

North Pacific Fishery Management Council

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SCIENTIFIC AND STATISTICAL COMMITTEE of the NORTH PACIFIC FISHERY MANAGEMENT COUNCIL June 1-3, 2009

The SSC met during June 1-3, 2009 at the Hilton Hotel, Anchorage, Alaska. Members present were:

Pat Livingston, Chair

NOAA Fisheries—AFSC

Robert Clark

Alaska Department of Fish and Game

Gordon Kruse

University of Alaska Fairbanks

Franz Mueter

University of Alaska Fairbanks

Farron Wallace

Washington Dept of Fish and Wildlife

Keith Criddle, Vice Chair

University of Alaska Fairbanks

Anne Hollowed

NOAA Fisheries—AFSC

Kathy Kuletz

US Fish and Wildlife Service

Lew Queirolo

NMFS—Alaska Region

Doug Woodby

Alaska Department of Fish and Game

Troy Buell

Oregon Department of Fish and Wildlife

George Hunt

University of Washington

Seth Macinko

University of Rhode Island

Terry Quinn II

University of Alaska Fairbanks

Members absent were:

Sue Hills

University of Alaska Fairbanks

Ray Webster

International Pacific Halibut Commission

C-3(d) BSAI Crab SAFE

Diana Stram (NPFMC), Forrest Bowers (ADF&G), and Jack Turnock (NMFS-AFSC) presented information from the Crab Plan Team report and SAFE analyses.

Table 1 shows the SSC recommendations for tier designations, years of biomass or catch, gamma (a multiplier for natural mortality), natural mortality, and OFL. This year, the SAFE reports for Pribilof Islands golden king crab and Adak red king crab will be reviewed in September by the Crab Plan Team (CPT) and in October by the SSC. Next year, the assessments will be ready for the May CPT meeting.

General recommendations to all assessment authors for future assessments:

1. As reiterated from our June 2008 report, “future stock assessments should provide analyses to support the choice of γ ...” in Tier 4. Currently, analysts have used, and the Crab Plan Team and the SSC have supported, a value of 1 for γ in the calculation $F_{OFL} = \gamma M$, in which M is natural mortality, which results in a proxy for F_{MSY} . The SSC recommends that analysts provide rationale for the selection of $\gamma=1$. The value of 1 for γ is the default value used in Tier 5 for groundfish and should be conservative for crab stocks, since only the legal male component of the adult stock is harvested. However, analysis in the Environmental Assessment for Amendment 24 to revise overfishing definitions for crab showed that values of γ between 2 and 3 might be appropriate for F_{msy} estimation for some Bering Sea crab stocks. Therefore, it is desirable to investigate whether alternative approaches can be developed. Some suggestions for doing this

2. will be forthcoming from the crab data weighting and stock assessment workshop, held in Seattle during the May Crab Plan Team meeting. A report from that workshop will be available in time for the September Crab Plan Team meeting.
3. The SSC encourages stock assessment authors and the Plan Team to discuss whether there is evidence for a common year that corresponds with a shift in recruitment across stocks. If there is not a single year, then evidence should be examined for a number of years that are common across groups of species or areas.

EBS Snow Crab

Public testimony was provided by Leonard Herzog (Alaska King Crab Harvesters Co-op), and Arni Thomson (Alaska Crab Coalition).

The SSC has reviewed this assessment several times over the last few years. The central component of this assessment is a length-based model, which integrates length composition, fishery catch, and survey data. A CIE review and an external review completed last year provided many useful suggestions for improvement. **The SSC supports continued use of this model for stock status determinations and specifications.**

The SSC appreciates the author's efforts to improve methodological descriptions and to undertake retrospective and projection analyses. The SSC concurs with the recommendations made on page 10 of the Introduction to the SAFE, for improvements to be completed this year (for the September Plan Team meeting) and next year (for the May Plan Team meeting).

The SSC has three additional recommendations for the stock assessment authors to complete by September (or next June, where noted):

1) Provide a comparison of model results between the model using old survey data in this document, and a model using newly revised data that corrects previous errors in the database. The SSC is interested in seeing the results of this analysis, to evaluate the sensitivity of the model to changes in the biomass time series. We do not envision a complete MSE evaluation with the new data for September, because a project to do that is being funded by NPRB.

2) The SSC strongly reiterates the need for additional work on the effect of selectivity on the stock assessment. In October 2008, the SSC requested an analysis of survey selectivity, to be presented at this meeting. We noted that the model estimates of selectivity (approximately = 1, depending on year) are considerably higher than those estimated by an underbag experiment, as shown in Figure 24. The requested analysis has not yet been conducted. Instead, the current SAFE report explains that a second field experiment is to be done this year to provide new experimental estimates. While it is commendable to conduct these new experiments to obtain improved estimates, the results of the original selectivity study by Somerton and Otto (1999, Fish. Bull. 97) are currently the best scientific information available, and may be more realistic than the new model derived estimates.

The SSC requests that, by June 2010, the stock assessment author include a thorough investigation of the effects of using the model-derived survey selectivities, in comparison to using the experimentally derived survey selectivities of Somerton and Otto (1999), and the results of new field experiments on selectivity, to be conducted in the summer of 2009. Specifically, the SSC requests comparisons of all reference points, including $B_{35\%}$ and $F_{35\%}$, as well as time series of mature and legal male biomass estimates, fits to survey size frequencies for male and female crabs, and projections of future populations toward the rebuilding target.

3) The projection analyses in the document show that the probability of achieving the rebuilding target in the next two years is less than 50%, under current harvest policy. However, the analyses suggest that a

50% probability of rebuilding could be achieved, with a substantial reduction in fishing mortality. The Plan Team recommends such an approach and suggests how it would be implemented. The SSC requests that forecast errors be included in the projection graphs, so that the uncertainty in the projections can be better visualized. Also, it would be helpful for the author to provide an indication of the uncertainty in the rebuilding target biomass. This could be done either for the original target in the Rebuilding Plan, or for an updated target based on more recent information, or both. This will help show how uncertainty in data and model inputs affect the perception of stock rebuilding.

The SSC concurs with the Plan Team recommendations for OFL: the stock should be managed under Tier 3, the range of years (1979 and later) used for parameter estimation is appropriate, and OFL should be determined using $F_{35\%}$ and the model. Council staff informed the SSC that the revised snow crab SAFE will be available for SSC review at the October Council meeting. To accommodate this additional level of review, the Alaska Department of Fish and Game will delay setting the EBS snow crab TAC until after SSC review in October.

Unlike the Plan Team, the SSC has no recommendation on the issue of adjusting TAC downward, to increase the probability of reaching the rebuilding target within the 10 year timeframe required in the rebuilding plan (year 2011). The topic of how often to evaluate and revise harvest rebuilding plans during the stock rebuilding period has been debated nationally in scientific and management circles. There is no clear consensus on the optimal approach, but it is clear that there are tradeoffs. However, this does not remove the obligation to rebuild overfished stocks.

The SSC recommends that changes in rebuilding policy be carefully evaluated under a range of management scenarios and population responses. The current harvest strategy provides for rebuilding to the target level. Progress in stock rebuilding has already been made, and the time of rebuilding will depend on future recruitment trends, population status, and magnitude of harvesting. The SSC seeks clarification, before the October Council meeting, about its role in providing advice on rebuilding overfished crab stocks in which management authority has been delegated to the State of Alaska.

Bristol Bay Red King Crab

A length-based model, using trawl survey data, catch data (retained + bycatch), length-frequencies from the fishery, and fishery CPUE data, is used to estimate abundances and management parameters. This model was first introduced in 1995, and underwent some major changes in 2004. Last year's model was based exclusively on post-1984 data, but at the request of the CPT and the SSC, this year's model was again fit to the full time series from 1968 through 2009. Additional changes from last year include the incorporation of revised trawl survey data from 1975 through 2008, incorporation of the Bering Sea Fisheries Research Foundation (BSFRF) survey data for 2007/2008, and allowances for temporal variation in female maturity and in male and female natural mortality. The authors present results for three models: Model 1 includes a fixed natural mortality ($M=0.18$) with "additional" mortality terms for males and females in 1980 through 1984, and for females in 1976 through 1979 and 1985 through 1993. Model 1 also includes the BSFRF survey data. Model 2 assumes a constant $M=0.18$ across years and includes BSFRF data. Model 3 is similar to Model 1, but without the BSFRF data.

The results suggest that Model 2 fits the data very poorly, as evidenced by the much higher value of the negative log-likelihood and by poor fits to the survey data (Fig. 12). Models 1 and 3 have very similar fits in terms of the log-likelihood, but there are some marked differences in the estimated biomass series, in particular, during the peak in the late 1970s / early 1980s and in recent years. However, estimates from both models are well within the 95% confidence intervals of the survey data. The SSC supports continued exploration of the implications of including the BSFRF data. However, the SSC concurs with the CPT that, without better documentation of the BSFRF data, and without some examination of its apparent influence on biomass trajectories, the data should not be included for setting the OFL for 2009/10. The

SSC also remains concerned about the apparent ad-hoc approach to incorporating additional mortality terms, as detailed below.

In addition to the choice of models, another issue concerns the time period over which recruitment estimates should be averaged to estimate $B_{35\%}$ (as a proxy for B_{MSY}). As in last year's assessment, the authors argue for using the recruitment series since 1995, because of the documented 1989 regime shift (affecting recruitment about 6 years later, in 1995) and the apparent higher productivity following the regime shift (Figure 33). The SSC provisionally accepted the 1995 through 2008 period for last year's assessment and concurs with the author's and the CPT's choice of the 1995 through 2009 recruitments for estimating $B_{35\%}$ in this year's assessment.

The SSC concurs with the CPT recommendation that the stock continue to be managed under Tier 3 and that Model 1, using the 1995 through 2009 series of estimated recruitments, be used as a basis for estimating $B_{35\%}$ and the associated F_{OFL} and OFL , once 2009 survey data are incorporated.

The SSC appreciates the authors' responsiveness to previous requests and the improved documentation of the model, model results, and much of the underlying data. We recognize that the Bristol Bay red king crab model is one of the best developed crab stock assessments and encourage further development of the model in an attempt to move the stock to an eventual Tier 1 designation. However, a number of issues remain to be resolved, and the SSC offers the following points for consideration in the 2010 assessment cycle:

1. We request that the authors continue to explore a model that uses a constant M over time or other ways of accounting for the large biomass peak in the late 1970s / early 1980s and the subsequent steep decline in crab abundance. It remains unclear whether the decline was due to increased mortality (e.g., predation by Pacific cod), a shift in productivity, or a fishing impact. In particular, any changes in fishing mortality should be modeled as such, based on the history of changes in gear and fishing practices. Although Model 2 fit the data poorly, the reasons for the poor fit, in particular to the latter parts of the time series, are not entirely clear and may, in fact, suggest failure of convergence in the optimization routine, rather than model misspecification.
2. The incorporation of a number of periods that allow for "additional" male and/or female mortality needs to be re-evaluated, and a sound rationale for the choice of these periods must be provided. For example, the rationale for why the time periods are different for males and females and why female mortality differs between 1980 through 1984, 1976 through 1979, and 1985 through 1993 is not clearly stated. To the extent practicable, these periods should be based on clearly documented oceanographic and biological considerations.
3. The SSC continues to question the rationale for using the 1995 through the current time period of recruitment for estimating $B_{35\%}$. We recognize that the rationale is more developed for this stock than for some other stocks and that it is primarily based on a perceived shift in productivity in 1989 (first apparent in the 1995 recruitment of 6-year old crab). However, while recruitment was somewhat higher in the post-1988 period, the difference in mean recruitment is not significant (fertilization years 1977-88, i.e. post 76/77 shift, vs. 1989-2002: $t = 0.125$, $p = 0.91$; 1979-88, the period used in the assessment, vs. 1989-2002: $t = 1.57$, $p = 0.13$). Therefore, we request that model runs continue to be based on both periods, for comparison, and that the rationale for using only the post-1988 period be re-evaluated, perhaps as part of a broader evaluation of appropriate productivity periods across crab stocks in this region.
4. There is a discrepancy between the recruitment estimates summarized in Table 6, those shown in Figure 33, and those shown in the stock-recruitment relationship in Figure 35. The latter seem to be labeled by year of hatching, rather than the year of mating, as stated in the legend. These need to be checked, in order to provide appropriate recruitments for estimating reference points. In

addition to the parameter estimates in Table 6, it would be very useful if the document included a table of actual recruitment estimates.

5. The rationale for using three different time periods for estimating average size at 50% maturity (Figure 9) is unclear and needs to be clearly articulated in the document. For example, these periods differ from those that were used to model additional mortality for females, and it could be argued that the same mechanism may be responsible for higher mortalities and smaller size-at-maturity, suggesting that the same periods be used for modeling changes in these parameters. A more objective approach to modeling size-at-maturity might be to fit a smooth trend to size at 50% maturity over time or use an appropriate algorithm to find change points in the time series.
6. The SSC appreciates the inclusion of likelihood components that incorporate appropriate coefficients of variation, rather than arbitrary weights. We request that the weighting issue be explored further, following recommendations from the recent stock assessment/data weighting workshop. Possible approaches to pursue include conducting additional sensitivity analyses to examine the influence of different weights, estimating effective N for multinomial likelihood components within the model, as is done for many groundfish assessments, or employing a fully Bayesian implementation of the model with appropriate priors, as recommended by the CPT.
7. In addition to using the BSFRF data to get an improved estimate of capture probability by size, the data should also be included in a model alternative presented to the CPT and SSC. However, as noted earlier, all data must be clearly described and documented and the model fit to the data should be shown.

Tanner Crab

Estimates of MMB biomass are derived annually from information collected during the EBS trawl survey. Following this summer's survey, assessment authors will incorporate new estimates into revised assessments for CPT review in September 2009. Fish ticket and observer data are used to estimate retained and non-retained catch, and assumed handling mortality rates are applied to the non-retained portion of the catch, to estimate a total catch OFL. Estimated abundance of legal males increased over 2007 abundance by 9%, largely due to a high density of legal males observed at a single survey station. Although the stock was determined to be rebuilt in 2007, the 2008 survey showed a marked decline in estimated abundance across all other size classes of males and females, possibly signifying the commencement of a declining period of abundance for this stock.

The revised EBS bottom trawl time series was not used in the Tanner crab assessment. **This information is important for stock status determination and the SSC recommends use of the revised time series for the final assessment in 2009. The SSC agrees with the CPT and authors that the OFL for this stock should be based on the Tier 4 control rule, since no formal assessment has been developed for the entire EBS region. The SSC agrees with the CPT and authors that B_{REF} be based on the average mature male biomass (MMB) for the years 1969 through 1980, discounted by fishery removals (retained and non-retained mortalities) and natural mortality between the time of survey and mating, and that $\gamma=1.0$ and $M=0.23$. This equates to a B_{REF} of 189.76 million pounds of MMB.** The SSC notes that the current BSAI Crab SAFE Introduction mistakenly lists the range of years for calculating B_{REF} as 1975 through 1980.

The SSC recommends that the stock assessment authors should:

1. Use the most recent data available, including revised survey data to be available for review in September and revised bycatch data from the groundfish fisheries when those become available.
2. By September, 2009, provide complete documentation on data sources and the calculations and assumptions used in the stock assessment for computing OFL. Table headings should clearly and

accurately describe the data, including indicating when data includes a handling mortality assumption.

3. Develop an assessment model that incorporates the entire stock area in the next assessment cycle.

Pribilof Islands Red King Crab

The SSC agrees with the Plan Team recommendations for management of Pribilof Islands red king crab under Tier 4, setting $\gamma=1$, $M=0.18$, using the 1991 through 2009 period to determine the average mature male biomass as a proxy for B_{MSY} , once the 2009 bottom trawl survey results for this area are available. The SSC appreciates the inclusion of estimates of B_{MSY} proxies for the two time periods, 1980 through 2009 and 1991 through 2009, and looks forward to the results of the final analysis in October. The Plan Team's rationale for beginning the time series at 1991, was based on the observation that red king crab were relatively uncommon in the area, prior to 1991. The SSC would like to see this rationale included in the final SAFE report. The SSC also looks forward to seeing the implementation of the catch-survey analysis in next year's iteration of the assessment.

The SSC notes that there is a possibility that the abundance trends of red king crab are related to those of blue king crab, in that red king crab may be replacing blue king crab in the Pribilof Islands area. Given this possibility, it would be valuable to include interactions between these crab species, as a factor in any future development of population dynamics models. This might take the form of a single king crab model with partitioning of size class abundances between the two species, or of two separate models with a factor in each to account for the interaction.

In regards to ecosystem considerations, the SSC would like to see consideration given to time trends in the abundance and potential influence of major fish predators, including arrowtooth flounder. Also, the SSC suggests that calculations of the impact of pot gear on the substrate should be based on the area inhabited by the Pribilof Islands red king crab population, rather than the entire area of the Bering Sea shelf.

Pribilof Islands Blue King Crab

The SSC agrees with the Plan Team recommendation for management of Pribilof Islands blue king crab under Tier 4, with $\gamma=1$, $M=0.18$ using the 1980 through 1984 and 1990 through 1997 time periods, to determine the average MMB as a proxy for B_{MSY} , estimated as 9.01 million pounds. The SSC appreciates seeing the written justification in the SAFE omission of the 1985 through 1989 period, because it may not represent the productivity potential of the current stock.

This stock was declared overfished in 2002 and, even though there has not been any directed fishing since 1999, the stock has continued to decline. It is unlikely that it will be rebuilt by the end of the rebuilding plan 10 year horizon in 2012. Recognizing that a new rebuilding plan will be needed, and that additional protective measures could be taken, the SSC commends the Plan Team for considering five alternatives (listed in the September 2008 plan team minutes) to reduce bycatch of blue king crab, four of which pertained to closing areas to all targeted groundfish harvest or just to directed Pacific cod harvest. The fifth alternative was to modify pot gear for Pacific cod. If the Council initiates a review of these alternatives, the SSC requests that the analysts identify expected bycatch reductions that might be accrued. The SSC also encourages additional observer coverage as appropriate to improve monitoring of blue king crab bycatch. While the Plan Team suggested not considering this fifth alternative, the SSC suggests that use of a slick ramp for Pacific cod pots to make entry into a pot difficult for king crab should be considered.

In regards to a revised rebuilding plan, the SSC recommends reconsideration of the time frame for estimation of B_{REF} in terms of potential environmental changes that may have altered the potential productivity of the population. The SSC also requests that when a revised rebuilding plan is developed, it

should include an analysis examining information on stock separation from the St. Matthew Island blue king crab stock and the possibility of competitive or predation interactions with Pribilof Islands red king crab.

St. Matthew Island Blue King Crab

St. Matthew blue king crabs are assessed by a four-stage catch-survey analysis of males only. This stock was declared overfished in 1999, and the fishery has since been closed and managed under a rebuilding plan. This stock has been recovering, and mature male biomass exceeded the rebuilding target in 2008. If this occurs in 2009, as well, which the Crab Plan Team feels is likely, the stock will be considered to be rebuilt.

Five model scenarios were analyzed. Among these, the Crab Plan Team recommended scenario 1, with a fixed catchability coefficient (q) and natural mortality (M), with a separate M estimated for 1999. **The SSC agrees with the choice of model scenario 1, the Plan Team's recommendation for Tier 4 designation, and the Plan Team's itemized comments listed on p. 18 of the introduction section of the Crab SAFE.** In summary, these are: (1) towards possible future Tier 3 designation, continue model refinements for review at the May 2010 Crab Plan Team meeting; (2) include bycatch in the estimation model, so that a total male catch OFL can be estimated and, ultimately, total male and female catch OFL; (3) include confidence intervals on model output and CVs for surveys; (4) examine the sensitivity of weighting choices; (5) include separate likelihood components for total number of crab and breakdown to size classes; (6) report the number of parameters for each model scenario; (7) justify how changes in molting probability affect model results; and (8) run the model to determine how the stock might respond at a F_{MSY} proxy to inform B_{MSY} .

Norton Sound Red King Crab

This assessment utilizes a length-based model that combines multiple sources of data, including information from four surveys and three fisheries. The revised model does not include discard mortality or mortality from non-directed fishery bycatch. The stock trajectory exhibited a sharp decline in the 1980s, from high biomass levels during the 1970s, followed by a gradual increase after 1996. The harvest rate was high in the late 1970s and early 1980s, and it fluctuated around 10% after 1983. The authors addressed the SSC request for a likelihood profile on natural mortality.

The CPT recommended, and the SSC agrees, that the assessment model output be used as the basis for estimating biological reference points for the 2009/10 season. The author provided scenarios under two different assumptions regarding natural mortality ($M = 0.3$ and $M = 0.18$). The CPT recommended, and the SSC concurs, that the scenario based on $M = 0.18$ be used for estimating stock status in 2009. The CPT also recommended, and the SSC concurs, that this stock qualifies for Tier 4 management, that the reference time period for estimation of B_{MSY} proxy should be 1983 through 2009, and γ should be set at 1. **Based on these considerations, the SSC recommends a 2009/10 OFL for Norton Sound red king crab of 0.71 million pounds (retained catch OFL).**

In addition to the recommendations above, the CPT provided the following recommendations for improvements to the model (see following paraphrased from CPT minutes). The SSC agrees with the CPT that these additional requests should be addressed in the 2010 assessment including:

1. The assessment model from the previous year should be included in the current assessment in order to evaluate the impact of changes made to the model, and to have those results as a fall-back option if the current model is unsuitable and rejected for OFL-determination.
2. In this assessment, stock losses due to natural mortality and retained catch are considered. Mortalities due to directed fishery discards and non-directed bycatch are not included; thus,

handling mortality is explicitly set equal to zero. In the absence of observer data on discards and bycatch, the assessment should include a sensitivity analysis as to a plausible range of non-retained mortalities. Also, the approach used in the Bristol Bay red king crab assessment for estimating discarded catch in the directed fishery should be investigated, with the results compared to those from the zero non-retained mortality assumption.

3. The assessment should be updated for September 2009, with the 2008/09 retained catch, in order to determine if overfishing was occurring in 2008/09.
4. Further analysis of the retrospective pattern in the assessment should be performed given concerns regarding the consistent pattern indicating an overestimate of biomass, compared to the trawl survey.
5. The assessment should include an assumed bycatch and discard mortality.

The CPT also requested, and the SSC concurs, that subsequent assessments include an OFL calculation based on Tier 5. However, the SSC continues to encourage the author to work on the Norton Sound red king crab assessment model, with a long-term goal of moving this stock to Tier 3. In particular, the SSC requests that likelihood profiles on natural mortality be included in the 2010 assessment, to re-examine the results when bycatch mortality and discard are included in the model.

The SSC recognizes that the author made last-minute adjustments to the SAFE chapter, in response to CPT requests. Several sentences appear to be remnants from the earlier version and should be fixed. For example:

1. Page 15 2nd paragraph. The author should clarify that the information available for the assessment has changed since the publication of Zheng et al. 1998. The conclusions made in 1998, may not reflect the conclusions that would be made with the current model under different assumptions of the baseline natural mortality rate.
2. Page 17, first full paragraph, last sentence. This sentence appears to be in conflict with the recommendation for setting $\gamma = 1$.

Aleutian Islands Golden King Crab

Public testimony was provided by Linda Kozak (Kozak & Assoc.) and Dick Tremaine (Norton Sound Economic Development Corporation).

The Crab Plan Team has determined that the assessment model for Aleutian Islands golden king crab is insufficient, and should not be used. They recommend managing this stock under Tier 5, using a retained catch OFL. **The SSC agrees with Tier 5 designation for this stock, but had much discussion over the time period to be used to calculate catch averages.**

The Crab Plan Team recommends using the time period of 1990/1991 through 1995/1996, whereas the SSC continues to recommend the period of 1985/1986 through 1995/1996. The SSC and Crab Plan Team agree that data prior to 1985/1986 are not appropriate to include, due to a reduction in the minimum size limit in 1985. The Crab Plan Team argued that catches during 1985/1986 through 1989/1990 are inappropriate for OFL estimation, because declines in average weight (from 4.5 to 4.1 lbs) and fishery CPUE (from 11.9 to 8.0 crabs per pot) during this period might be indicative of an unsustainable level of harvest. However, the SSC finds that those declines are rather small, relative to variability over the history of the fishery. Moreover, the SSC notes that the fishery may have been affected by other factors, such as changes in fishing effort, market price, and other BSAI crab fishing alternatives. The SSC notes that the management system was relatively constant from 1985 onward. This provides another

justification for using the longer time period to calculate catch averages. A longer time period likely provides a more robust estimate than a shorter time period.

The SSC recommends a retained catch OFL of 9.18 million pounds (i.e., same as last year) under Tier 5, based on average catch over 1985/1986 to 1995/1996. The SSC looks forward to further improvements in model development, in hopes that this stock can be managed under Tier 4 in the near future.

The SSC endorses the detailed CPT comments on page 8 of the May 2009 Crab Plan Team Report, which in summary are: (1) fits to size-composition data suggest model mis-specification; (2) need for clarity on fully selected F given that selectivity does not reach 1.0 at any size; (3) investigation of unexpected model results that suggest that some large crab are discarded; (4) consideration of whether eq. 25 is redundant with eq. 21 with clarification on what is observed vs. predicted and examination of model sensitivity to removal; (5) consideration that the penalty terms are in disparate units, which may have substantial effects on model performance; (6) fix typos on variables for C and D in eqs. 10 and 11; and (7) include scenarios both with and without commercial CPUE data consistent with previous SSC advice.

Table 1. SSC recommendations, June 2009

(Note: diagonal fill indicated parameters not applicable for that tier level, while shaded sections are to be filled out for the final SAFE in September 2009 and bold indicates changes from the CPT recommendations.)

Chapter	Stock	Tier	Status (a,b,c)	B_{MSY} or $B_{MSYproxy}$	Years ¹ (biomass or catch)	2009 ² MMB	2009 MMB / MMB_{MSY}	γ	Mortality (M)	2009/10 mill lbs [retained]	OFL
1	EBS snow crab	3			1979-current [recruitment]				0.23 (males, immat.) 0.29 (mature females)		
2	BB red king crab	3			1995-current [recruitment] ⁵				0.18 default estimated otherwise ⁴		
3	EBS Tanner crab	4		189.76	1969-1980 [survey]			1.0	0.23		
4	Pribilof Islands red king crab	4			1991-current [survey] ⁵			1.0	0.18		
5	Pribilof Islands blue king crab	4		9.01	1980-1984; 1990-1997 [survey] ⁵			1.0	0.18		
6	St. Matthew Island blue king crab	4			1989-current [model estimate] ⁵			1.0	0.18 (1978-98, 2000-08); 1.8 (1999)	[total male catch]	
7	Norton Sound red king crab	4	a	0.18 3.07	1983-current [model estimate]	5.83	1.9	1.0	0.18	0.7125 [retained]	
8	AI golden king crab	5			1985/86-1995/96 [retained catch]					9.18 [retained]	
9	Pribilof Island golden king crab	5			TBD [retained catch]					TBD [retained]	
10	Adak red king crab	5			TBD [retained catch]					TBD [retained]	

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 2/15/2010 at time of mating.

³ Model mature biomass on 7/1/2009

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.

⁵ Revised EBS trawl survey time series data used

C-4(b) Bering Sea Chinook salmon PSC avoidance data collection

Mark Fina (NPFMC) and Jeannie Heltzel (NPFMC) provided an overview of the minutes of the Comprehensive Data Collection Committee meeting on data collection needs for monitoring and assessment of the efficacy and impacts of Amendment 91. Alan Haynie (AFSC) and Ron Felthoven (AFSC) presented a discussion paper on AFA Pollock Fishery Data Collection and Chinook Salmon PSC Avoidance Incentive Program analysis. The paper outlines a menu of data elements that could be collected and the types of questions the data could be used to address. Public testimony was provided by Glenn Reed (Pacific Seafood Processors Association), Stephanie Madsen (At-Sea Processor Association), and Brent Paine (United Catcher Boats).

The Council's purpose for the Chinook PSC Avoidance Data Collection Program is not clearly articulated. This has resulted in some ambiguity regarding the choice of metrics to assess program performance, with respect to that purpose, and identification of the data needed to address those metrics. The question is whether, in the Council's view, a functional Chinook PSC Avoidance Program is demonstrated by a simple reduction in Chinook PSC count in the AFA pollock fisheries or by an increase in net benefit to society. Data and analytic needs depend on which of these questions is central to the Council's purpose for program monitoring and evaluation. **The six sample analytic goals outlined in the discussion paper (page 3) could serve as a focus for refinement of the Council's purpose statement. The SSC notes that, while the discussion paper considers questions that address program effects on some aspects of the pollock fishery (e.g., incremental operating costs of compliance), it does not address questions that explore the broader extent to which PSC avoidance savings translate into increased returns of salmon to their streams of origin (and, thus, value to people and communities dependent on those returns), nor how Chinook PSC avoidance compliance may impact profitability, sectoral economic stability, operational size-sector competitiveness, and consolidation within the regulated pollock sectors.**

The SSC recognizes the administrative and procedural time-constraints associated with Amendment 91 implementation (which is dependent upon data acquisition). The present target date (October 2009) for this action precludes design and implementation of a highly complex and elaborate data acquisition program. **The SSC suggests that consideration be given to a phased implementation of the data collection program.**

The structure of the salmon bycatch reduction program is unique. We do not have prior experience with similar programs off Alaska, or elsewhere. Thus, there are no programs that can be used to judge the likely intended and unintended economic, social, cultural, or distributional impacts of this program. Experience with other innovative management programs off Alaska suggests that unintended impacts are likely. Therefore, the SSC reiterates the need for a comprehensive program evaluation in the near future. As noted in our April, 2009 report:

the efficacy and consequences ...of Amendment 91 should be subjected to a thorough program review three to five years after implementation.

The discussion paper could benefit from a formal listing of hypotheses that derive from the key questions, and an appendix that describes models and hypothesis tests that would be used to explore the hypotheses. In addition, the appendix could assess the likelihood that the data to be collected would be sufficiently well-behaved to lead to rejection of null hypotheses.

D-1(a) Permit fees

The SSC received a presentation (via teleconference) on the draft RIR/IRFA from Ben Muse (NMFS-AKR). Public testimony was provided by John Gauvin (Best Use Cooperative).

The draft analysis contains a thorough review of benefits and costs involved in charging fees to cover the costs of issuing permits in various fisheries managed by the NPFMC. The SSC notes that some “special” types of permits (e.g., experimental fishing permits and food donation permits) may present “public goods” benefits. For these permits, benefits may accrue to a broader collection of beneficiaries (e.g., the public at large) in addition to providing benefits to the holders of these permits. **The SSC recommends that the draft analysis be released for public review.**

D-1 (b) ACL work plan

Jane DiCosimo (NPFMC), Grant Thompson (NMFS, AFSC), and Jack Turnock (NMFS, AFSC) presented information on the NPFMC’s Annual Catch Limit Workshop, held May 21-22, 2009, at the Alaska Fisheries Science Center, Seattle, Washington.

Jane DiCosimo reviewed the actions needed to bring the Groundfish, Crab, and Scallop Fishery Management Plans into compliance with the revised Magnuson-Stevens Reauthorization Act (MSRA). The required actions outlined in these Action Plans differ by FMP and are detailed in D-1(b) (1-3).

The SSC provides the following general comments regarding the timeline for revising FMPs to comply with the MSRA. Altering the analytical approach for setting harvest specifications for groundfish, crab, and scallops is an important activity that should be carefully analyzed, while the timeline for completion of these analyses is very short. **If the NPFMC elects to consider major modifications to the harvest strategy in the FMPs, then the scope of this analysis will be large because of the technical interactions between species and fishing sectors, and different stakeholders involved, making it difficult to meet the required timelines for compliance with ACL provisions of the MSRA.**

The technical guidelines for the MSRA recommend that scientific uncertainty and management uncertainty be taken into account when setting annual catch limits. A summary of three approaches to assessing scientific uncertainty in stock assessments that were discussed at the NPFMC ACL workshop were presented: 1) a qualitative approach, 2) a probability only (PO) approach, and 3) a decision theoretic (DT) approach. An example was presented that applied the PO approach, but limited the source of uncertainty to trawl survey data. Next presented were results from an application of the PO approach to Tanner crab, which assessed the size of the buffers relative to the probability of exceeding the FOFL (including the sloping control rule) under different levels of uncertainty in $F_{35\%}$, natural mortality, maturity, and handling mortality. Finally, the DT approach used a factorial analysis to assess the magnitude of the uncertainty buffer under various assumptions of absolute risk aversion and different levels of uncertainty in natural mortality, process error at all ages except age-0, recruitment (age-0), and relative spawning per recruit. The SSC noted that the PO and DT approaches were highly technical and the SSC did not have sufficient lead time to review the methodology. The SSC was, therefore, unable to make recommendations on a preferred analytical approach to assessing uncertainty.

The SSC notes that the qualitative approach would require several judgment calls on weights and buffers, and suggests that it would be useful to list the sources of uncertainty that have not been addressed. However, the SSC does not believe that authors should attempt to make judgment calls on the magnitude of the uncertainty and the weights or the buffers. The SSC was informed that assessing all sources of uncertainty in the assessment was not a requirement of the MSRA, so simplicity is desirable in the formulation of the amendment packages.

The SSC recommends to stock assessment authors that, if harvest strategies are modified to explicitly incorporate uncertainty in the buffer between OFL and ABC, then authors should strive to select the “best estimate” for parameterizing models and not the most precautionary estimate.

Groundfish FMPs:

Preliminary review of proposed Amendments to the GOA and BSAI Groundfish FMPs is scheduled for October or December 2009. Actions required to modify the FMPs are outlined in Agenda Item D-1(b)(1).

In the case of groundfish management, a buffer currently exists between the OFL and the ABC (ACL). Thus, it is expected that the groundfish management strategy will be compliant with the provisions of the technical guidelines for the MSRA. The key activity will be to assess the level of precaution currently afforded by the management strategy for the groundfish stocks or stock complexes. It was reported that NMFS groundfish assessment authors plan to apply the PO and DT approaches to assess the performance of the current harvest strategy. These analyses should be completed by August 1, 2009. **The SSC supports this activity and will comment on the results at the October NPFMC meeting.**

It was reported that analyses of species currently listed in the Groundfish FMP's will be needed to determine which species or species groups should be included in the FMP and which of these species within the FMP should be managed as Ecosystem Components (EC) or as components "in the fishery." One strategy would be to remove non-specified species from the FMP, and consider forage fish and prohibited species as candidates for EC management. NMFS analysts presented a vulnerability assessment tool at the NPFMC workshop that considers the susceptibility of a species to fisheries and the productivity of the species. Workshop participants recommended that the vulnerability of forage species, target species, non-target species (members of the "other species" complex), and prohibited species should be assessed over the summer. **The SSC supports the recommendation to conduct the vulnerability analysis and will comment on management category assignments at the October Council meeting.**

Crab FMP

Preliminary review of the proposed amendments to the BSAI Crab FMP is scheduled for June 2010. Actions required to modify the BSAI crab FMP are outlined in Agenda Item D-1(b)(2).

It appears that the major change required is that ABCs (ACLs) will have to be determined, in addition to OFLs. **The SSC seeks clarification about ACL requirements, as well as the SSC role in ACL determinations in FMPs in which TAC-setting has been deferred to the State of Alaska.**

The SSC reiterates concern that the current timeline for review of OFL determinations for crab stocks does not allow an SSC review of the final OFL recommendations prior to the release of the TACs by the State of Alaska. It is the SSC's hope that this issue will be revisited by the Council and Board of Fisheries.

If the Crab FMP is modified to provide an ABC (ACL) control rule, it should explicitly consider uncertainty. Workshop participants suggested that the PO and DT approaches could be considered as a method for setting the buffer between ABC (ACL) and OFL. The workshop report suggested that groundfish could be used as a starting point: the analysis should include a table, by tier category, with the implied assumptions regarding P* or the level of risk aversion underlying each buffer. However, the SSC noted that crab assessment authors do not necessarily need to tie their selection of uncertainty buffers to the results from the retrospective analysis of the performance of the groundfish harvest strategy. The SSC recommended that crab stock analysts work over the summer on PO techniques like that presented for Tanner crab. This PO approach could be extended to Tier 3 crab stocks, using model estimates of OFL including uncertainty in current biomass, $F_{35\%}$ and $B_{35\%}$. There are several outstanding sources of uncertainty in crab assessments, including, biomass measure (male limited), vulnerability, and spatial differences in growth and reproductive processes.

Scallop FMP

Preliminary review of proposed Amendments to the Scallop FMP is scheduled for June 2010. Actions required to modify the BSAI scallop FMP are outlined in Agenda Item D-1(b)(3). The SSC notes that, like crab, major modification of the Scallop FMP will be needed for ACL specification. **As in the case of crab, the SSC had uncertainty about ACL requirements, and the SSC's role in ACL determinations in deferred management situations.**

The SSC reviewed alternative approaches for the scallop ACL analysis (item 38 in the workshop report). **The SSC concluded that the approaches identified by the workshop participants represented a reasonable suite of alternatives.**

D-2(a) Trawl Sweep requirements in the Bering Sea flatfish fishery

The SSC received a presentation of an initial review draft of the EA/RIR/IRFA for this action, from Diana Evans (NPFMC) and Melanie Brown (NMFS-AKR). Public testimony was received from John Gauvin (Best Use Cooperative) and George Pletnikoff (Greenpeace). The SSC reviewed a discussion paper on this action in February 2007, and thanks the analysts for their efforts to address SSC comments from that time. The analysis reports on a potentially economically and environmentally desirable fishery technology change, which should be regarded as a good first step to reduce adverse fishing impacts imposed by Bering Sea flatfish trawls on the benthic ecosystem.

The SSC notes that the option to expand the boundaries of the St. Matthew Island Habitat Conservation Area (SMIHCA), as presented in the analytical document, has little obvious relation to the modified trawl sweep requirement, and recommends that the document be clarified to explain why gear modification and area restrictions are being considered simultaneously. While the draft EA/RIR/IRFA provides sufficient information in relation to the proposed action requiring use of modified trawl sweeps, the same is not true for the alternatives that consider opening of the modified gear trawl zone (MGTZ or "wedge") or the proposed expansions of the SMIHCA boundaries. **Therefore, the SSC recommends that the draft not be released for public review and that a revised document should be reviewed by the SSC when these issues have been addressed.**

Specific recommendations for improvements to the document are:

- Modify the title of document to better reflect all of the actions contemplated. The current title refers solely to trawl sweep modifications, but should also refer to the proposed changes to boundaries of the MGTZ, SMIHCA, and the Northern Bering Sea Research Area.
- Include a detailed map of the distribution of NMFS trawl survey tows, in relation to the MGTZ and the SMIHCA, and analysis of the species composition of tows occurring in those areas.
- Include input from the Crab Plan Team (CPT) on the proposed changes to the SMIHCA boundaries. It was noted that agency members of the CPT could access confidential information to aid in developing their recommendations. Alternatively, a confidentiality waiver could be sought.
- Add depictions of MGTZ and SMIHCA options to all maps of fishing effort, target species, non-target species, marine mammal, and seabird distributions, especially those for blue king crab.
- The definition of the 2.5 inch clearance performance standard for modified sweeps needs to be clarified in the RIR. As written, the performance standard requires that a minimum of 2.5 inches clearance "from the bottom" or "from the substrate" must be maintained, clearly an unenforceable standard, and contrary to the definition of the performance standard in the draft regulatory language.
- Statements regarding the effects of modified sweeps on invertebrates (e.g. page vii) should be qualified to indicate size and statistical significance of effects.

- Discussion of potential effects of MGTZ and SMIHCA options on seals, walrus, seabirds, and subsistence resources should be expanded. There is a known walrus haul-out on the east side of St. Matthew Island, and known high densities of some seabird species in the area, directly east of St. Matthew Island.
- Tables 1 and 34 state that “*reduction in impacts is expected to improve the productivity of fish stocks beyond what they would have been under the status quo.*” This statement conflicts with the finding of “*no substantial beneficial impact*” to habitat from the adoption of Alternative 2, reported in the EA, and similar findings on page 115 of the RIR. Only one can be correct. The documents should be brought into agreement.

Alternatives 2 and 3 were reviewed by the SSC, as part of the Amendment 89 analysis, at which time concern was expressed about requiring the gear modification. The concern was based on small sample sizes, limited sampled habitats, and limited information on impacts to target catch rates, bycatch rates, and PSC rates. While additional work has been conducted on effects of modified sweeps on benthic habitats, the SSC notes that no additional research has been conducted on target species catch rates, bycatch rates, or PSC rates. The SSC recommends that, if the MGTZ is opened, the NMFS trawl survey should be expanded into that area. In addition, at least 100% observer coverage should be required on all vessels fishing in the MGTZ.

Discussion in the document of economic impacts and small entity implications of the proposed alternative fishing area changes is inadequate. For example, there was no discussion regarding impacts to other fisheries that may be affected by changes in the definition of SMIHCA. As a result, the public would be unlikely to find the necessary data and analysis in the current document to understand the relative benefits and costs of those actions, and to whom each may accrue.

The SSC notes that if the Council wishes to move forward with Alternative 2 (require modified trawl sweeps in Bering Sea flatfish fisheries) at this meeting, that action could be separated from the MGTZ alternative and SMIHCA option, but that this may not be optimal for some stakeholders.

D-2(b) Catch specifications for BSAI skates

The SSC heard a presentation by Jane DiCosimo (NPFMC) on the need to adopt Amendment 95 to the BSAI Groundfish FMP. The purpose of the amendment is to manage skates as a target species category, rather than have these continue to be included in the “other species” category. The amendment also specifies the maximum retainable amounts (MRA) for skates.

Skates are long-lived species, with low fecundity. They are, therefore, vulnerable to overfishing. As presently managed in the “other species” category, a target fishery for skates could develop using the entire ABC and TAC for all species in the “other species” category. To provide more protection for skates in the BSAI, Amendment 95 assigns skates to the Target Species category, thereby requiring the NPFMC to annually establish OFL, ABC, and TACs for skates, as is presently done for skates in the GOA.

The proposed Amendment will provide the desired management control, without significantly impacting other fisheries or ecosystem components. The analysis is complete and well justified. We commend the authors on including a discussion of the MRA issue and the potential for the proposed changes to MRAs to allow an increase in skate catch. **The SSC recommends that the draft document be released for public review.**

D-3(a) Status Report on HAPC process

In preparation for the next RFP process for HAPC sites, the SSC formed an ad-hoc group, composed of SSC and plan team members, to review HAPC proposal evaluation criteria. The workgroup has just been formed and a chair has been assigned. The workgroup will meet over the summer to design a set of rating criteria that will be used to evaluate candidate HAPC sites. These criteria will be presented to the Plan Teams in September and to the SSC and Council in October.

D-3(b) Northern Bering Sea research plan

An Alaska Fisheries Science Center (AFSC) workgroup is preparing a research plan for the North Bering Sea research area (NBSRA), as stipulated under Amendment 89 to the BSAI Groundfish FMP. Cynthia Yeung (NMFS-AFSC) presented a draft outline of the research plan. The workgroup seeks guidance from the SSC on the plan outline, the proposed trawl studies, and recommendations for a future workshop. Public testimony was given by Arthur Lake (Bering Sea Elders Advisory Group), John Gauvin (Best Use Cooperative), and Dorothy Childers (Alaska Marine Conservation Council).

The draft outline identified four components: (1) preliminary trawl surveys to establish baselines; (2) non-pelagic trawl impact studies; (3) fishery-dependent research; and (4) ecological studies. Only component 2 was described in any detail. The outline is in an early stage of development, and was provided as a starting point for discussion.

The draft plan stated that there is a “lack of baseline information on the bottom habitats and community ecology of the North Bering Sea (NBS) for assessing the effects of non-pelagic bottom trawling”. Although it mentions the ongoing BEST/BSIERP studies in the NBS, the outline does not fully acknowledge the scope of these and other studies that have occurred in the area over the past four decades. Areas utilized by marine mammals, seabirds, crab, listed species, and subsistence resources and users should be mapped. These data should be compiled and integrated, either as part of component 1 of the new research plan, or as a new separate mapping and retrospective analysis component. The results of this retrospective analysis may inform the experimental study design and designation of trawl/no trawl areas.

The SSC suggests the expansion of the AFSC summer trawl surveys into the NBSRA to collect data and monitor benthic communities there. Such new survey data will be important to estimate potential fishery resources, as well as species that may be impacted.

The before-after, control-impact (BACI) experimental design appears to be appropriate for investigation of the impact of non-pelagic trawling on the benthic environment (component 2). However, the authors should clarify details of the proposed experiment, such as whether there is spatial overlap of trawl and control study sites, what constitutes a modified research trawl compared to commercial trawls, and how the impacts of research trawls and survey trawls will affect the results. The research plan could consider using low impact sampling methods, such as submersibles or ROV's. Also, the design might consider the potential effects from pelagic trawlers, which occasionally make bottom contact, to minimize these influences on study results. The authors should also clarify whether experimental areas will be open to commercial fishing or only under research charters to commercial vessels.

Component 3, ‘Fishery-dependent research’ is not well described in the document, but it includes recommendations for areas within the NBSRA that should not be opened to bottom trawling. The SSC concludes that the proposed non-pelagic trawling boundary of 63°N parallel (north with no trawling, south with experimental trawling) is arbitrary and has no physical or biological basis, other than roughly dividing the NBSRA into equal parts. The 63°N cuts through the St. Lawrence Island Conservation area

and omits most of the Spectacled Eider Critical Habitat Area. The SSC suggests that part of the goal of the proposed workshop should be to define these boundaries, and should include a synthesis of detailed maps and information on the distribution of benthic habitats, non-target and protected species, as well as resources important to Native community subsistence users.

The explanation of the 'Ecological studies' component is sparse and general, so it is difficult to comment on how this might integrate into the whole plan. In the introduction, the authors note the potential for direct and indirect effects of non-pelagic trawling on protected species and on higher trophic levels in general. However, the current study plan outline does not address these effects, other than referencing ecological studies, and refers only to 'affected benthic invertebrates and their linkages to managed fish stocks'. This component of the plan should more fully explain how it will integrate linkages to upper trophic levels, including eiders, whales, walrus, and subsistence resources. In addition, the impetus for the NBSRA study plan is the potential redistribution of fisheries due to climate change, yet the outline does not indicate how it will incorporate environmental change into the plan. Some research (e.g., Grebmeier) has already indicated that ecological changes are occurring in this region, owing to climate change.

The SSC agrees with the proposal to convene a workshop to prepare a detailed research plan. The SSC recommends that at least two workshops be convened, with the first occurring in Alaska and at a time when members of Bering Sea communities can participate. Two potential meetings in 2009, include the October 22-24, Alaska Federation of Natives Annual Convention, and the December 1-5 BIA Providers Conference, both to be held in Anchorage. Native communities should be brought into this process early, and should be provided with guidance as to information that could be of value for the workshop. For instance, information on harvested subsistence resources and subsistence harvest areas is critical. The second workshop could occur in Seattle or Anchorage, to accommodate researchers, and would benefit by inclusion of investigators from historic and on-going studies, such as OCSEAP, St Lawrence Island Polynia Studies, cetacean research, and BEST/BSIERP. Identification of subsistence and other resources in advance of this meeting, would help identify appropriate scientists to invite. In addition to researchers, this second workshop should include some managers, to identify potential management alternatives and Council information needs, questions, and priorities. The workshops should also include members of the fishing industry, to identify interest in potential commercial species and areas. Participants from ADF&G and federal agencies with specific knowledge of subsistence practices should also be included.

The SSC recommends that the research plan include a timeline of expected task completions and products, such as scheduling of workshops, deadlines for completed maps, and when to complete the priority list of research questions. The plan should identify priorities for protected resources, areas of interest to industry, and areas important to communities for subsistence, including the habitats that support subsistence species. The SSC heard in public testimony, which included industry representatives, that there is no rush to have a final research plan in place. The current timeline may not allow for a fully informed process, and it is important that the draft plan include management issues and involve all interested parties. **The SSC requests clarification from the Council on the timeline for development of the NBSRA research plan, which was stated in the presentation as 2010, but may have been changed to 2011.**