**DRAFT REPORT**
**of the**
**SCIENTIFIC AND STATISTICAL COMMITTEE**
**to the**
**NORTH PACIFIC FISHERY MANAGEMENT COUNCIL**
**October1st – October 3rd, 2012**

The SSC met from October 1st through October 3rd at the Hilton Hotel, Anchorage AK.

Members present were:

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| Pat Livingston, Chair<br>*NOAA Fisheries—AFSC* | Robert Clark, Vice Chair<br>*Alaska Department of Fish and Game* | Jennifer Burns<br>*University of Alaska Anchorage* |
| Henry Cheng<br>*Wash. Dept. of Fish and Wildlife* | Alison Dauble<br>*Oregon Dept. of Fish and Wildlife* | Sherri Dressel<br>*Alaska Department of Fish and Game* |
| Anne Hollowed<br>*NOAA Fisheries—AFSC* | George Hunt<br>*University of Washington* | Gordon Kruse<br>*University of Alaska Fairbanks* |
| Kathy Kuletz<br>*US Fish and Wildlife Service* | Seth Macinko<br>*University of Rhode Island* | Franz Mueter<br>*University of Alaska Fairbanks* |
| Jim Murphy<br>*University of Alaska Anchorage* | Lew Queirolo<br>*NOAA Fisheries—Alaska Region* | Terry Quinn<br>*University of Alaska Fairbanks* |
| Kate Reedy-Maschner<br>*Idaho State University Pocatello* | Farron Wallace<br>*NOAA Fisheries—AFSC* | Ray Webster<br>*International Pacific Halibut Commission* |

## B-1(b) Plan Team nominations

The SSC reviewed the Plan Team nominations of Dr. Christopher Siddon to the Bering Sea and Aleutian Islands Groundfish Plan Team, and Elisa Russ and Mark Stichert to the Gulf of Alaska Groundfish Plan Team. The SSC finds all three individuals to be well qualified, with appropriate expertise that will assist each of the Plan Teams. The SSC recommends that the Council approve these nominations.

## C-1(c) Charter Halibut: Review Methodology for 2013 limits

Scott Meyer (ADFG) presented a discussion of preferred methods for projecting charter halibut yields in IPHC Areas 2A and 2C under several alternative management measures. Jane DiCosimo (NPFMC) provided context for the analysis by discussing the status of the proposed commercial/charter catch sharing plan for Pacific halibut, and the process by which the Council and the IPHC put charter halibut control measures into regulation. Gregg Williams (IPHC) outlined a potential change in setting CEYs for Pacific halibut to an approach that explicitly evaluates risks to the stock. Roland Maw (United Cook Inlet Drift Association), Bruce Gabrys (commercial fisherman), and Linda Behnken (Halibut Coalition) gave public testimony.

The analyst outlined a number of methods for projecting charter halibut harvest under different management restrictions, along with an approach to estimating discard mortality. The SSC supports the choice of projection methods given the uncertainty in future harvest due to the effects of management actions on charter behavior and due to changes in the underlying size distributions of the stock. These methods are appropriately conservative in tending to give projected estimates that are likely higher than the realized harvest.

The SSC recommends that consideration be given to getting records of the condition of discarded fish in order to improve estimates of discard mortality rates. The SSC recognizes that, with variability among charter operators' practices and geographical differences in size distribution, it will be important to ensure that such data are representative of all discards. During discussion, the SSC noted that the greatest uncertainty in estimating total discard mortality is due to the lack of data on the size distribution of discarded halibut, which cannot be improved without measurement of discarded fish.

The SSC supports the examination of changes in the size distribution of halibut for subsets of IPHC setline survey stations in areas of the greatest charter harvest in order to help understand how changes in stock composition may affect projections of harvest.

The SSC recognizes that understanding human behavior is especially critical in anticipating the differential impacts associated with the form that charter halibut catch management may dictate. Charter halibut operations market an opportunity to realize *a priori* expectations. At present, our understanding of how prospective anglers' expectations are influenced by halibut retention regulations is largely based on anecdotal information. Because the form catch retention management takes (e.g., one-fish, reverse slot, maximum length) has the potential to profoundly affect economic demand for trips, an analysis of halibut charter demand should be a priority.

Regarding the time series forecasting models, the SSC suggested the use of AICc or similar criteria for model selection, and recommended that 95% confidence intervals be presented to convey forecast uncertainty. There may be bias in model selection when the mean squared difference is used as a basis for comparing the mean, moving average, exponential smoothing and double exponential smoothing models detection of trends in the series. This will also affect the modeling framework.

The analysis represents a time series analysis and could be cast in a general ARIMA modeling framework because the double exponential, single exponential, and mean smoothing of a data series are special cases of ARIMA(0,2,2), ARIMA (0,1,1), and ARIMA(0,0,0) processes.

Therefore, the analysis should consider using:

i) ACF, differencing (ARIMA(0,1,0)) and unit roots test (for stationarity and invertibility) to objectively identify whether there is a trend;
ii) AICc and BIC for the choice of statistical models (ARIMA(p,d,q));
iii) all available data to fit all possible models instead of dropping the first 6 points. This can help to lower the uncertainty of the predicted values. The exponential smoothing model only requires one starting point instead of six points.

The first order differencing ARIMA(0,1,0) is a powerful tool to identify the trend and allows the model to satisfy both the stationarity and invertibility criteria. It is not likely that the second order differencing (ARIMA(0,2,0)) will be needed.

**C-2(a) Groundfish Plan Team reports**

The SSC received presentations from Grant Thompson (NMFS-AFSC) and Diana Stram (NPFMC) on a number of recommendations from the BSAI and GOA Plan teams. For the most part, the SSC supports the GPT recommendations, but also had comments and additional recommendations on some of the items presented that are provided below.

**Retrospective Analysis**

A retrospective pattern is a systematic inconsistency among a series of estimates of the population size, or related assessment variables, based on increasing periods of data. A retrospective pattern is an indication something is inconsistent (data and/or model). The SSC concurs with the working group and the

Groundfish Plan Team (GPT) recommendation that for Alaska groundfish assessment with Tiers 1-3 age-structured models, a retrospective analysis should be done as part of the model evaluation.

The authors have provided three examples with possible biological explanations in the report. Choice among possible explanations can improve the relationship between data and the proposed model, and model forecasting. They can also consider using possible statistical explanation(s) to understand and improve the proposed model from the retrospective pattern of the estimated spawning biomass series. These include:

i) adding one unknown parameter when there is a sudden jump in the sequential retrospective pattern;

ii) robustness of the estimated virgin spawning biomass;

iii) the relationship between the estimated virgin spawning biomass and the availability of data in the proposed model; and/or

iv) whether the input parameter(s) has/have reasonable value(s).

It may help the GPT to adapt or abandon the use of estimated B0 and/or $B_{MSY}$. The estimated spawning biomass is not a direct estimate from the model output. It varies with the proposed model and is a byproduct of several estimates from the model output. So, it is a challenge to provide explanation whether it is caused by data and/or the proposed model. The authors can investigate the retrospective pattern of the estimated recruitment because it is a direct estimate from the model and can be compared directly with the observed catch data.

**Methods for Survey Averaging**

There are at least three reasons for wanting to average survey abundance or biomass over time: (a) to obtain a good estimate of biomass for use in Tier 5 calculations, (b) to apportion biomass to subareas, and (c) to interpolate between survey data points. The appropriate method for each reason could be different. The Joint Groundfish Plan Team discussed Kalman filter (KF) and random effects (RE) models as alternatives to unweighted or weighted averaging techniques, which have been used for the most part in groundfish stock assessments.

Equations should be included for the Kalman filter (KF) and random effects (RE) models. The equations can help reviewers to identify the structure of errors in observation and state equations. In addition, the use of KF approach can model process errors, measurement errors and random effects in one likelihood that is free of high dimensional integrals. The weakness of the KF approach is that the KF estimates are somewhat different than maximum likelihood estimates. In addition, identification of over-parameterization in the KF approach is very difficult. So, the authors should check whether they have sufficient replicates and data for their proposed model. The RE models usually help the authors to understand the correlation of two random effects and its prediction ability is the same as the fixed effects models. The Discussion section of the report could be strengthened to include observations such as that bias will increase with increasing weight given to past observations when there is a trend in the data, and this is a particularly undesirable property of the equal-weighting methods. Precision, on the other hand, will generally improve as more data are included, and this is the goal of using more than the most recent survey results. The Kalman filter essentially balances these by accounting for both within-survey and between-survey variability, leading to estimates which are both more precise than using a single survey, but generally have relatively little bias compared to more naive weighting methods. Including this kind of text in the discussion will help provide stronger motivation for changing to a KF type weighting scheme for a range of species, without being completely dependent on a very specific simulation study.

Regarding the tables of simulation results, the final rows of each table contain averages over all previous rows. These rows do not generally provide a meaningful comparison of the methods and should be removed. For example, a weighting scheme that is strongly negatively biased when the trend is positive but positively biased when the trend is downwards will not seem so bad when biases are averaged over both types of trend.

The SSC concurs with the Team that stock assessment authors for Tier 5 stocks should continue to use status quo methods for survey averaging, and that they should also calculate alternate RE estimates, so that experience can be gained over time in how similar or different the estimates are from the two approaches.

**BSAI and GOA Pacific cod models**

Grant Thompson (NMFS-AFSC) and Diana Stram (NPFMC) presented Plan Team recommendations for models that will go forward for consideration at the November Plan Team meeting. These models are based on proposals by the senior assessment author(s), the Plan Teams, the SSC, and the public following the process established in recent years. For the BS Pacific cod stock, the Plan Team recommends including the currently accepted model (Model 1) and Model 5 because it is parsimonious and includes a number of features that improve fit to the data. The Plan Team recommended the author bring forward a version of Model 5 that incorporates time varying selectivity for the fishery, if time permits and is worthwhile. The SSC supports Plan Team recommendations and encourages the author - if time permits - to bring forward a model that considers time varying survey Q to see if that produces better fit to the survey data. The SSC also agrees with the Plan Team request for the author to bring forward Models 1.1 and 4 to provide a check on the candidate models. In response to a previous SSC request, the author completely re-parameterized the inter- and intra-annual weight-length relationship in a way that follows an explicit phenological process and is biologically reasonable. This change is incorporated in Model 5. The SSC believes this provides a significant improvement in the fit to the data that should be carried forward in Model 5. The approach could also serve as a model for other assessments.

The Plan Team reviewed two models for Aleutian Island Pacific cod. Model 1 was based on the EBS model, but with only one season. Model 2 was like Model 1 but included time-varying growth. These models illustrated that there is an obvious trade-off between modeling growth and recruitment. The Plan Team recommends that the two models presented in the preliminary assessment be updated with the most recent data and be brought forward for presentation at the November Plan Team meeting so as to continue progress on development of this assessment. The SSC agrees with Plan Team recommendations and looks forward to further development of the Aleutian Island model. The author mentioned that he has requested ageing of historical samples and intends to incorporate these into further assessments. Also, the development of an empirical growth relationship outside of the assessment model would be informative. **When the SSC judges this assessment as appropriate for setting management benchmarks, it will be used to set separate OFL and ABC for the Aleutian Island Pacific cod stock. This could happen as soon as the next assessment cycle (2014 fishing season).**

The Plan Team reviewed a suite of GOA Pacific cod models that centered on SSC, Plan Team and public comments and recommendations. The Plan Team recommended that the base model used last year be brought forward for consideration in November and that the authors explore models that consider fixed Q, drop the sub 27 size category, drop the mean length-at-age data and authors' preferred model. The SSC agrees with Plan Team recommendations and looks forward to future model developments and a more thorough documentation of the recent model improvements.

**Kamchatka Flounder Model**

Kamchatka flounder are currently managed under Tier 5 using an estimate of natural mortality (M) and 7-year averages of trawl survey biomass from the Bering Sea shelf and slope and Aleutian Islands.

Kamchatka flounder have been distinguished from arrowtooth flounder in the survey since about 1991 or 1992 and in the fishery since 2007. Arrowtooth and Kamchatka flounder have been managed separately since 2011 because a directed fishery emerged for Kamchatka flounder in 2010.

The analysts developed a provisional sex-specific length-based assessment model that also estimates numbers at age with a length-age matrix. Inputs include catches from the EBS shelf and slope surveys and Aleutian Islands survey. Species-specific commercial catches are available only since 2007. Over the period of 1991 to 2006, it is assumed that Kamchatka flounder constituted 10% of the catch comprised of Kamchatka flounder, arrowtooth flounder, and Greenland turbot.

The Plan Team recommended additional sensitivity analyses of alternative values of M, further development of the age-structured model to be reported in September 2013, and inclusion of an alternative Tier 5 analysis using M=0.13. The SSC appreciates the efforts of the analysts to develop this initial assessment for this species and supports the Plan Team's requests of the analysts. In addition to those, the SSC adds the following requests:

1. Report on what is known (or assumed) about stock structure. The assumption seems to be that Kamchatka flounder from the EBS and Aleutian Islands represent one stock. Are there any data at all that can be brought to bear on stock structure? For instance, do length/age frequency distributions from the Aleutians and EBS suggest synchrony in year classes?
2. Evaluate the sensitivity of the assessment to the assumption that Kamchatka flounder of a fixed sex ratio constituted 10% of the catch of arrowtooth flounder and Greenland turbot over 1991-2006. Also, the assessment reports that Kamchatka flounder have been consistently identified in trawl surveys starting in 1991 (executive summary) or 1992 (introduction). Does the start year of the time series affect the resulting assessment?
3. Report on the sex ratio of the commercial and survey catches, as well as the estimated population.
4. The weight-length relationships shown in the upper and lower panels of Fig. 7-6 appear to be identical. One of the two must be in error.
5. Consider whether any other methods (e.g., Alverson and Carney, Jensen) are available to generate alternative estimates of M. Also, consider whether there is evidence for different estimates of M for males and females. Is there evidence of sex-specific M's for closely related species?
6. Report whether data are available to examine potential changes in growth over time. Given the similarity in diets among Kamchatka and arrowtooth flounder and the increase in arrowtooth flounder biomass, there may be potential for changes in growth of Kamchatka flounder over time. If the reported size at age data for the Aleutian Islands in 2010 represents the only such data available, then such an analysis is not possible at this time.
7. In Fig. 7-5, consider truncating the x-axes so that the length-frequency histograms are spread out and easier to examine for year-to-year modal progressions.
8. The analysis assumes dome-shaped selectivity for the shelf survey and asymptotic selectivity for the slope and Aleutian Islands survey. Some justification is provided. Consider evaluating the sensitivity of the assessment to these assumptions.
9. Report what weightings were used for the three surveys. Confidence intervals appear to be tighter for the shelf survey compared to the slope and Aleutian Islands survey. Consider evaluating the sensitivity of the assessment to alternative weighting of the three survey time series. Also, the model appears to overestimate periods of low shelf survey biomass and underestimate periods of high shelf survey biomass (Fig. 7-16). Why? Are there potential model mis-specifications? Would this residual pattern be addressed with higher M estimates?

10. What is the justification for the sharp drop in full-selection F from 2009 to 2011? This appears to be counterintuitive, given that this is the time period corresponding to development of the targeted Kamchatka flounder fishery.
11. Explain the years that are represented in the averages shown in Fig. 7-18 in the associated figure caption.
12. Consider including tables of resultant population estimates (numbers or biomass) at age and time series of estimated recruitment.
13. Present and discuss model fit diagnostics (e.g., residuals) and discuss the model's ability to replicate the various input data series.

To the extent possible, the SSC recommends that the author address some of the more minor issues above in time for the November/December 2012 assessment cycle. Otherwise, the SSC looks forward to further model development to address the other more substantial issues in the next assessment cycle.

**Greenland Turbot update**
There were major changes made to this assessment, so it is being vetted to the Plan Team and SSC per standard operating procedure. The SSC supports the recommendations of the Plan Team. In their description of the models with varying SigmaR, the authors use the word "parsimonious" when they appear to mean "best fitting" or something similar, and we request the authors correct this to avoid confusion over the nature of the models being fitted.

**BSAI Skates**
There were major changes made to this assessment, so it is being vetted to the Plan Team and SSC per standard operating procedure. The author used the updated version 3 of Stock Synthesis, and a Schnute growth curve rather than a von Bertalanffy. Fishery and survey selectivities are allowed to be dome-shaped, and a new density-dependent survivorship function developed by Mark Maunder is used. The oldest age is increased from 25 to 30, and only the most recent year of length-at-age data is used.

These changes result in modest increases in biomass, fishing mortality, ABC, and OFL. The Plan Team approved of the changes to the assessment and recommended that three models be developed for November/ December: the model with last year's configuration, the revised model, and an extension of the new model, in which growth parameters are estimated internally in the model. The Plan Team also recommended that the author try lowering the starting size of the plus group to 110 cm. The SSC concurs with these recommendations but also recommends an additional model with all three length-at-age datasets be considered for November/ December.

**C-2(b) Groundfish Catch Specifications**
The SSC received a presentation from Grant Thompson (NMFS-AFSC) and Diana Stram (NPFMC) on the proposed harvest specifications for groundfish in both the BSAI and the GOA for 2013 and 2014. The SSC recommends approval of these specifications.

**C-3 Observer Program**
A presentation was given by Craig Faunce (NMFS-AFSC) on the NMFS Annual Deployment Plan (ADP) for the North Pacific Groundfish Observer Program in 2013. Public testimony was provided by Rachel Dunkersloot (Alaska Marine Conservation Council), Paul Olson (The Boat Company), Dan Falvey (Alaska Longline Fishermen's Association), and Jon Warrenchuk (Oceana).

The SSC appreciates the extensive work done to finalize the ADP that provides details on the rationale for the rate of observing to contain program costs, and mechanics of observing catches at sea and dockside sampling for groundfish fisheries in Gulf of Alaska and Bering Sea/Aleutian Islands. While the ADP is not a regulatory document, the SSC was asked to provide comments on adequacy of the sampling design to achieve the multiple goals of the observer program. We primarily focused our comments on methods and rates of observing the partially-observed strata (trip selection for vessels >57.5’ and vessel selection for vessels 40 to 57.5’) in the ADP since very few changes were made to the 100% observed vessels. Our general comments on the sampling design are:

- **The new sampling design for partially-observed vessel types is a significant improvement over the current sampling design in that a single rate (13%) is applied to all strata and the selection of either vessels or trips is completely randomized to avoid the observer effect thought to exist in the current deployment plan. This will greatly increase the likelihood that statistics derived from observed trips are unbiased with respect to the unobserved trips.**
- The sampling design and rate for 2013 represents an initial effort to deploy a completely randomized design with equal coverage across all partially-observed vessels greater than 40 feet in length. It is likely that this initial effort will not be optimal with respect to management needs and cost-benefit. We envision that once these data are collected and analyzed, revisions to the design and overall ADP will be forthcoming to attempt to optimize the deployment of observers to meet Council management objectives and priorities, and deliver the highest precision possible per dollar spent on the observing program.
- We also recognize that efforts to optimize the sampling design in the future will require that a set of performance measures be developed to guide improvements in the face of multiple and complex management objectives. Performance indicators will need to specify target levels, control levels, and frequency of evaluation.
- Responses to logistical concerns in deploying observers will also have to evolve over time as newly observed fleets respond to implementation of the 2013 ADP.
- As the ADP evolves in future years, we anticipate that sampling rates in each stratum, duration of observing needed in the trip-selection stratum, and the use of Electronic Monitoring devices will all change as a result of information acquired from the new sampling design.

The SSC also had the following specific technical suggestions on development of the ADP in the future:

- Review the randomization method in the sampling protocols to assess whether there is possible bias, correlation and autocorrelation among sampling points or data.
- Provide rationale for the statement "The rate of sampling will be iteratively adjusted until a set of *C* values is achieved such that 90% of them were at or below the $4.2M amount that equates to 2013 start-up funds." In addition, the authors should rerun the simulation with replicates to get the variance of the sampling rate.
- Consider use of balanced sampling in order to improve the efficiency of the sampling design with limited sampling effort.
- Consider use of balanced bootstrapping or simulation techniques in the simulation, and/or derive the parametric distribution analytically. This can help to review and check the simulation results for bias.
- Set and record the seed in the simulation as it can help potential reviewers to repeat and verify the simulation results.

## C-4(b) Steller Sea Lion EIS analytical approach

### Chapter 8 – RIR methods

Dr. Ben Muse (NMFS-AKR) presented the analytical framework that will be used in the RIR for the Steller Sea Lion Protection Measures EIS. Public testimony was provided by David Fraser (Adak Community Development Corp.).

The SSC was asked to focus on methodological considerations, emphasizing their relevance, appropriateness, and adequacy to carry-out the mandatory economic and socioeconomic impacts, including distribution considerations associated with the SSL EIS.

The presentation was excellent and very informative. **In general, the SSC believes that the methodology is sound, well established, and reasonable.** When these economic analytical protocols are applied to the biological, ecological, and administrative attributes associated with the action, the SSC believes one can anticipate a meaningful, informative, and technically sufficient RIR/IRFA.

There are a few elements of the RIR that should be modified or clarified. The document would benefit from more information on how cost items were allocated into fixed vs. variable costs in Table 8.20. In particular, maintenance is assumed to be split evenly between the two, but the basis for the assumption is not stated.

As the document evolves, it is important for the authors to clearly and accurately portray how the cost information should be used. The RIR estimates that variable costs are roughly 51-57% of gross revenue. It appears that this ratio is assumed to be constant across all the alternatives. If so, then the use of variable costs will shed absolutely no additional information in comparing alternatives than is already provided by gross revenue estimates. This is because all revenue estimates will be adjusted by the same, constant amount, and therefore, the relative impacts of the alternatives in terms of both ranking and ratios will be identical for gross revenue and net revenue estimates. Although the use of net revenue estimates will not be useful for evaluating alternatives, they will give a rough estimate of the financial impacts on the impacted fisheries. In the future, the SSC hopes that a framework will be developed that will allow for a more robust use of cost information, including relaxing the assumption that alternatives may impact revenue, but will have no impact on the variable cost ratio.

The document includes a discussion of the contingent valuation estimates of the willingness-to-pay (WTP) for changes in sea lion populations. In the background section (8.2.11), the document provides estimates for the WTP for 1% and 2% increases in sea lion populations. Given that the RPA does not predict an increase in populations, the RIR needs to justify the basis upon which it is deriving benefit estimates based on a 1-2% increase. If the purpose is to provide a rough sense of the order of magnitude of the benefits, then this should be made clear.

The discussion of fishery taxes (section 8.2.12) seems to include all taxes in the communities, not just those taxes received from the potentially impacted fisheries. To facilitate a more accurate assessment of the potential impacts to the communities, it would be helpful if the discussion is clear about the share of tax revenues that could be affected. To the extent possible, the accompanying tables should separate out tax revenues from the potentially impacted fisheries.

One pertinent consideration offered in public comment warrants additional evaluation. Because of the unique status of the community of Adak, provided under several Congressional mandates and Council actions, the suggestion was made that the period following the 2000 SSL BiOp is not reliable or reflective of the community-based fishing effort, targeting patterns, and catch deliveries characteristic of Adak-adjacent areas. The SSC suggests that the analysts consider inclusion of pre-2000 fishing data in their baseline description.

**The SSC endorses the proposed methodological approach for performance of the SSL EIS Chapter 8 RIR/IRFA.**

**Chapter 10 – Community Impacts**

Presentations were provided by Ben Muse (NMFS-AKR) and Mike Downs (AECOM). There was no public testimony.

This is a preliminary draft of the Community Impacts chapter for the SSL Protection Measures EIS in which the SSC is asked to comment on the methodology to inform revisions and completion of the remainder of the EIS. As the authors noted, some sections are more complete than others owing to the short time between contracting the work and the deadline for this initial review draft. The SSC commends the authors on the volume and high quality of data and analysis that was rapidly assembled for this initial review, acknowledging that there are still many incomplete sections.

The SSC noted that contracting the compilation and analyses of existing data to inform an action may not capture the changing nature of communities and their evolving capacities to respond to policy changes, and suggests contracting new data collection efforts when community impact analyses are needed. Fieldwork, especially in Adak, would strengthen sections where there may be no available data, but the SSC understands that this will likely not be performed for this analysis because of budget and time concerns. Given these constraints, phone calls to communities and stakeholders are reasonable substitutes. For future studies, the SSC recommend that resources be directed to support fieldwork in communities.

With reference to the Principal Components Analysis, in which a ranking of community engagement was performed, the SSC notes that the eight variables are subjective, and changing any of these variables could change the ranking. Variables to consider are proximity to the fishery, community dependency on the fishery, among many possibilities. If the current variables are retained, a rationale for selecting these should be provided.

Given the village of Atka's status as the top subsistence harvester of Steller sea lions in the State, and their new capacity for processing Pacific cod, this community should be included more directly in the analysis. It was also noted that it is likely that subsistence harvesting in Adak is more frequent than is acknowledged in the document.

It was noted that, in a few places, the presentation of statistics can dramatically alter the characterization of a situation. For example, it would be more telling for community impacts to express Adak's vessel engagement in the Pacific cod fishery in the AI subarea as a proportion of Adak's fleet, not as a proportion of the total fixed gear catcher vessels fishing the area (p. 50). If there is a single vessel participating, it still amounts to 50% of Adak's fleet (p. 31). Statistical descriptions should be carefully evaluated for their portrayal of community impacts.

**C-5(b) AFA Vessel Replacement GOA Sideboards**

The SSC received a presentation of the draft analysis from Mark Fina (NPFMC). Public testimony was provided by Brent Paine (United Catcher Boats).

This document presents a clear identification of the suite of alternatives under consideration by the Council to address the structural change made in the original AFA, by implementation of the Coast Guard Act (CGA). The document lays out the elemental components that differ among the no action alternative, the 'status quo' alternative (that differs from no action here), and several options for treating the ambiguities that emerge from imprecise or incomplete articulation of AFA modifications in the CGA.

The draft also does a nice job statistically documenting the historical participation, catch, gross revenues, product outputs and forms, etc., from the BS and GOA fisheries that have been prosecuted by vessels that may be affected by this action. The descriptive content is robust.

Armed with a clear articulation of the problem, detailed treatment of the competing alternatives and their differences, and the empirical data just mentioned, the next step in this RIR/IRFA should be an "analysis of expected economic, socioeconomic, and distributional outcomes" of each action alternative, compared to the baseline. This last critical step hasn't been initiated in this draft. Questions that need to be addressed include: What purpose did AFA have in prohibiting vessel replacement except in extreme cases of loss? What costs have emerged from these constraints? Have there been benefits to the fisheries, communities, participants from this limitation? What purpose did the CGA have in modifying these restrictive rules? What costs did the authors see in the original limitations and how would the liberalization affect the economic performance (in all its relevant dimensions) in AFA fishery and those other groundfish target fisheries in the GOA and BSAI, with or without sideboards and exemptions? Do economic and operational incentives exist (or can they be anticipated) that will result in exercising these liberalized replacement rules? What role may cooperative fishery management structures play in the patterns of replacement, effort distribution, monitoring complexities and burdens, etc., under these action alternatives?

Each alternative must be assessed to the fullest extent practicable, recognizing the limitations on some forms of critical data. Who are the winners and losers? What forms will economic and socioeconomic changes in response to each alternative likely take? Are there employment impacts? Will consumers realize changes in price, quality, supply? Are there spill-over effects that may result in benefits, costs, distributional changes, management costs or complexities? What might one conclude about the net national benefit of each alternative action? How are impacts distributed across entities, by size category?

Not every one of these topics will have a nexus to the choice set under consideration, but the analysis has an obligation to raise the question. This has not been sufficiently attempted in this early draft. The opportunity to meet these obligations **before release** for public review should be exercised. **The SSC recommends not releasing this draft for public review**.

### C-6(a) BSAI Crab ROFR

The SSC received a presentation of the draft analysis from Dr. Mark Fina (NPFMC). Public testimony was received from Steve Minor (North Pacific Crab Association) and Frank Kelty (City of Unalaska).

**The SSC recommends that the analysis be released for public review following revisions to address comments made below.**

The SSC commends the analyst for the work performed on what is a challenging assignment. This is, however, a difficult document to read and the SSC is concerned about its "accessibility" to a general audience. This concern is not a reflection on the author, but rather, the convoluted nature of the document is a direct result of the choices made by the Council in trying to safeguard communities from the particular program it designed for the crab fisheries in the BSAI. The SSC urges the author to try to make explanations of the Council's menu of options as easily comprehensible as possible.

The contemplated actions inevitably involve a clash of interests between those vested with processing quota shares via the crab program designed by the Council and communities that the Council is also concerned about. Care should be taken in the choice of language used to describe tradeoffs to avoid a vocabulary that appears to favor one set of interests over another (e.g., "interfere," "impinge," "disrupt").

It appears that there is considerable variation in the level of transparency involved in the relationship between "entities" (created under the ROFR provision) and the actual communities of concern. The analysis would benefit from additional information about the nature of the relationship between the communities of concern and the entities that represent them in terms of the ROFR provision.

Statements in the document regarding the likely impact on net benefits to the nation and distributional zero sum games between communities need to be more carefully qualified. If society values the existence of isolated communities featuring single processing operations, then it is not clear that the transfer of PQS to larger, more diverse communities is a mere distributional issue. If on the other hand, none of the ROFR options under consideration can prevent such a transfer, then the current assessment of effects on net benefits may be more plausible. The document should be revised to treat the discussion of inter-community tradeoffs with more care and to appropriately qualify the statement about effects on net benefits.

### C-6(b) BSAI Crab active participation requirements

The SSC received a presentation of the draft RIR/IRFA from Dr. Mark Fina (NPFMC). Public testimony was provided by Mark Gleason (Alaska Bering Sea Crabbers), by Joe Sullivan (Intercooperative Exchange), and Edward Paulson (representing self).

Based upon the presentation by Dr. Fina and the SSC's reading of the initial draft document, it is apparent that key policy and design questions, necessary to proceed to a complete and informed analytical package, have not been adequately articulated by the Council. The analyst systematically enumerates each of these missing components, providing a clear list of each decision point, and requests specific Council guidance. At present, the draft is fragmented, incomplete, and deficient. Further progress on this action is dependent on the Council providing direction on its expectations for the management action.

Assuming the Council chooses to proceed with a revised Active Participation action, the SSC did identify several specific concerns with the analytical content of the current draft that may be relevant. There are several specific arguments made in the draft that should be clarified or reconsidered in any subsequent draft. On page 16, for example, under Price Effects, the assertion is made that "*Shares are likely to trade at a free market price …*" and further that price effects are likely to be small. This may be true, but it is important to note that any time one imposes a constraint on the pool of eligible buyers, the price will decrease, all else equal. The QS market is substantially constrained.

The discussion of the influence of CDQ groups on demand and price in this market further confounds the 'free market price' assertion. The analysis observes that CDQ groups "… may be willing to pay premium prices (for crab QS)." Given CDQ groups enjoy market-distorting advantages (e.g., subsidized allocations, small entity status), their presence in this market has a substantial potential to influence demand and, thus, market prices. In such an economic environment, one would not expect the "predicted" free market price outcome. A more nuanced discussion of the market for shares is recommended.

On another point, while the general intent of the <u>action</u> alternative seems reasonably clear (i.e., to facilitate transfer of owner-QS to active participants), there is a question as to why the Council would wish to constrain "permanent transfers" (implicitly) on the seller's side of the transaction. It would appear that if a non-participating QS owner wished to divest his/her/its holdings, that would be in full accord with the purpose of the action and should not be impinged. At present, the action alternative imposes a limit on the seller. However, if the SSC correctly interprets Council intent, the alternative could be modified to say, "*To be eligible to permanently <u>acquire</u> and retain…*", the reasoning would be clear and the action would better comport with the action objectives.

In the top section of page 23 of the draft, the text expresses concern that excessively high "landings thresholds" (i.e., active participation levels) could disadvantage crewmembers seeking to acquire QS, despite their consistent participation in the fishery in question. The analysis gives as an example crew aboard vessels that are consistently active, but catch relatively small amounts of crab during the season.

This can result in the risk of failure to consistently, year-in-year-out, meet catch threshold requirements. The SSC notes two matters requiring further examination. The first is to examine whether setting the landings minimum threshold, as proposed, accomplishes the outcome the Council wishes for the program. The analyst must look to the Council for guidance.

The second consideration is perhaps less evident, at least in the SSC's reading of the analysis. It is not clear from the draft how QS, owned by a crewmember that is annually on the knife's edge of qualification as 'active', would be managed? That is, once owner-QS is acquired, what provisions exist for suspension or revocation (of attributable IFQ) if, in years subsequent to the acquisition, the minimum threshold is not met?

The administrative mechanism needed to implement such a program is not presented (e.g., an administrative appeal process, disposition of withheld IFQ, season harvest impacts) and attributable cost, funding source, distribution affects are undefined.

While the kernel of the management action is clearly presented by the Council in its Purpose and Need statement, the analysis may require further Council guidance to determine if this is the optimal way to meet the objective.

**The SSC recommends that the draft not be released at this time.** Further development of the action must await guidance from the Council. The SSC would welcome the opportunity to review a revised document, should the Council choose to proceed with this action.

### C-6(g) Crab SAFE

Diana Stram (NPFMC) and Bob Foy (NMFS-AFSC, CPT Chair) presented the Crab Plan Team report and sections of the Crab SAFE. The SSC reviewed the SAFE chapters and information provided by the Plan Team with respect to the stock status information from 2011/2012 relative to total catch in that time period (Table 1). The SSC notes that no stock was subject to overfishing in 2011/2012. In addition, Table 2 contains the SSC recommendations for 2012/2013 for stocks.

The Crab Plan Team requested clarification from the SSC on the general utility of the maxABC control rule. The SSC agrees that applying a 10% buffer to set ABC below OFL remains appropriate until parameter and model uncertainty can be more appropriately quantified, which will probably require a broader discussion of structural uncertainties across both crab and groundfish assessments. The SSC recommends that a workgroup of some CPT and SSC members be established to revisit this issue.

Table 1. Information for overfishing determination for BSAI crab stocks for 2011/12. Values are in thousand metric tons (kt).

| Chapter | Stock | 2011/12 OFL | 2011/12 ABC | 2011/12 Total catch |
|---|---|---|---|---|
| 1 | EBS snow crab | 73.5 | 66.15 | 44.7 |
| 2 | BB red king crab | 8.80 | 7.92 | 4.09 |
| 3 | EBS Tanner crab | 2.75 | 2.48 | 1.24 |
| 4 | Pribilof Islands red king crab | 0.393 | 0.307 | 0.005 |
| 5 | Pribilof Islands blue king crab | 0.00116 | 0.00104 | 0.0004 |
| 6 | St. Matthew Island blue king crab | 1.70 [total male catch] | 1.5 [total male catch] | 0.95 [total male catch] |
| 7 | Norton Sound red king crab | 0.30 | 0.27 | 0.20 |
| 8 | AI golden king crab | 5.17 | 4.66 | 2.95 |
| 9 | Pribilof Islands golden king crab | 0.09 | 0.08 | Conf. |
| 10 | Adak red king crab | 0.05 | 0.014 | 0.02 |

Table 2. SSC recommendations for 2012/2013 (stocks 1-6). Note that recommendations for stocks 7-10 represent those final values recommended by the SSC in June 2012. Bold indicates where SSC recommendations differ from Crab Plan Team recommendations. Note diagonal fill indicated parameters not applicable for that tier level. Values in thousand metric tons (kt).

| Chapter | Stock | Tier | Status (a,b,c) | $F_{OFL}$ | $B_{MSY}$ or $B_{MSYproxy}$ | Years[1] (biomass or catch) | 2012/13[2] [3] MMB | 2012 MMB / $MMB_{MSY}$ | $\gamma$ | Mortality (M) | 2012/13 OFL | 2012/13 ABC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | EBS snow crab | 3 | b | 1.42 | 154.7 | 1979-current [recruitment] | 146.3 | 0.95 | | 0.23(females) 0.329 (imm) 0.273 (mat males) | 67.8 | 61.02 |
| 2 | BB red king crab | 3 | b | 0.31 | 27.5 | 1984-current [recruitment] | 26.32 | 0.96 | | 0.18 default Estimated[4] | 7.96 | 7.17 |
| 3 | EBS Tanner crab | 3 | a | 0.61 | **33.45** | **1982**-current [recruitment] | 42.74 | **1.28** | | 0.337 (females), 0.252 (mat males), 0.249 (imm males and females) | **19.00** | 8.17 |
| 4 | Pribilof Islands red king crab | 4 | b | 0.11 | 5.14 | 1991-current | 3.30 | 0.64 | 1.0 | 0.18 | 0.60 | 0.46 |
| 5 | Pribilof Islands blue king crab | 4 | c | 0 | 3.94 | 1980-1984 1990-1997 | 0.50 | 0.13 | 1.0 | 0.18 | 0.00116 | 0.00104 |
| 6 | St. Matthew Island blue king crab | 4 | a | 0.18 | 3.56 | 1978-current | 5.63 | 1.58 | 1.0 | 0.18 | 1.02 [total male catch] | 0.92 [total male catch] |
| 7 | Norton Sound red king crab | 4 | a | 0.18 | 1.59 | 1980-current [model estimate] | 1.93 | 1.2 | 1.0 | 0.18 0.68 (>123 mm) | 0.24 | 0.22 |
| 8 | AI golden king crab | 5 | | | | See intro chapter | | | | | 5.69 | 5.12 |
| 9 | Pribilof Island golden king crab | 5 | | | | See intro chapter | | | | | 0.09 | 0.08 |
| 10 | Adak red king crab | 5 | | | | 1995/96–2007/08 | | | | | 0.05 | 0.03 |

[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 2/15/2013 at time of mating.

[3] Model mature biomass on 7/1/2012

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

**Snow Crab**

After extensive model development over the past few years, two models were brought forward in this assessment. This year's base model was Model 6 from the September 2011 assessment. Some of the basic features of the current base model are: (1) annual recruitment deviations are estimated and distributed among size classes assuming gamma distribution with equal recruitment assumed for males and females, (2) mean width after molting is estimated as a linear function of pre-molt width with priors from limited growth data and post-molt lengths are distributed among size bins assuming a gamma distribution, (3) mature female mortality is fixed at M = 0.23, male M and immature M are estimated in the model with priors M=0.23 and se(M) = 0.054, (4) the probability of new shell crab maturing is estimated as a smooth function in the model to match the observed fraction mature by size, and (5) survey selectivity for the BSFRF and NMFS data in the study area are estimated separately for males and females within the model.

In addition to the base model, a second model was explored that implements a quadratic relationship between pre-molt and post-molt size. Priors for the parameters of the relationship were estimated by D. Somerton based on recent molting experiments.

**The SSC agrees with the CPT recommendation to adopt the current base model for specification purposes for 2012/13. Results from the assessment place the EBS snow crab stock in Tier 3a, given that mature male biomass at mating in 2011/12 was estimated at 107% of the proxy for $B_{MSY}$ ($B_{35\%}$). The SSC concurs with the author and CPT recommendations that the ABC be less than maximum permissible given the structural uncertainty of this model and to use a 10% buffer for setting ABC. This results in a OFL for 2012/13 - as determined by the $F_{35\%}$ control rule - of 67.8 kt (149.5 million lb) and an ABC of 61.0 kt (134.5 million lb).**

The SSC has the following recommendations for the author:

- The SSC agrees with CPT recommendations to more fully and directly integrate results from recent growth-increment studies into the assessment. There was considerable improvement in the model in terms of the likelihood by adding two additional growth parameters with large consequences for our view of stock status**. Hence, the growth parameterization should be a high-priority area for further exploration.**
- The authors may want to update their introduction to note that snow crab not only occur in the western North Atlantic are now permanently established on the eastern side of the Atlantic in the Barents Sea (J. Alvsvåg, A.-L. Agnalt and K. E. Jørstad (2009). Evidence for a permanent establishment of the snow crab (*Chionoecetes opilio*) in the Barents Sea. Biological Invasions 3: 587-595. DOI: 10.1007/s10530-008-9273-7)
- The values in Table 13 need to be clarified. While values are described as "likelihood" in the header, they appear to be log-likelihood values. This is somewhat confusing because assessments typically report the actual objective function values, i.e. the negative log-likelihood.
- A number of figures need axis scales and/or axis labels (e.g., Figs 80, 82, 83, 98, 99 & 100) and an explanation of abbreviations (Fig. 99,100).
- To address ongoing concerns over disproportionate harvesting on the southern portion of the stock, the SSC recommends that the authors work through the stock structure worksheet for snow crab.

**Bristol Bay Red King Crab**

This fall, the authors conducted a straightforward update of the preferred Model 7ac that was selected by the Plan Teams and the SSC this spring.

This year's SAFE addressed some but not all of the SSC comments from previous years. In October 2011 the SSC requested that the author include two new options in 2012: (1) an option with no additional M periods and (2) an option without additional M periods and an additional survey selectivity period in the early 1980s. Because no additional modeling work was done for Bristol Bay red king crab in May 2012, the authors indicated that they would address SSC model requests in May 2013.

In October 2011, the SSC noted that the preferred Model 7ac applied higher M for the period 1980 through 1984 for males, and 1980 through 1984, 1976 through 1979 and 1985 through 1993 for females, and requested additional justification for selecting these additional natural mortality periods. In Appendix 1 of this year's SAFE, the authors described four potential factors for high mortality during the early 1980s. The authors concluded that combinations of fish mortality, natural mortality, disease, and predation may have contributed to the decline. **The SSC appreciates this information, however, Appendix 1 does not specifically address why natural mortality was higher during the specific years identified in the model other than to note that "the model fit the data much better with these three parameters than without them." Is there any corroborating evidence for these particular time periods?**

In October 2011, the SSC requested that the authors review the re-tow data for males to determine whether the decision to eliminate re-tow data for males is still the best use of the available data. In this year's SAFE, the authors provide a detailed analysis that provides compelling evidence that males shift their distribution by the time of the re-tows so that male abundance is underestimated. The SSC appreciates the authors' attention to this issue. The SSC notes that the authors may want to consider the comments and recommendations regarding the use of resampling stations in the NMFS survey provided in the CIE review reports on the trawl surveys.

From previous CPT and SSC reviews, the authors provided three alternate time periods to determine Biological Reference Points: 1969-1983, 1969-2012, and 1984-2012. In particular, the authors used average recruitment over each of the three time periods to calculate B35%. Results of this analysis show that selection of the time period is extremely important. If the early time period is used, the stock would be declared overfished. If the entire time period is used the stock would be considered close to overfished. The authors recommended using the intermediate time period 1984-2012 corresponding to the 1976/77 regime shift, in which the stock is not overfished.

**The SSC appreciates the authors' consideration of breakpoints for estimation of biological reference points; however, we note that the analysis is incomplete.** At the request of the SSC, participants at the Stock-Recruitment (SR) Workshop in April 2012 considered methods for estimating possible time periods as the baseline for calculating reference biomass. The provisional Workshop report identified 6 methods to identify temporal breaks in the productivity of stocks. Essentially, the authors used a combination of Alternative A2.1 (review of the recruitment time series), Alternative A2.4 (identify statistical breakpoints in an environmental time series) and Alternative A2.3 (identify breakpoints in the R/S relationship) in their analysis. Specifically, they only evaluated the change in productivity for a pre-defined suite of breakpoints. The SSC asks the authors to consider the recommendations in the provisional SR workshop report wherein a full range of possible breakpoints is considered, and consideration of the provisional preferred alternative A2.6. The SSC acknowledges that SR relationships and environmental shifts in carrying capacity are at the core of the selection of breakpoints in stock productivity.

As a part of future discussions of the pros and cons of taking the next step to use the breakpoints for the determination of reference points, the SSC requests that the authors and the CPT consider the reliability of the SR relationship and whether the reliability is sufficient to move the stock to Tier 1 or 2. In the case of crab stocks where experience from the GOA shows depletion can result in extended periods of low production, the authors should consider the ecological risks associated with managing the stocks at low stock size and whether this approach is consistent with the precautionary approach.

**The SSC agrees with the caveat included in the SR report that the provisional preferred approach is "*intended only to estimate the breakpoints; estimates of other quantities obtained in the process of determining the breakpoints do not have to be used for management purposes*".** Thus, once a breakpoint is identified, the authors should consider its plausibility. In the case of BBRKC, the authors provided several lines of evidence to support their selection of the 1984-2012. This is a critical step in the analysis. While statistical methods can be used to identify potential breakpoints, some breakpoints may not be biologically plausible. A breakpoint should result in a full range of plausible recruitments at low and high spawning biomass levels and be consistent with a well-defined shift in the Bering Sea ecosystem. **The SSC agrees that the 1984 breakpoint is plausible and thus concurs with the authors' use of the time period 1984-2012 for determination of reference points for 2012/13. However, given the uncertainty associated with selection of time periods, the SSC considers selection of the time period to be a source of uncertainty in the assessment that contributes to our decision to recommend a 10% buffer between the ABC and the OFL.**

The authors considered two methods for evaluating retrospective bias in the assessment: (1) historical results and (2) the 2011/2012 model hindcast results (within-model approach). As was observed in previous years, the within-model approach showed a consistent trend where the model overestimates MMB. The SSC agrees with the CPT that the model appears to be slow to respond to declines in MMB. The SSC requests that the authors consider the mechanisms underlying the consistent overestimates in the model. The SSC requests that the authors consider the Joint PT report on retrospective analysis in future reports. Specifically, we ask the authors to include a plot of retrospective bias as a percentage of terminal year MMB. In the absence of a clear mechanism to explain why the model is slow to respond to declines in MMB, the SSC continues to view this trend as a source of additional uncertainty in the assessment that contributes to our recommendation for a 10% buffer between ABC and OFL.

**The SSC accepts the ABC and OFL recommendations of the authors and the CPT. Based on the results of Model 7ac, the stock is in Tier 3b resulting in an OFL and ABC of 7960 t and 7170 t respectively. The stock is not overfished and overfishing did not occur.**

Recommendations for next year:

In addition to the CPT recommendations for additional models in 2013, the SSC requests that the authors develop: (1) an option with no additional M periods and (2) an option without additional M periods and an additional survey selectivity period in the early 1980s.

Research:

1. Shifts in the center of distribution of BBRKC can be a function of depletion of the stock, the crab closure area, shifts in larval drift, habitat selection, or fishing. Study which of these potential causes contributes to the selection of a time period.
2. Work with flatfish authors to come up with a consistent approach to treatment of biomass outside of the survey area.
3. Look at changes in maturity, molting probability, and selectivity over time.
4. Look at impact of dropping hotspots as per CIE review.
5. Look at impact of corner stations for hotspots as per CIE review.
6. Look at BBRKC – impact of re-tows as per CIE review.
7. Conduct field studies of catchability (side-by-side tows).

The SSC and the PTs made several requests for additional model runs in 2011. These requests still stand.

## Tanner Crab

The SSC received a report on the Tanner crab stock assessment from Lou Rugolo (NMFS-AFSC) and Jack Turnock (NMFS-AFSC). Diana Stram (NPFMC) and Bob Foy (NMFS-AFSC) provided the Crab Plan Team's review and comments. Andre Punt (Univ. Washington) reported on a break-point analysis that constitutes an appendix to the stock assessment. Public testimony was provided by Edward Poulsen (Alaska Bering Sea Crabbers).

The Tanner crab stock assessment model (TCSAM) was accepted by the SSC in June 2012 for use in managing the Tanner crab fishery as a Tier 3 stock. Recent changes in the assessment model in response to comments by the Crab Plan Team and SSC are described in the assessment document. Some short-term and long-term recommendations have yet to be addressed. The Crab Plan Team provided a number of additional long-term recommendations, as listed on p. 5 of the Crab Plan Team report from their September 2012 meeting and the SSC supports those requests. However, based on response by the analysts to questioning, it was not clear to the SSC that model fits to discards in the snow and red king crab fisheries was a large issue. The SSC encourages the analysts to continue to explore alternative model formulations (variable growth, variable mortality, etc.) that may address patterns in model residuals (e.g., Fig. 37 and 39). **The SSC continues to support use of TCSAM (base model = model 0) for assessment and management of the eastern Bering Sea Tanner crab as a Tier 3 stock, starting with this year's (2012/13) assessment.**

The status determination of the eastern Bering Sea Tanner crab stock under Tier 3 hinges heavily on the choice of the time period used to calculate mean recruitment. Five time periods for averaging recruitment were explored: R1 (1966-1972), R2 (1966-1988), R3 (1982-2012), R4 (1966-2012), and R5 (1990-2012). These are shown in Fig. 56 of the assessment report, where year corresponds to year of recruitment to the model, which occurs at approximately crab age 5. The assessment authors recommended R2. This choice was not supported by the Crab Plan Team because this time period may not represent the current reproductive potential of the current stock. Also, some members were concerned about using recruitment estimates for 1966-1973 because there are no direct estimates of these recruitments. Those estimates are hindcast by TCSAM based on observations primarily in the survey time series, which begins in 1974. Instead, the team recommended using recruitment averaging time period R5 (1990-2012). This recommendation was based on a break-point analysis conducted by a team member and reported as an Appendix to the assessment. This break-point analysis, which examines changes in the relationship between a measure of stock productivity and stock biomass, was one of the methods considered for this purpose at a recent joint plan team recruitment workshop. The Tanner crab data support a change in relationship in 1985 (year of spawning) corresponding to 1990 (year of recruitment to the assessment model). Adoption of the use of R5 under a Tier 3 assessment would result in an increase in the OFL from 2.75 thousand tons in 2011/12 (based on Tier 4 analysis) to 19.02 thousand tons in 2012/13 (based on Tier 5 using the R5 period). The Crab Plan Team recommended a three-year stair-step approach toward setting ABCs in a precautionary manner under R5 to allow for additional analyses to address some uncertainties.

The SSC was hesitant to accept either the stock assessment author's or team's recommendations on the period of averaging. The author's recommendation (R2: 1966-1988) does not include more recent years of low stock productivity. Although the SSC continues to support break-point analyses as a useful approach to identify periods of productivity, the SSC was hesitant to accept the team's recommendation (R5: 1990-2012) at this meeting. First, the analysis was somewhat cursory and several additional research needs on this analysis were identified, including exploring alternative stock-recruit formulations (e.g., Beverton-Holt), and the possibility that the shift in productivity is due to depensation (reduced productivity due to spawner limitation). Second, results indicated several potential break points with similar measures (AICc) of model fit (Appendix Fig. 2). Third, break-point model fits were shown for break points in 1965-1976 and 1989-2001, but those for 1977-1988 were not shown (Appendix Fig. 1). The SSC would be interested to see these.

**As an interim measure, the SSC recommends management of the eastern Bering Sea Tanner crab fishery under Tier 3 using the time period of averaging of recruitment R3 (1982-2012). This results in an OFL of 19.00 thousand tons for 2012/13. The SSC recommends an ABC of 8.17 thousand tons for 2012/13 by using the stair-step approach recommended by the Crab Plan Team for the same reasons given by the team.** As a matter of happenstance, the specifications for 2012/13 are identical using either R3 or R5. In making this interim recommendation to use R3, the SSC attempted to consider a time period represented by reasonably estimated recruitments. In this regard, the SSC discussed the merits of the R3 (1982-2012) and R4 (1966-2012) alternatives. The SSC felt that the time period corresponding to reasonably estimated recruitments was likely to correspond to some time period somewhere in between these two alternatives (i.e., some starting year after 1966 and before 1982) for the following reasons. First, the time series of recruitments estimated by the base model shows huge confidence intervals on the recruitment estimates corresponding to fertilization years through the late 1960s (Fig. 42), so those earlier years are clearly not reliable. These correspond to periods of recruitment to the model through the early 1970s (Fig. 56). Second, related to this and as previously stated, some members of the team were concerned about using recruitment estimates for 1966-1973 because there are no direct estimates of these recruitments. Third, the SSC discussed that there may be ecological justification for a break point in productivity sometime within the time frame represented by a time series intermediate between R3 and R4. A major ecosystem regime shift occurred in the late 1970s. This shift included a large increase in some groundfish stocks and declines in some forage fish, crab, shrimp and other species. Stomach analyses show that major predators of young Tanner crab are Pacific cod, flathead sole, and to a lesser extent, yellowfin sole. Shifts in predation mortality could alter productivity as measured by recruitment to the model relative to spawning biomass. In addition to identifying the first year of the recruitment time series, the inclusion of the most recent recruitments, which are equally uncertain, should also be reconsidered.

**The SSC requests further analysis of alternative recruitment time periods by the stock assessment authors and Crab Plan Team to include options based on years in which recruitment was reasonable estimated, additional break-point analyses, and evidence for shifts in Tanner crab life history and ecology.** The SSC requests that one option should include a time series spanning the extent of reasonably estimated recruitments based on confidence intervals for recruitment. Based on Fig. 42, it would seem that this time series should start with fertilization years beginning in the late 1960s (e.g., 1966), corresponding to a years of recruitment to the model starting in the early 1970s (e.g., 1971). Other options might include time periods corresponding to years in which recruitment was directly observed, and break-point analytical results including models with the break point in 1990 and other years with favorable AICc scores (Appendix Fig. 2). In evaluating the alternatives, the analysts and team should consider evidence for shifts in life history and ecology, which might include changes in predation and oceanography. SSC member Gordon Kruse mentioned a recent cooperative study using a Regional Ocean Modeling System (ROMS) showing a marked reduction in the retention of Tanner crab larvae in the Bristol Bay area and an increase in settling in the Pribilof Islands area since 1990. A manuscript reporting on these results is currently under revision and will be provided to the Crab Plan Team shortly.

Over the long term, Tanner crab productivity should be evaluated based on better measures of spawning biomass than mature male biomass, as currently used, which ignores the dominant role of females in reproduction. Ongoing studies on reproductive potential of red king crab and snow crab may shed some light on this. Toward this, the SSC requests the assessment authors to include a plot similar to Fig. 54 of the assessment chapter in which recruitment (y-axis) is plotted against egg production indices (x-axis) from Fig. 14.

**Pribilof Islands Red King Crab**

The fishery for red king crab in the Pribilof Islands district has been closed since 1999 due to concerns of low abundance, imprecision of biomass estimates, and pot bycatch of blue king crab, which are classified as overfished. Fishing mortality since the closure of the directed fishery has been limited to incidental catches in other crab fisheries and in Groundfish fisheries. The SSC supports the CPT recommendation to continue using the same base years as used previously (1991 to the current year) for determination of $B_{MSY}$ for the Pribilof Islands red king crab stock. The SSC also supports a Tier 4b designation for this stock, noting that the estimate of mature male biomass (3,302 t) is below $B_{MSY}$ (5,136 t). Unlike previous years, estimates of mature male biomass (MMB) were calculated in the assessment as a 3-year weighted moving average, centered on the current year and weighted by the inverse variance. Under the Tier 4b designation, the OFL for 2012/2013 is 569 t.

The SSC agrees with the CPT recommendation to include additional uncertainty ($\sigma_b = 0.4$) when calculating the ABC using the P* approach, resulting in an ABC of 455 t. The SSC's support for this approach is based in large part on the recognition that the brief history of exploitation of this stock makes it difficult to identify an appropriate period of time suitable for establishing $B_{MSY}$, such that the true distribution of the OFL is poorly known.

The SSC supported the following CPT recommendations for the 2013 assessment: include CV's in tables of abundance estimates, include confidence intervals in the table of weighted moving average estimates of abundance, and consider the use of Kalman filter as an alternative to moving average for estimation of MMB. The SSC requests that the authors include the observed and the state equations used for the Kalman filter analysis.

**Pribilof Islands Blue King Crab**

The SSC supports the CPT and author's recommendation for management of Pribilof Islands blue king crab under Tier 4c. Following the advice of the CPT, the SSC recommends a Tier 5 calculation of average catch mortalities between 1999/2000 and 2005/2006, resulting in a total catch OFL of 1.16 t. Similarly, the SSC supports using a 10 percent buffer for the ABC calculation, resulting in an $ABC_{max}$ of 1.04 t. The Pribilof blue king crab stock is overfished, however overfishing did not occur during the 2011/2012 season.

The MSY stock size ($B_{MSY}$) is based on mature male biomass at mating ($MMB_{mating}$) which serves as an approximation for egg production. For 2011/2012, $B_{MSY}^{prox}$ = 3,944 t of $MMB_{mating}$ derived as the mean MMB from 1980 to 1984 and 1990 to 1997. The stock demonstrated highly variable levels of MMB during both of these periods likely leading to uncertain approximations of $B_{MSY.}$

Retained catches for Pribilof Island blue king crab have not occurred since 1998/1999. Bycatch and discards have been steady or decreased in recent years, although a change in calculation methodology led to an increase in 2011/12. Stock biomass decreased between the 1995 and 2008 surveys and continues to fluctuate with no significant change estimated for recent years due to the high uncertainty in estimates. Based on September 2011 CPT and SSC comments, biomass estimates are now based on a 3-year weighted average, centered on the current year and weighted by the inverse of the variance.

A revised rebuilding plan was approved by the Council in June 2012 and will soon go through final review by the Secretary of Commerce. The revised rebuilding plan closes the Pribilof Habitat Conservation Zone to Pacific cod pot fishing.

**Saint Matthew Island Blue King Crab**

In June 2012, the SSC approved use of the three-stage catch-survey analysis for the fall 2012 fishery under Tier 4. From this model, the estimated biomass (MMB) in 2012 is 5.63 thousand t. The estimated total male OFL is 1.02 thousand t, as recommended by the team. Likewise, the maxABC is 1.02 thousand t based on CV = 0.5 and P*=0.49. However, the SSC concurs with the Crab Plan Team recommendation for a 10% buffer for an ABC of 0.92 thousand t due to structural assumptions and observational uncertainties in this assessment.

The SSC offers the following remarks to the assessment author. There is significant improvement in model evaluation. The SSC agrees with the Crab Plan Team on the need to develop diagnostic tools to understand and improve model performance (e.g., residual plots). For 2013, the SSC concurs with the Crab Plan Team that the author should explore an alternative model that merges characteristics of model B and model C, perhaps allowing two different Ms (one for 10 years ago and one for the recent 10 years). In addition, the SSC recommends that the author should fix the seed in the simulation, as it can help future reviewers to repeat and verify the simulation results. The Crab Plan Team offered some additional comments to the author, with which the SSC concurs. In addition, the SSC identified an important research need to investigate the annual molting frequency (and growth increment) with pre-molt size.

**Aleutian Islands Golden King Crab CPUE Standardization**

The authors have developed a method to standardize catch and effort for observer pot sample data and retained catches (fish ticket data) for future input to the assessment model. They incorporated recommendations made by the Crab CPT at its May 2012 meeting and the SSC at its June 2012 meeting. The SSC agrees that the assessment authors have made significant improvement in the model. The authors might consider using CART (classification and regression tree) models to investigate interactions among predictor variables, while avoiding the problems with co-linearity.

**D-1(d) Northern Bering Sea Research**

The Northern Bering Sea Research Area (NBSRA) discussion paper was presented by Steve MacLean (NPFMC). Public testimony was presented by Dorothy Childers (Alaska Marine Conservation Council)

This discussion paper was intended to provide background information to the Council for evaluating the feasibility and need to continue developing a NBSRA research plan. Efforts to develop a research plan began in 2009. The SSC received an outline in June 2010 and a report on the plan in June 2011. The 2011 report focused primarily on a proposed paired design of a before-after-control-impact (BACI) study to be conducted in the northern Bering Sea (NBS). Based on responses from community workshops and SSC comments on the draft plan, the Council suspended development of a NBSRA Research Plan. The current document responds to the Council's request for a document that summarizes information on the NBS ecosystem, potential impacts from bottom-trawl fisheries, outcomes of community workshops, description of areas likely to attract commercial interests, and feasibility of conducting more research on effects of trawling. The purpose to which this white paper will be used to frame future actions was not made clear in the document or in meeting guidance.

The SSC appreciates that addressing all of the above requests was challenging given the paucity of historic information on the NBS and the rapid pace of current studies and climate-driven changes to a complex ecosystem. While AFSC staff did respond with an expanded document**, the document will need considerable revision if it is to be used to inform the public or incorporated into a research plan.** The SSC found the outline of historic research efforts and sources of data useful, but the document was incomplete and its organization confusing. There were also contradictory statements that may have resulted from dealing with the same issue in multiple locations. Most of the SSC's editorial corrections will be provided to the AFSC authors in a separate document.

The ecosystem chapter provided a very brief overview of the underlying physical and biological oceanography of the NBS, but provided limited discussion of benthic pelagic coupling, potential changes in other physical or biological aspects (pH, storm seasonality, invasive species, range extensions) nor discussion of how these factors may interact or change seasonally. Notably, the benthic ecosystem most likely to be impacted was only described in a few sentences with no inclusion of a food web diagram. There was no discussion about current fisheries in the NBSRA – either commercial or subsistence. It would seem critical to any plan being developed that there be a clear understanding of the current exploitation rates, and the ways in which ongoing human activities might be impacting the system.

Sections on marine mammals, birds, invertebrates, and fish were inconsistent in the amount and type of information presented, information accuracy, and conclusions relative to potential impacts from bottom-trawling. Species of particular importance as subsistence resources were not fully addressed, such as seabirds (ie, the adults and eggs of auklets, kittiwakes, murres, gulls), fish (ie, herring, capelin, smelts), and invertebrates (clams). The pending federal action with respect to listing and critical habitat for bearded and ribbon seals was not mentioned. There was inadequate coverage of cumulative effects, such as changes in climate and ice extent, that may have impacts on prey available to upper trophic level groups. This is particularly relevant for benthic foraging species such as grey whales, walrus, and bearded seals, which may be forced to change their foraging locations and concentrations in response to shifts in prey abundance, or the presence of sea ice in preferred foraging areas. In particular, walrus that are aggregating on shore (rather than dispersed across sea ice) may have much higher than 'normal' impacts on benthic communities in the areas surrounding terrestrial haulouts. Fishing pressures in these areas, if overlapped, may have much greater impacts on walrus than in other areas.

The section on the design and method considerations for a study on the impact of bottom trawls captured many of the key issues. The paper summarized studies in the southeastern Bering Sea that showed that only minimal bottom trawl impacts were observed that could not be differentiated from random variation. Yet, researchers have been able to detect and quantify the recovery of the benthos from foraging activities of grey whales and walrus. The paper suggests that if commercial bottom-trawl fisheries are developed, the chronic effects of bottom-trawling could be examined through use of closed and open-area boundaries in the Modified Gear Trawl Zone. The paper's authors rightly note that '… discerning bottom-trawl impacts on the NBS ecosystem **will require substantial commitment in time and resources**.' Overall, good study design, statistical and ecological analyses, and understanding of local recovery dynamics will be needed. Further, the paper notes that these studies will need to be long term to capture ecosystem-level changes, and this will be more challenging given the changes predicted to occur in the NBS. A major impediment to such a study is the lack of funding.

The paper notes that communities bordering the NBSRA are 'dominated by subsistence activities and seasonal employment opportunities' and rightly concludes that this issue is of particular importance to members of those communities. However, **a more explicit section summarizing (and providing references for) what is known about subsistence uses of key species by the communities is needed. The SSC reiterates that it is important to involve local communities into the process early in development of NBS plans and that the research focus should be on the benthic environment,** which is most likely to be impacted by bottom-trawl fisheries. Should the Council move forward with development of a NBSRA Research Plan, it should improve this discussion paper with respect to protected resources and potentially impacted ecosystem components. More importantly, it will need to include local community input and commit to a long term program.