stations fished in common during each of the five surveys. The CPUE (catch per pot lift) indices from those 96 stations for the male sex and shell-condition categories listed above were used in the assessment.

NMFS observer data were used to estimate groundfish trawl and fixed-gear bycatch. Bycatch composition data were not available so total biomass caught as bycatch was estimated by summing blue king crab biomass from federal reporting areas 524 and 521 according to gear type.

Stock biomass and recruitment trends

The stock is estimated to have been above B_{MSY} during 2008/09 through 2010/11 and is projected to be above B_{MSY} in 2011/12. MMB has fluctuated substantially over three periods. MMB increased during the first period (1978 to 1981) from 7.6 to over 17.6 million lb, followed by a steady decrease to 2.9 million lb. in 1985. The second period had a steady increase from the low in 1985 to 13.3 million lb. in 1997 followed by a rapid decrease to 2.8 million lb. in 1999. The third period had a steady increase in all size classes from the low in 1999 to the present high of over 15.8 million lb. in 2011/2012.

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

The CPT and SSC recommends that the stock be in Tier 4, with gamma (γ)=1 used for calculating F_{OFL}, and stock status level a. The CPT concurs with the use of the author recommended survey-based assessment while the model is undergoing revisions. The B_{MSYproxy} varies as a function of years used to calculate average MMB. The time period for estimating B_{MSYproxy} is 1989/90 to 2009/10 because the stock was harvested at extremely high rates before 1986 and this time period incorporates stock abundance during rebuilding. The B_{MSYproxy} during this time period is 6.865 million lb. The OFL is a total male OFL, as recommended by the team. The maxABC is based on cv = 0.5 and P*=0.49, which is 3.6 million pounds. However, to do the nature of the scientific uncertainty in the OFL, the team recommended a 10% buffer for an ABC of 3.4 million lb (1,530 t). Unaccounted for scientific uncertainty for this stock relates to the estimate of natural mortality, and that the survey does not cover the stock distribution (catchability) or the location of fishery. The trawl survey is a poor indication of abundance and may underestimate abundance. However, how the abundance index in the survey relates to the crab caught in the fishery or the total population is uncertain. The team discussed how to use this uncertainty to calculate an ABC because there is no expectation for information or analyses to resolve these uncertainties in the near future.

Historical status and catch specifications (kt) of St. Matthew blue king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		4.39	closed	closed	0.16		
2008/09	1.81	4.87	closed	closed	0.09	0.74 [retained]	
2009/10	1.52	5.79	0.53	0.20	0.25	0.78	
2010/2011	1.52	6.7	0.73	0.57	0.64	1.04	
2011/2012		7.17*				1.7	1.5

* Forecast based on survey data available in the 2011 assessment under the assumption that the 2010/11 catch is equal to the OFL. This value will be updated during the September 2012 assessment when the 2012 survey data and the 2011/12 catch data become available.

Historical status and catch specifications (millions lb.) of St. Matthew blue king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08		9.7	closed	closed	0.35		
2008/09	4.0	10.74	closed	closed	0.20	1.63 [retained]	
2009/10	3.4	12.76	1.17	0.46	0.53	1.72	
2010/2011	3.4	14.77	1.6	1.26	1.4	2.29	
2011/2012		15.8*				3.74	3.4

The total catch for 2010/11 (1.4 million lb) was less than the 2010/11 OFL (2.29 million lb) so overfishing did not occur during 2010/11. Likewise, the 2010/2011 MMB (14.77 million pounds) is above the MSST (3.4 million lb.) so the stock is not overfished.

Additional Plan Team recommendations

The team made additional recommendations for the stock assessment model for the 2012 assessment cycle. These recommendations are contained in the September 2012 Crab Plan Team report.

7 Norton Sound red king crab

Fishery information relative to OFL setting

This stock supports three main fisheries: summer commercial, winter commercial, and winter subsistence. The summer commercial fishery, which accounts for the majority of the catch, reached a peak in the late 1970s at a little over 2.9 million pounds retained catch. Retained catches since 1982 have been below 0.5 million pounds, averaging 275,000 pounds, including several low years in the 1990s. Retained catches in the past three years have been about 400,000 pounds.

Data and assessment methodology

Four types of surveys have been conducted periodically during the last three decades: summer trawl, summer pot, winter pot, and preseason summer pot, but none of these surveys were conducted every year. To improve abundance estimates, a length-based stock synthesis model of male crab abundance was previously developed that combines multiple sources of survey, catch, and mark-recovery data from 1976 to 1996. A maximum likelihood approach was used to estimate abundance, recruitment, and catchabilities of the commercial pot gear. The model has been updated with data from 2010/11 and estimated population abundance in 2011. The current model assumes $M=0.18yr^{-1}$ for all length classes, except

$M=0.288\ yr^{-1}$ for the largest (> 123 mm CL) length group.

Stock biomass and recruitment trends

Mature male biomass was estimated to be on an upward trend following a recent low in 1997 and an historic low in 1982 following a crash from the peak biomass in 1977. Estimated recruitment was weak during the late 1970s and high during the early 1980s with a slight downward trend from 1983 to 1993. Estimated recruitment has been highly variable but on an increasing trend in recent years. Uncertainty in biomass is driven in part by temporal (every 3 to 5 years) and spatial variability in trawl survey coverage.

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

The team recommended Tier 4 stock status for Norton Sound red king crab. The model was the same as that recommended by the Team for the 2010 assessment. This model estimates bycatch mortality in the directed fishery, assumes M to $0.288\ yr^{-1}$ for the largest length bin and $0.18\ yr^{-1}$ for other length bins, and assumes flat selectivity for the summer fishery. The estimated abundance and biomass in 2011 are:

Legal males: 1.471 million crabs with a standard deviation of 0.199 million crabs.
Mature male biomass: 4.699 million lb with a standard deviation of 0.644 million lb.

Average of mature male biomasses during 1983-2011 was used as the B_{MSY} proxy and the CPT chose gamma =1.0 to derive the F_{MSY} proxy.
Estimated B_{MSY} proxy, F_{MSY} proxy and retained catch limit in 2010 are:

- B_{MSY} proxy = 2.490 million lb,
- F_{MSY} proxy = 0.18

The maximum permissible ABC would be 0.65 million lb. A retrospective analysis in the assessment showed that each time new data are added, estimates of historic abundance become lower, i.e. the assessment tends to over-estimate abundance, particularly in the most recent year. Regressing the predicting legal abundance one year beyond the end of the assessment against the corresponding estimates from 2011 indicates that hindcast legal abundance is 59.2% of the estimate. Applying a 59.2% adjustment as a bias correction to the OFL results in a recommended ABC of 0.388 million lb.

In June 2011, the SSC recommended an ABC of 0.59 mill lb. The rationale for the SSC recommendation is provided in their minutes (SSC minutes June 2011).

Status and catch specifications (kt)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2007/08		2.00	0.15	0.14	0.18		
2008/09	0.81[A]	2.38[A]	0.19	0.18	0.21	0.31[A]	
2009/10	0.70[B]	2.64[B]	0.17	0.18	0.22	0.32[B]	
2010/11	0.71[C]	2.47[C]	0.18	0.19	0.22	0.33[C]	
2011/12	0.56[D]	2.13[D]	0.16	0.18		0.30[D]	0.27

A-Calculated from the assessment reviewed by the Crab Plan Team in May 2008
B-Calculated from the assessment reviewed by the Crab Plan Team in May 2009
C-Calculated from the assessment reviewed by the Crab Plan Team in May 2010
D- Calculated from the assessment reviewed by the Crab Plan Team in May 2011

Status and catch specifications (millions lb.)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2007/08		4.40	0.32	0.31	0.36		
2008/09	1.78[A]	5.24[A]	0.41	0.39	0.43	0.68 [A]	
2009/10	1.54[B]	5.83[B]	0.38	0.40	0.43	0.71 [B]	
2010/11	1.56[C]	5.44[C]	0.40	0.42	0.46	0.73 [C]	
2011/12	1.25[D]	4.70[D]	0.36	0.40		0.66 [D]	0.59

A – Calculated from the assessment reviewed by the Crab Plan Team in May 2008
B – Calculated from the assessment reviewed by the Crab Plan Team in May 2009
C – Calculated from the assessment reviewed by the Crab Plan Team in May 2010
D - Calculated from the assessment reviewed by the Crab Plan Team in May 2011

Total catch in 2010/11 did not exceed the OFL for this stock thus overfishing is not occurring. . Stock biomass is above MSST; thus, the stock is not overfished.

Additional Plan Team recommendations

The CPT agrees with the authors that systematic declines in the retrospective estimates of abundance points to a model mis-specification that needs to be resolved.

The retrospective analysis shows a strong influence of the periodic trawl survey data. The CPT recommends conducting a retrospective analysis in which profiles are provided for other parameters. The 2011 assessment included only a likelihood profile for M based on the full time series.
Other requested changes and modification for the next assessment include:

- Provide greater consideration of selectivity as applied to the fisheries and surveys.
- Model notations used for equations need to be clarified.

This stock would be a good candidate for the subject of a modeling workshop.

8 Aleutian Island golden king crab

Fishery information relative to OFL setting

The directed fishery has been prosecuted annually since the 1981/82 season. Retained catch peaked during the 1986/87 season at 14.7 million lb , but average harvests dropped sharply from the 1989/90 to 1990/91 season to an average harvest of 6.9 million lb. for the period 1990/91–1995/96. Management based on a formally established GHL began with the 1996/97 season. The 5.9 million lb GHL, based on the previous five-year average catch, was subsequently reduced to 5.7- million lb beginning with the 1998/99 season. The GHL (or TAC, since the 2005/06 season) remained at 5.7 million lb through the 2007/08 season. Average retained catch for the period 1996/97–2007/08 was 5.6 million lb. In March 2008, the Alaska Board of Fisheries increased the TAC for this stock in regulation, to 5.985 million lb. Average retained catch for the period 2008/09–2009/10 was 5.8 million lb. This fishery is rationalized under the Crab Rationalization Program.

Data and assessment methodology

An assessment model is currently being developed for this stock. Available data are from ADF&G fish tickets (retained catch numbers, retained catch weight, and pot lifts by ADF&G statistical area and landing date), size-frequencies from samples of landed crabs, at-sea observations from pot lifts sampled during the fishery (date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc), triennial pot surveys in the Yunaska-Amukta Island area of the Aleutian Islands (approximately 171° W longitude), tag recoveries from crabs released during the triennial pot surveys, and bycatch from the groundfish fisheries. These data are available through the 2009/10 season and the 2006 triennial pot survey. Most of the available data were obtained from the fishery which targets legal-size (≥6-inch CW) males and trends in the data can be affected by changes in both fishery practices and the stock. The triennial survey is too limited in geographic scope and too infrequent to provide a reliable index of abundance for the Aleutian Islands area. A triennial survey was scheduled for 2009, but was cancelled.

Stock biomass and recruitment trends

Although a stock assessment is in development, it has not yet been accepted for use in management. There are consequently no estimates of stock biomass. Estimates of recruitment trends and current levels relative to virgin or historic levels are also not available.

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

The CPT recommends that this stock be managed as a Tier 5 stock in 2011/12. B_{MSY} and MSST are not estimated for this stock. Observer data on bycatch from the directed fishery and groundfish fisheries provides the estimate of total bycatch mortality. Bycatch data from the directed fishery for years after the 1990/91 season (excluding 1993/94 and 1994/95 seasons due to insufficient data) and from the groundfish fisheries since the 1993/94 season were used. For other time periods under consideration there are no directed fishery observer data prior to the 1988/89 season and observer data are lacking or confidential for four seasons in at least one management area in the Aleutian Islands during 1988/89–1994/95.

Thus, the CPT concurred with the author's recommended approach for establishing the OFL. This method is as follows:

OFLTOT = (1+RATE90/91-08/09)•OFLRET(85/86-95/96) + BM_{GF} 93/94-08/09 = 11.40 million lb

where:

RATE90/91-08/09 = mean annual rate = (bycatch mortality in crab fisheries)/(retained catch) over the period 1990/91-2008/09.

OFLRET85/86-95/96 = mean annual retained catch over the period 1985/86-1995/96, and

BM_{GF}93/94-08/09 = mean of annual bycatch mortality in groundfish fisheries over the period 1993/94-2008/09.

The recommended OFL is set following the June 2010 recommendation of the SSC, but uses additional historical data on bycatch that was not available for review in 2010.

The team concurred with the author's recommendation to set the ABC based on the maximum permissible from the ABC control rule which specifies an ABC based on a 10% buffer on the OFL. The recommended ABC is 10.26 million lb.

Historical status and catch specifications (millions lb.) of Aleutian Islands golden king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	5.70	5.51	6.25		
2008/09	NA	NA	5.99	5.68	6.31	9.18[A]	
2009/10	NA	NA	5.99	5.91	6.51	9.18[A]	
2010/11	NA	NA	5.99	5.97	6.56	11.06	
2011/12	NA	NA	5.99			11.40	10.26

A – retained catch

Historical status and catch specifications (kt) of Aleutian Islands golden king crab

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	2.59	2.50	2.83		
2008/09	NA	NA	2.72	2.58	2.86	4.16[A]	
2009/10	NA	NA	2.72	2.68	2.95	4.16[A]	
2010/11	NA	NA	2.72	2.71	2.98	5.02	
2011/12	NA	NA	2.72			5.17	4.66

A – retained catch

No overfished determination is possible for this stock given the lack of biomass information. Total catch in 2010/11 was below the retained catch OFL thus overfishing did not occur.

Additional Plan Team recommendations

In May 2011, the plan team reviewed a developing stock assessment model for Aleutian Islands golden king crab. Use of an assessment model could allow for this stock to be moved out of Tier 5 and would provide focus for establishing research and data collection priorities. The team recommended incorporation of plan team comments into the model for the September 2011 plan team meeting but did not recommend adopting the model for OFL determination in this year. The team subsequently reviewed the modeified stock assessment model at the September 2011 CPT meeting. Specific model recommendations are contained in the September 2011 Crab Plan Team report. This stock was identified for inclusion in the 2012 Crab Modeling workshop to assist the author in further development of this model.

9 Pribilof Island golden king crab

Fishery information relative to OFL setting

The Pribilof District fishery for male golden king crab ≥ 5.5 in carapace width (≥ 124 mm carapace length) developed in the 1981/82 season. The directed fishery mainly occurs in Pribilof Canyon of the continental slope. Peak directed harvest is 856-thousand lb during the 1983/84 season. Historical fishery participation has been sporadic and retained catches variable. The current fishing season is based on a calendar year. Since 2000, the fishery was managed for a guideline harvest level (GHL) of 150-thousandlb. Non-retained bycatch occurs in the directed fishery as well as Bering Sea snow crab, Bering

Sea grooved Tanner crab, and Bering Sea groundfish fisheries. Estimated total fishing mortality in crab fisheries averages 78-thousand lb (2001-2010). Crab mortality in groundfish fisheries (July 1–June 30, 1991/92–2009/10) averages 6-thousand lb. There was no participation in the directed fishery from 2006-2009; one vessel participated in 2010. Pribilof District golden king crab is not included in the Crab Rationalization Program.

Data and assessment methodology

Total golden king crab biomass has been estimated during NMFS upper-continental-slope trawl surveys in 2002, 2004, and 2008. There is no assessment model for this stock. Fish ticket and observer data are available (including retained catch numbers, retained catch weight, and pot lifts by statistical area and landing date), size-frequency data from samples of landed crabs, and pot lifts sampled during the fishery (including date, location, soak time, catch composition, size, sex, and reproductive condition of crabs, etc), and from the groundfish fisheries. Much of the directed fishery data is confidential due to low number of participants.

Stock biomass and recruitment trends

Estimates of stock biomass (all sizes, both sexes) were provided for Pribilof Canyon. The 2008 Pribilof Canyon area-swept estimate of golden king crab biomass from the triennial slope survey was 2.026 million lb (CV=38%). This estimate is not being used for estimating stock biomass because it does not represent the whole distribution of the stock.

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

The Team recommends this stock be managed under Tier 5 in 2012.

The assessment author presented three alternatives for establishing the OFL. The Team concurs with the author's recommendation for an OFL based on Alternative 1 for 2012 of 0.2 million lb and the maximum permissible ABC of 0.18 million lb. The ABC was derived by applying the Tier 5 control rule a 10% buffer of the OFL, ABC = 0.9 * OFL. The OFL was derived based on the following data:

$OFL_{TOT,2012} = (1+R_{2001\text{-}2010}) * RET_{1993\text{-}1998} + BM_{NC,1994\text{-}1998} + BM_{GF,92/93\text{-}98/99}$

- R2001–2010 is the average of the estimated average annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010.
- RET1993-1998 is the average annual retained catch in the directed crab fishery during 1993–1998 (period of unconstrained catch).
- BMNC,1994-1998 is the estimated average annual bycatch mortality in non-directed crab fisheries during 1994–1998.
- BMGF,1992/93–1998/99 is the estimated average annual bycatch mortality in groundfish fisheries during 1992/93–1998/99.

The average of the estimated annual ratio of pounds of bycatch mortality to pounds of retained in the directed fishery during 2001–2010 is used to estimate bycatch mortality in the directed fishery during 1993–1998 because, whereas there are no data on bycatch for the directed fishery during 1993–1998, there are such data from the directed fishery during 2001–2010 (excluding 2006–2009, when there was no fishery effort).

The estimated average annual bycatch mortality in non-directed fisheries during 1994–1998 is used to estimate the average annual bycatch mortality in non-directed fisheries during 1993–1998 because there is no bycatch data available for the non-directed fisheries during 1993.

The estimated average annual bycatch mortality in groundfish fisheries during 1992/93–1998/99 is used to estimate the average annual bycatch mortality in groundfish fisheries during 1993-1998 because

1992/93–1998/99 is the shortest time period of crab fishery years that encompasses calendar years 1993–1998.

Status and catch specifications (t)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2008	N/A	N/A	68	0	0.0		
2009	N/A	N/A	68	0	0.5	77.1[A]	
2010	N/A	N/A	68	Conf.	Conf.	77.1[A]	
2011	N/A	N/A	68			81.6	
2012	N/A	N/A				90.7	81.6

A= Retained-catch OFL
Conf. = confidential

Status and catch specifications (millions lb)

Year	MSST	Biomass (MMB)	GHL	Retained Catch	Total Catch	OFL	ABC
2008	N/A	N/A	0.15	0	0.000		
2009	N/A	N/A	0.15	0	0.001	0.17[A]	
2010	N/A	N/A	0.15	Conf.	Conf.	0.17[A]	
2011	N/A	N/A	0.15			0.18	
2012	N/A	N/A				0.20	0.18

A= Retained-catch OFL
Conf. = confidential

No overfished determination is possible for this stock given the lack of mature biomass information. Although catch information is confidential under Alaska statute (AS 16.05.815) the assessment author indicated that the retained catch did not exceed the retained catch OFL of 0.17 million lb therefore overfishing did not occur. The 2011 fishery is ongoing until the GHL is achieved or until December 31.

10 Adak red king crab

Fishery information relative to OFL and ABC setting

The domestic fishery has been prosecuted since 1960/61 and was opened every season through the 1995/96 season. Since 1995/96, the fishery was opened only in 1998/99, and from 2000/01-2003/04. Peak harvest occurred during the 1964/65 season with a retained catch of 21.193 million lb. During the early years of the fishery through the late 1970s, most or all of the retained catch was harvested in the area between 172° W longitude and 179° 15' W longitude. As the annual retained catch decreased into the mid-1970s and the early-1980s, a large portion of the retained catch came from the area west of 179° 15' W longitude.

Retained catch during the 10-year period, 1985/86 through 1994/95, averaged 0.943 million lb, but the retained catch during the 1995/96 season was low, only 0.039 million lb. There was an exploratory fishery with a low guideline harvest level (GHL) in 1998/99; three Commissioner's permit fisheries in limited areas during 2000/01 and 2002/03 to allow for ADF&G-Industry surveys, and two commercial fisheries with a GHL of 0.5 million lb. during the 2002/03 and 2003/04 seasons. Most of the catch since the 1990/91 season was harvested in the Petrel Bank area (between 179° W longitude and 179° E longitude) and the last two commercial fishery seasons (2002/03 and 2003/04) were opened only in the

Petrel Bank area. Retained catches in those two seasons were 0.506 million lb (2002/03) and 0.479 million lb (2003/04). The fishery has been closed since the end of the 2003/04 season.

Non-retained catch of red king crabs occurs in both the directed red king crab fishery (when prosecuted), in the Aleutian Islands golden king crab fishery, and in groundfish fisheries. Estimated bycatch mortality during the 1995/96-2009/10 seasons averaged 0.003 million lb in crab fisheries and 0.022 million lb in groundfish fisheries. Estimated annual total fishing mortality (in terms of total crab removal) during 1995/96-2009/10 averaged 0.109 million lb. The average retained catch during that period was 0.084 million lb. This fishery is rationalized under the Crab Rationalization Program only for the area west of 179° W longitude.

Data and assessment methodology

The 1960/61-2007/08 time series of retained catch (number and pounds of crabs), effort (vessels, landings and pot lifts), average weight and average carapace length of landed crabs, and catch-per-unit effort (number of crabs per pot lift) are available. Bycatch from crab fisheries during 1995/96-2009/10 and from groundfish fisheries during 1993/94-2009/10 are available. There is no assessment model in use for this stock. The standardized surveys of the Petrel Bank area conducted by ADF&G in 2006 and 2009 and the ADF&G-Industry Petrel Bank surveys conducted in 2001 have been too limited in geographic scope and too infrequent for reliable estimation of abundance for the entire western Aleutian Islands area.

Stock biomass and recruitment trends

Estimates of stock biomass are not available for this stock. Estimates of recruitment trends and current levels relative to virgin or historic levels are not available. The fishery has been closed since the end of 2003/04 season due to apparent poor recruitment. An ADF&G-Industry survey was conducted as a commissioner's permit fishery in the Adak-Atka-Amlia Islands area in November 2002 and provided no evidence of recruitment sufficient to support a commercial fishery. A pot survey conducted by ADF&G in the Petrol Bank area in 2006 provided no evidence of strong recruitment. A 2009 survey conducted by ADF&G in the Petrol Bank area encountered a smaller, ageing population with the catch of legal male crab occurring in a more limited area and at lower densities than were found in the 2006 survey and provided no expectations for recruitment. A test fishery conducted by a commercial vessel during October-December 2009 in the area west of Petrel Bank yielded only one legal male red king crab.

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

The CPT recommends that this stock be managed under Tier 5 for the 2011/12 season. The CPT concurs with the assessment author's recommendation of an OFL based on the 1995/96–2007/08 average total catch. The CPT recommends a total catch OFL for 2010/11 of 0.12 million lb, following the recommendation of the SSC in June 2010 to freeze the time period for computing the total-catch OFL at 1995/96–2007/08.

The team recommends that the directed fishery remain closed given concerns of stock status. The team struggled to establish an ABC which would account solely for bycatch in other fisheries. Groundfish bycatch in recent years has accounted for the majority of the catch of this stock. The maximum permissible ABC is 0.111 million lb based on the Tier 5 control rule of a 10% buffer on the OFL. However, the CPT recommends an ABC of 0.074 million lb based on the maximum annual groundfish and crab fishery bycatch during the period 1995/96–2009/10.. Based on the limited information available on this stock, the team struggled to adequately quantify the uncertainty in order to develop an ABC below the maximum permissible. The team recognizes that the stock is distributed over a wide area, making an appropriate recommendation for an ABC difficult.

The SSC recommended an ABC of 0.03 in June 2011, their rationale for this choice is reflected in their minutes from that meeting (SSC minutes June 2011).

Status and catch specifications (t) of Adak RKC.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	Closed	0	4.99		
2008/09	NA	NA	Closed	0	6.35	208.7[A]	
2009/10	NA	NA	Closed	0	5.44	226.8[A]	
2010/11	NA	NA	Closed	0		54.43[B]	
2011/12	NA	NA				54.43[B]	12

A-Retained catch OFL based on 1984/85-2007/08 mean retained catch
B-Total catch OFL of 54.43 t based on the average for 1995/96-2007/08.

Status and catch specifications (millions of lb) of Adak RKC.

Year	MSST	Biomass (MMB)	TAC	Retained Catch	Total Catch	OFL	ABC
2007/08	NA	NA	Closed	0	0.011		
2008/09	NA	NA	Closed	0	0.014	0.46[A]	
2009/10	NA	NA	Closed	0	0.012	0.50[A]	
2010/11	NA	NA	Closed	0	0.004	0.12[B]	
2011/12	NA	NA				0.12[B]	0.03

A-Retained catch OFL based on 1984/85-2007/08 mean retained catch
B-Total catch OFL of 0.12 million lb based on the average for 1995/96-2007/08.

No overfished determination is possible for this stock given the lack of biomass information. Total catch was below the OFL in 2010/11 therefore overfishing did not occur.

Table 3 Crab Plan Team recommendations for September 2011 (stocks 1-6). Note that recommendations for stocks 7-10 represent those final values recommended by the SSC in June 2011. Note diagonal fill indicates parameters are not applicable for that tier level. Values in metric tons (t)

Chapter	Stock	Tier	Status (a,b,c)	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	Years[1] (biomass or catch)	2011/12[2] [3] MMB	2011 MMB / MMB_{MSY}	γ	Mortality (M)	2011/12 OFL	2011/12 ABC
1	EBS snow crab	3	b	1.42	147.48	1979-current [recruitment]	133.8	0.91		0.23(females) 0.319 (imm) 0.299 (mat males)	73.50	<maxABC
2	BB red king crab	3	a	0.32	27.3	1984-2011	29.76	1.05		0.18default Estimated[4]	8.80	7.19
3	EBS Tanner crab	4	b	0.05	83.33	1974-1980	26.06	0.31	1.0	0.23	1.57	1.57
4	Pribilof Islands red king crab	4	b	0.08	5.13	1991/92-2010/11	2.58	0.50	1.0	0.18	0.393	0.307
5	Pribilof Islands blue king crab	4	c	0	8.84	1975/76-1984/85 1990/91/-1997/98	0.37	0.04	1.0	0.18	0.01	.0104
6	St. Matthew Island blue king crab	4	a	0.18	6.87	1989/90-2009/10	7.17	1.04	1.0	0.18	1.7	1.5 [total male catch]
7	Norton Sound red king crab	4	a	0.18	1.13	1983-current [model estimate]	2.13	1.9	1.0	0.18	0.30	0.27
8	AI golden king crab	5				See intro chapter					5.17	4.66
9	Pribilof Island golden king crab	5				See intro chapter					0.09	0.08
10	Adak red king crab	5				1995/96–2007/08					.054	0.014

1 For Tiers 3 and 4 where B_{MSY} or $B_{MSYproxy}$ is estimable, the years refer to the time period over which the estimate is made. For Tier 5 stocks it is the years upon which the catch average for OFL is obtained.
2 MMB as projected for 2/15/2012 at time of mating.
3 Model mature biomass on 7/1/2011
4 Additional mortality males: two periods-1980-1985; 1968-1979 and 1986-2008. Females three periods: 1980-1984; 1976-1979; 1985 to 1993 and 1968-1975; 1994-2008. See assessment for mortality rates associated with these time periods.

Table 4 Maximum permissible ABCs for 2011/12 and Crab Plan Team recommended ABCs for those stocks where the Plan Team recommendation is below the maximum permissible ABC as defined by Amendment 38 to the Crab FMP. Note that the rationale is provided in the individual introduction chapters for recommending an ABC less than the maximum permissible for these stocks. Values are in 1000 t. Note that recommendations for Norton Sound red king crab and Adak red king crab represent those final values recommended by the SSC in June 2011.

Stock	Tier	2011/12 *Max*ABC	2011/12 ABC
EBS snow crab	3a	73.4	<maxABC
Bristol Bay red king crab	3a	8.78	7.19
Pribilof Islands red king crab	4b	0.390	0.307
Pribilof Islands blue king crab	4c	NA	0.0104
Saint Matthew blue king crab	4a	1.63	1.50
Norton Sound red king crab	4a	0.29	0.27
Adak red king crab	5	0.05	0.014

Table 5. Stock status in relation to status determination criteria 2010/11
(Note diagonal fill indicates parameters not applicable for that tier level)

Chapter	Stock	Tier	MSST	B_{MSY} or $B_{MSYproxy}$	2010/11[4] MMB	2010/11 MMB / MMB_{MSY}	2010/11 OFL 1000 t	2010/11 Total catch
1	EBS snow crab	3	73.7	147.5	196.6	1.33	44.4	26.7
2	BB red king crab	3	13.63	27.26	32.64	1.19	10.67	7.71
3	EBS Tanner crab	4	41.67	83.34	26.73	0.32	1.61	0.87
4	Pribilof Islands red king crab	4	2.57	5.14	2.75	0.54	0.35	0.004
5	Pribilof Islands blue king crab	4	4.42	8.84	0.29	0.033	1.81	0.18
6	St. Matthew Island blue king crab	4	1.52	3.04	6.70	2.20	1.04 [total male catch]	0.64 [total male catch]
7	Norton Sound red king crab	4	0.71	1.42	2.47	1.74	0.33	0.22
8	AI golden king crab	5					5.02	2.98
9	Pribilof Island golden king crab	5					0.08	Conf.
10	Adak red king crab	5					0.05	0.02

4 MMB as estimated during this assessment for 2009/10 as of 2/15/2010.