

SCIENTIFIC AND STATISTICAL COMMITTEE
Report to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
February 1st – 3rd, 2016

The SSC met from February 1st through 3rd at the Benson Hotel, Portland, OR.

Members present were:

Farron Wallace, Chair
NOAA Fisheries—AFSC

Robert Clark, Vice Chair
Alaska Department of Fish and Game

Chris Anderson
University of Washington

Lew Coggins
U.S. Fish and Wildlife Service

Sherri Dressel
Alaska Department of Fish and Game

Kari Fenske
Washington Dept. of Fish and Wildlife

Jason Gasper
NOAA Fisheries—Alaska Region

Brad Harris
Alaska Pacific University

Anne Hollowed
NOAA Fisheries—AFSC

George Hunt
University of Washington

Gordon Kruse
University of Alaska Fairbanks

Seth Macinko
University of Rhode Island

Matt Reimer
University of Alaska Anchorage

Alison Whitman
Oregon Dept. of Fish and Wildlife

Members absent were:

Jennifer Burns
University of Alaska Anchorage

Franz Mueter
University of Alaska Fairbanks

Terry Quinn
University of Alaska Fairbanks

Kate Reedy
Idaho State University Pocatello

SSC Election of Officers

The SSC reappointed Farron Wallace as chair and reappointed Robert Clark as vice chair. We also welcome new SSC member Jason Gasper (NMFS-AKR), and thank Lew Queirolo and Steve Martell for their service on the SSC.

B-1 Plan Team Nominations

The SSC reviewed the Plan Team nominations of Ken Goldman and Ben Williams to the Scallop Plan Team as well as Miranda Westphal to the BSAI Crab Plan Team. The SSC finds all of these nominees to be well qualified, with appropriate expertise that will assist these Plan Teams. The SSC recommends that the Council approve these nominations.

C-3 Norton Sound Red King Crab specifications

Diana Stram (NPFMC) presented an overview of the Norton Sound red king crab stock assessment and related Crab Plan Team (CPT) comments. There was no public testimony.

The catch specification process for Norton Sound red king crab occurs off-cycle at the February Council meeting and not later in the year with the other crab assessments because of the need for assessment in advance of the CDQ fishery, which occurs as early as May. Also, because of this advanced timing, the assessment model for Norton Sound red king crab now starts the assessment year on February 1 rather than February 15 as is used in other crab assessments.

The assessment was updated with new data, including the 2015 summer commercial fishery (total catch, catch length composition, and discard length composition), 2014/15 winter commercial catch, and 2014/15 subsistence catch. The assessment examined 15 model alternatives in addition to the base model (Model 0). Alternative models examined various combinations of the following modifications: (1) estimation of an M multiplier for crabs >123 mm carapace length (CL), (2) estimation of a single constant M for all length classes, (3) estimation of M for crabs ≤123 mm CL and an M multiplier for those >123 mm CL, (4) expansion of the size range included in the model from 74-124 to 64-134 mm CL, and (5) reduction of the length class intervals from 10 to 5 mm. The author and CPT recommended use of Model 5, which contains an estimated multiplier from the baseline natural mortality rate for the lengths >123mm CL, expanded length classes from the previous 6 length classes spanning 74 to >123mm CL to 8 length classes covering 64 to >133mm using the same 10 mm length intervals. Of all models considered, model 5 had no major retrospective pattern and the lowest Mohn's rho.

The SSC concurs with the choice of Model 5 and management of this stock under Tier 4a, as recommended by the assessment author and CPT. The SSC also agrees with the resultant 2016 OFL (equal to the max ABC) of 0.71 million lbs (0.32 thousand t) and the choice of a 20% buffer yielding a 2016 ABC of 0.57 million lbs (0.26 thousand t).

In recommending the 20% buffer, the CPT cited concerns with model specification, lack of bycatch data, and issues associated with high M in the largest size class. However, the SSC noted that, as indicated on page 12 of the SAFE document and as verified by ADF&G during questioning, there are no fisheries in Norton Sound with red king crab bycatch. So, bycatch should not contribute to uncertainty. Notwithstanding this, the SSC feels that the 20% buffer is appropriate owing to uncertainties about model specification, particularly concerning the largest size class. In addition, the SSC noted that, while the model has no major retrospective biases (Fig. 17), there are some large discrepancies between predicted versus observed trawl survey abundance estimates in some years, including the most recent survey (Fig. 6).

The SSC appreciates the authors' replies to previous SSC comments. However, the SSC requests additional clarification on two replies. First, in response to a request to consider fixing trawl survey selectivity (did the author mean catchability?) to 1.0, the author indicated that this was not done because the parameter is not always 1.0. Please clarify the basis for this understanding that it is not always 1.0. Second, in reply to the SSC's alternative hypotheses about the "missing" large crabs (namely, localized depletion, high M, or migration outside of the area), the author cited spring and fall surveys. The timing of the "loss" may be informative with respect to the timing of molting. Namely, does the timing indicate that crab may go "missing" in association with the molting period? The SSC appreciates this additional information.

With regards to the issue of the "missing" large crab, the SSC offers two additional suggestions. First, a tagging project with satellite pop-off tags on the largest size class may offer new insights about the location of these large animals. Second, the SSC noted relatively high proportions of 134+ mm CL crab in the summer commercial catches taken during 1980-1982 (Table 4). The SSC requests the analyst investigate whether there are observer data that could be examined to verify those high proportions, including the geographic location of catches that included these animals. The SSC notes, however, that these apparent high proportions could instead simply be an artifact of poor recruitment (i.e., a relative lack of small crab, rather than relative increase in large animals).

The SSC was very interested in the conflicting observations about molt timing in April/May versus August/September. Moreover the comment about potential biennial mating is very intriguing. Both could have consequences on the assessment model. These topics should be priorities for future research.

The SSC thanks the author for the well-organized assessment, including the logical sequence of alternative models. Two minor comments follow:

1. In the heading for table b on p. 17, please explain what values are shown in the table.
2. For each figure, please indicate which model results are being shown.

Finally, the SSC endorses the excellent recommendations by the CPT.

C-4 Halibut Management Framework

The SSC received a presentation about the Halibut Framework from Dan Hull (NPFMC Chairman) and David Witherell (NPFMC). Dr. Bruce Leaman (IPHC) provided clarifying comments. Public comments were provided by Heather McCarty (Central Bering Sea Fishing Association), Mateo Paz-Children (City of St. Paul) and Linda Behnken (Alaska Longline Fishermen's Association).

The Framework was developed after the June 2015 Council action to reduce halibut PSC limits in the BSAI groundfish fisheries. The Council determined that a more explicit 'framework' for consideration of halibut management overall, including enhanced coordination with the IPHC process was needed.

SSC General Comments:

The SSC appreciates the Council's efforts to initiate this Framework and notes that the document captures many of the concerns we raised during review of the Halibut PSC RIR. It proposes a path towards addressing them through improved communication with the IPHC, increased coordination of ongoing Council activities and by acknowledging that work on critical research and data needs is a priority.

The Council requested that the SSC review research topics and data needs identified in the research section (Section 4.1) of the Framework towards identifying priorities and they identified the following research as their preliminary priorities:

- Development of the technical methods to index PSC limits to halibut abundance.
- Natural mortality variability with age/size/density to understand the effects of bycatch, wastage, and discards on the spawning biomass.
- Migration of halibut between areas and associated implications for management decisions.
- Discard mortality rates in all fisheries, as well as overall bycatch estimation in all fisheries.
- An integrated decision-making framework that addresses biological, economic, and social issues.
- Evaluation of potential ecosystem-level impacts of alternative methods to index halibut PSC limits based on yield or spawning potential.

The SSC notes that the research and data needs described in Section 4 of the Framework are all important. The SSC agrees that the six topics selected by the council are all priority areas of research and have

suggested the addition of one additional priority. Some specific comments related to these priority research and data needs are provided below.

Generally, the priority research areas listed in the Framework are complex and multi-faceted and should be considered long-term goals. While these information gaps are critically important for PSC management, the Council is unlikely to have new information to fill important knowledge gaps in the near term.

The halibut stock assessment (IPHC) workflow, the expected spatiotemporal impacts of PSC on the halibut stock, and the Management Strategy Evaluation (MSE) specification and workflow are not currently described in the Framework. Clarifying these is an important near-term goal and the SSC recommends the Council request that the IPHC provide a conceptual model of the stock assessment workflow with explanations of how information about migration, natural mortality, size/weight at age, and DMRs are parameterized or influence the assessment. Further, the SSC recommends the Council request that the IPHC provide the SSC with a presentation about the MSE explaining the approach and workflow. This information will be important for the Abundance-Based Methods (ABM) working group as well.

Short-term progress on halibut PSC can be achieved by coordinating several ongoing Council and AFSC activities. Scientists from AFSC (Anne Hollowed, Kotaro Ono, and Carey McGilliard) have developed a Multi-Species Technical (MST) interactions model which is suitable for simulating and assessing the sensitivity of halibut population dynamics to migration, natural mortality, size/ weight at age, and DMR assumptions. A significant challenge for this work will be addressing the mismatch between the focus on Bering Sea PSC and the coastwide nature of the halibut stock. The SSC considers such an analysis to be critical for understanding the impacts of information gaps on the Council's efforts to reduce PSC. The SSC recommends that the Council task their ABM and DMR working groups to collaborate with the MST modeling team. This will inform both short and long term needs. The SSC looks forward to workgroup reports when available.

The SSC notes that there is immense opportunity with on-going industry-based research (i.e. deck-sorting EFP) to develop a tagging program (e.g. wire, PIT or CWT) which could produce important information on halibut movement, and the relationship between viability and discard mortality in the near-term. The SSC considers this a critical research priority.

Framework Additions/Clarifications

- The SSC suggests that the research area *Impacts of short term, medium term, and long term changes in the environment relative to key aspects of halibut life history* be elevated to the list of selected priorities and modified. As written in the Framework this priority is narrowly worded to focus on environmental effects. The SSC emphasizes that continued research into the broader suite of factors potentially affecting changes in size-at-age should include: Prey abundance, competition with other species, fishing, and other factors should be considered as well. The SSC notes that the IPHC has been working through an NPRB grant on this topic; however, even at the completion of that project later this year there will be considerable work remaining.
- The SSC recommends adding IPHC and University studies to the list of NOAA studies that were in the appendices of the document. For instance, Jane Sullivan (UAF-SFOS) is working on the

impacts of selective harvesting of fast growing individuals and how that affects size at age. Sarah Webster (APU-FAST Lab) and co-authors recently completed a project examining the relationship between dietary carbon and nitrogen stable isotopes and size-at-age of Pacific halibut. There are quite a few other projects.

- The SSC recommends that in the Framework and in further PSC analyses both biomass and abundance information be provided where possible. Declining halibut size and weight-at-age under a commercial size limit makes trends in exploitable biomass, total biomass, and abundance difficult to interpret.
- The SSC highlights the importance of socioeconomic data and notes that a substantial amount of work remains to be done to collect these for fishery-dependent communities. In our discussion of the Groundfish Economic SAFE the SSC recommended a human-dimensions data workgroup be convened. The IPHC presentation requested above should provide a conceptual diagram with the entrance and exit points for social and economic to support the work of this task team.

Priority-Specific Comments

Development of the technical methods to index PSC limits to halibut abundance.

In December 2015, the Council established an interagency staff workgroup to further pursue approaches to abundance-based PSC management, with an initial report expected in April 2016. The workgroup will also address evaluation of potential ecosystem-level impacts of alternative methods to index halibut PSC limits based on yield or spawning potential. The SSC looks forward to the workgroup's discussion paper in April 2015.

Natural mortality variability with age/size/density to understand the effects of bycatch, wastage, and discards on the spawning biomass.

The SSC reiterates how difficult it is to estimate age-specific natural mortality rates. Measuring size-dependent natural mortality rates in the field is very difficult, especially when there are large migration events that may confound the problem. The SSC notes that research on this topic may not be cost-effective or prudent given the limited likelihood of achieving success. However, exploring the impacts of a range of natural mortality values in a simulation framework, would be valuable.

Migration of halibut between areas and associated implications for management decisions.

SSC agrees that this is a priority research area and agrees with the Framework authors that tagging of halibut on the NMFS Bering Sea trawl survey (initiated in 2015) will help to establish whether migratory pathways observed in historical studies still indicate transfer from the Bering Sea to all other areas. However, the sample sizes and anticipated returns are unlikely to be large enough to produce quantitative estimates of movement rates. Generally, information on movement rates (along with stock recruitment connectivity) is essential for determining how PSC management within each regulatory area affects other areas. Additional information on movement patterns could help with the refinement of assessment models, and with the development of operating models for MSE, as the MSE is likely to be the primary tool for evaluating changes to the harvest policy. The SSC understands the emphasis on juveniles and the Bering Sea, but notes that information on fish movements for all life stages and areas is important.

Discard mortality rates in all fisheries, as well as overall bycatch estimation in all fisheries.

The SSC notes that an interagency staff working group, in coordination with the groundfish Plan Teams, is developing a discussion paper/preliminary analysis for Council review in April 2016, with the potential for revisions to the existing DMRs for 2017. The SSC requests that the Council task the working group to determine the origins of the DMRs, the temporal changes, and justification of these changes.

The SSC also recommends that the priority be expanded to include:

- Efforts to assess discard mortality rates *in situ*, including evaluation of sample sizes, data collection and the use of advanced technology,
- Work to evaluate methods to reduce discard mortality (e.g. excluders, deck-sorting),
- Efforts to improve information about what is actually being discarded in all fisheries (size, sex, age, maturity, release mortality rates (e.g. sport fishery), etc).

The SSC suggests that halibut nursery areas may provide an opportunity for research on mortality and migration for the youngest ages. For instance, if young juveniles display some residency in a nursery area, then monitoring of age composition and fish densities over a series of years could allow mortality estimation for this early life stage.

An integrated decision-making framework that addresses biological, economic, and social issues.

The SSC notes that two proposals supporting this priority are under review for funding from Saltonstall-Kennedy and North Pacific Research Board. Funding announcements are expected in May.

C-5 Halibut Deck Sorting 2016 EFP

The SSC heard a presentation from John Gauvin (Alaska Seafood Cooperative) detailing an application for an exempted fishing permit (EFP). Jon Warrenchuk (Oceana) provided oral public testimony. The permit application supports additional work to develop and evaluate methods to reduce mortality of halibut PSC in the Amendment 80 sector in 2016. Results from previous EFP studies in 2009, 2012, and 2015 demonstrate the ability to increase viability and, theoretically, reduce discard mortality by deck sorting halibut from the target catch prior to discarding. The SSC commends the presenter on an effective description of the findings of past deck sorting EFP work and how those results shape the 2016 EFP application. **The SSC notes that this effort to reduce halibut PSC mortality is consistent with a number of the objectives articulated in the North Pacific Fishery Management Council's draft Halibut Management Framework and other general Council objectives to reduce PSC.**

The objective of the 2016 EFP is to field-test modifications to the procedures and approaches used in the 2015 deck sorting EFP that:

- 1) Move substantially toward implementation of deck sorting as an allowable fish handling mode for the non-pollock catcher-processor trawl fisheries (Amendment 80, CDQ, and Trawl Limited Access) in the Bering Sea;
- 2) Simplify and improve on elements that worked from the 2015 project; and
- 3) Address challenges and issues that arose in the 2015 EFP.

The application highlights four focus areas in the 2016 EFP program that differ from 2015:

- 1) Using a single set of modified procedures to account for halibut on EFP trips;
- 2) Addressing the long hours needed for catch accounting personnel to oversee the collection of data on halibut PSC below decks;

- 3) Including halibut in observer sampling protocols; and
- 4) Use of sea water holding tanks to investigate options for increasing halibut viability, decreasing orca predation, and allow increased time for sampling.

The applicants propose using a single set of catch handling and accounting procedures during EFP operations, regardless of whether a particular tow is processed with deck sorting. These standardized procedures will reduce confusion and improve coordination between the crew and observers and clarify processing responsibilities. Three observers will be employed in lieu of sea samplers to accomplish deck sorting and below deck sampling of halibut that arrive in the processing factory. This additional capability and shared duties should alleviate the long shifts (>12 hours) encountered during 2015 EFP operations.

The SSC commends the applicants for their extensive coordination with the Alaska Fisheries Science Center (AFSC) to unify data collected during deck sorting with standard observer data. However, additional tasks remain to be completed including: observer retraining, database modifications, and Discard Mortality Rate estimation procedures. The AFSC is supportive of the EFP and has made a series of specific protocol recommendations to increase the quality of the data while still allowing halibut to be efficiently sorted and released. The SSC notes that, based on the results from the 2015 EFP, the sampling methodology used in 2015 and proposed for use in 2016 appear to have provided good sampling coverage. Thus, SSC encourages using the same methods as proposed, but any obvious and tractable sampling improvements recommended by the AFSC or the observer program should be included as appropriate.

The EFP applicants propose a limited evaluation of the use of seawater holding tanks to investigate their utility to increase viability and minimize whale depredation of deck sorted halibut. While these ideas hold promise, the application is vague in the scope and methodology of this effort and it is difficult for the SSC to comment on the applicability or suitability of this portion of the study. During discussion with the presenter, it became obvious that methods to detect and quantify whale depredation are not well developed. Thus, it is presently unclear how this portion of the EFP will proceed. **The SSC recommends the applicants continue to work with the AFSC to finalize and coordinate efforts on this aspect of the EFP.**

Looking forward to potential implementation of deck sorting throughout the non-pollock catcher-processor trawl fleet, the SSC recognizes a number of critical information needs. **In particular, the relationship between viability measures and discard mortality is fundamental to understand the efficacy of deck sorting to achieve halibut PSC mortality goals.** The SSC also recognizes the need to better understand how broadly feasible deck sorting is among vessels in the fleet. Noting operational characteristics of vessels that opted to participate in the EFP versus those from the same sector that did not participate would help to quantify if feasibility is related to vessel characteristics. Additionally, it is important to have a better understanding of what factors explain variability in observed viability of deck sorted halibut. To investigate these relationships, the SSC recommends that EFP vessels collect haul-level covariates including: target species, haul time, haul length (start-stop coordinates), sea state, air temperature, bottom temperature, and tow catch amount (e.g., bag size or weight). Finally, the applicants clearly identified the importance of vessel incentives in both participating in the EFP and in the long-term if ultimately operationalized. The SSC believes that, if deck sorting is to be operationalized, it will likely involve a reduction of viability

sampling. In that event, it will be necessary to understand how to maintain vessel incentives while ensuring accountability to maintain the desired viability of deck sorted halibut.

The applicants identify three important research projects that will be supported through this EFP. The first is development of improved electronic monitoring procedures to account for bycatch using NMFS Fishery Monitoring and Analysis Division's chute camera system. The second aims to estimate survival of deck sorted halibut and to relate viability assessments with survival rate to support improved discard mortality rates. Finally, a proof-of-concept project is in development plans to use EFP vessels to support tag and release of deck sorted halibut to improve understanding of migration. **The SSC notes that each of these projects support priority information needs to improve scientific understanding and management of halibut stocks.**

The SSC concurs with the recommendation of the AFSC to approve this EFP application and commends the applicants for continuing to work towards reducing halibut PSC.

C-7 Electronic Monitoring Analysis

Diana Evans (NPFMC) presented a discussion paper on an analysis to integrate Electronic Monitoring (EM) into the North Pacific Groundfish and Halibut Observer Program (Observer Program) as developed by the EM workgroup (EMWG). Dan Falvey (ALFA) provided public testimony.

The discussion paper provides a draft purpose and need statement, alternatives, and components of an EM program to be considered in the EM implementation analyses that were developed through extensive discussions by the EMWG. Although the presentation was only informational, the SSC appreciates the update on progress towards operationalizing EM as a tool for use in the observing system. Public testimony emphasized that most of the details of implementing EM will be developed and documented in the Annual Deployment Plan, Contractor Agreement, and Vessel Deployment Plan.

The SSC commends the EMWG on their efforts so far and looks forward to updates on progress, as well as an initial review document anticipated in October 2016. The SSC notes that the draft purpose and need statement, as well as the alternatives and components, appear to be well thought out and appropriate in scope and intent at this time. We anticipate that these will be further refined as data from the pre-implementation studies are analyzed and new information is brought into the development of the initial review document.

In regard to components in the analysis, the analyst and EMWG note that more work is needed on the development of performance metrics and how best to implement biological sampling as part of, or in concert with, EM deployments. The SSC reiterates its October 2015 comments on these two important implementation issues:

- It will be important to develop metrics to evaluate success or failure of EM gear deployment, EM gear operation and reliability, video data quantity and quality, and veracity of counts derived from analysis of video data. Performance metrics can then be reported on in the Annual Report of the Observer Program.

- The SSC notes the importance of the EMWG continuing to consider how the loss of necessary biological information, accrued from human observers, will be replaced from sources such as EM collected data (e.g., stereo cameras to collect fish length) or information collected in other portions of the overall observer program.

The SSC also had the following comments on the components section of the analysis:

- In the feedback mechanisms section, it is unclear who will be reporting on the performance of vessel operators and NMFS management of the EM Program.
- In the Fees/Funding/Costs section, an important additional cost element is the cost of video analysis.

The SSC would also like to be provided any updates or analyses that may be available from 2015 or pre-implementation in 2016 at the June 2016 meeting.

D-3 Halibut/Sablefish IFQ Program Review

The SSC received a presentation from Marysia Szymkowiak (NMFS) and Sarah Marrinan (NPFMC) on a proposed work plan for a program review of the halibut/sablefish IFQ program. Public testimony was given by Linda Behnken (ALFA). The objective of the workplan is to describe the proposed scope of the IFQ program review and to serve as a starting point for a discussion of what should be included in the review. The intent of the review is to evaluate the IFQ program with respect to the ten original policy objectives that the Council had intended to address through the program. This will be the first comprehensive review of the halibut/sablefish IFQ program since it was implemented 20 years ago.

The SSC is pleased that this long-overdue review of the halibut/sablefish IFQ program is finally being undertaken. Programmatic reviews are critical for evaluating the extent to which the objectives of a program have been met and whether the program has resulted in any unintended and/or unforeseen negative consequences. This is especially true for the halibut/sablefish IFQ program, which was one of the first of its kind to be explicitly designed to achieve biological, economic, and social objectives.

Overall, the SSC commends the analysts for developing a comprehensive workplan that will cover many of the important policy issues listed under the Council's original objectives for the IFQ program. The SSC noted that the workplan is rather ambitious, and the analysts will need to make decisions about where to invest their analytical efforts. The SSC suggests that issues related to entry opportunities and community impacts are of particular importance for this program review, given the nature of the Council's social objectives for the program.

The SSC discussed three challenges for the program review as a whole. First, many changes unrelated to the IFQ program have occurred since program implementation, and thus, the ability to rightfully ascribe any observed trends to the program itself is challenging. Making a causal claim about the IFQ program would require construction of a careful counterfactual of what the trend would have looked like in the absence of the program, which would make this analysis an overwhelming project. It is therefore unreasonable to expect the program review to make causal claims regarding the impact of the IFQ program for many (if not all) of the Council objectives being considered in the review.

Second, many of the ten original Council objectives are broad and not measurable. Further, it is not clear how to determine whether trends in certain metrics are consistent with the Council's initial objectives, making it difficult for the analysts to make definitive statements as to whether or not the program met some of the policy objectives. In light of this challenge, the SSC suggests that, whenever possible, the analysts state an expectation for a change in any metric that is consistent with a program objective, and then evaluate whether the metric changed in that particular direction. For some measures, however, the extent or degree of the change is more important than the direction, so similar measures from similar fisheries may provide useful context for interpretation.

Third, the analysts noted several challenges for evaluating the IFQ program due to data limitations. For example, data related to crew has only been collected since 2006, which will likely prevent the analysts from investigating impacts on crew from the IFQ program implementation. In general, these data deficiencies highlight the importance of designing data collection strategies that facilitate retrospective program evaluations, which are a necessary component of evidence-based policy making.

The SSC offers the following suggestions for the IFQ program review:

- While the program review is intended to be comprehensive, it is not intended to be an exhaustive study of any one issue. **The SSC therefore recommends that the analysts include a section in the program review that highlights particular issues related to the program that would benefit from additional research in the future.**
- **The SSC recommends that the analysts include a section in the program review that highlights particular data deficiencies and gaps in data collection that are important for evaluating the impacts of the IFQ program.**
- The workplan is limited to evaluating effects of the IFQ program on its own fisheries, as well as the potential effects of non-IFQ regulations that interact with IFQ fisheries. **The SSC recommends that the program review also include a discussion of any spillover effects into non-IFQ fisheries as a result of the program.** Some potential measures to include in the review are changes in the portfolios of harvested species and fishery permit holdings of quota-receiving entities.
- The difference between wholesale and ex-vessel prices through time may provide a good measure of the distribution of fishery rents, which reflects bargaining power between processors and harvesters.
- The SSC cautions the analysts about loose use of the term "efficiency" in the context of a program review. If the Council devises measures to attain various social and economic goals they feel are important, then it is incorrect to speak of these same measures as imposing efficiency costs. They may involve reductions in economic productivity, but not efficiency.
- The SSC suggests that the section related to Biological Management Issues (Section 2.9) be undertaken with strong participation from AFSC and IPHC biological and assessment scientists, and further notes that a purely qualitative discussion might be most appropriate for this section.
- Further related to Biological Management Issues, the SSC notes that data will be limited for evaluating discard issues, due to a short time series of federal observer data, and suggests that IPHC logbooks may provide another potential source of information.
- Estimates of deadloss due to lost gear are difficult to quantify and the SSC suggests that there is literature available that provide information on ghost fishing.

- Search and rescue data from the United States Coast Guard could provide a useful measure of safety in the IFQ fisheries.

D-5 Crab Modeling Workshop Report

Diana Stram (NPFMC) and Jim Ianelli (AFSC) presented a summary of the Crab Modeling Workshop held in Anchorage, AK January 13-16, 2016. This workshop has been held annually since 2008, with a focus in recent years on development of a Generalized Model for Alaska Crab Stocks (GMACS). This year's workshop resulted in: 1) updating participants on new GMACS model features and functionality, 2) side-by-side comparisons of GMACS and the existing model for St. Mathews blue king crab (SMBKC) as well as progress on a Bristol Bay red king crab (BBRKC) model in GMACS, and 3) discussions about next steps in GMACS implementation, coding priorities and tasks needed to bring a GMACS model to the CPT in May. There was no public comment on this issue.

Major updates to GMACS in the past year include an expansion of selectivity flexibility, improved prior and bound specification, increased flexibility for size composition fitting, code changes that allow for multiple models to be set up and run concurrently, continued progress on the simulation functionality, and improvements to plotting functions and documentation.

In February 2014 the SSC requested that the GMACS model receive external review. A CIE review was conducted in July 2015 and the reviewer comments were generally positive. The reviewers noted that more model generalization will be necessary to assess more stocks using GMACS, and they also identified a suite of recommendations for future consideration. Many of the tasks and issues identified by the CIE reviews have already been addressed. Work is currently underway to allow seasonal time steps in the GMACS code. With the addition of seasons there was a suggestion that growth be handled as a seasonal event instead of a constant or continuous event, to mimic natural growth patterns. The GMACS model is able to accommodate catastrophic mortality events such as those observed in BBRKC.

The Crab Modeling workshop participants and the SSC discussed the need for continued funding and to identify a core group of code developers to provide modeling support in the future. There is an interest in reaching out to other regions where GMACS might be useful, such as the Northeast for lobster modeling, and an interest in providing a training session at some point to introduce assessment authors to GMACS. Future Crab Modeling Workshops will likely be held in Seattle to optimize participation and collaboration between AFSC, NOAA Office of Science and Technology, and UW faculty and students.

The SSC noted that the model documentation on the GMACS GitHub site and Wiki appears to be largely keeping pace with changes to the model structure, and encourages the core modeling team to continue to keep documentation up to date as the model evolves.

The SSC would like to recognize the extensive effort of the GMACS team since the inception of the project and in the progress made since the 2015 workshop. The GMACS authors, assessment authors, and workshop participants are commended for their continued hard work in bringing the SMBKC into GMACS so that a side-by-side comparison of the models could be made. The SSC looks forward to seeing the GMACS SMBKC model in June.

Other Items

Economic SAFEs for groundfish and crab

The SSC received a presentation of the 2015 iteration of the Groundfish Economic SAFE from Ben Fissel (NMFS-AFSC), and the Crab Economic SAFE, from Brian Garber-Yonts (NMFS-AFSC). The Economic SAFEs provide information on status and trends in social and economic dimensions of the groundfish and crab fisheries, to support evaluation of management and regulatory decision making, and are provided as an appendix to the stock assessment. The SSC requested an annual presentation by the authors/analysts of the Economic SAFE and appreciates this opportunity to review the drafts with the analysts who prepared the document.

The Groundfish Economic SAFE report benefits from past work in improving accessibility, coverage, format, and presentation; members of the SSC draw on it regularly throughout the year. The executive summary highlights major trends in individual fisheries, and the evolving indices chapter allows readers to quickly assess the presence and source of major deviations from longer-term levels and trends. The major new component this year is an abstract of a set of product market profiles prepared by The McDowell Group, tracing key seafood product forms from harvest to their final markets. These profiles replace outdated and less thorough market descriptions in past SAFE reports. **The SSC finds these updated market profiles highly informative and supports updating them every two to three years, so they remain accurate as product markets evolve.**

The Crab Economic Safe also benefited from similar improvements and responsiveness to previous comments from the SSC. **The SSC requests that concise summaries of information contained within the presentation, but not included in the Crab Economic SAFE document itself (e.g., data on the proportion of landings in all rationalized fisheries that is leased) be incorporated into the document.**

The SSC appreciates efforts at continuous improvements to the SAFE reports, which were limited this year by personnel changes at the AFSC. For the 2016 reports, the SSC suggests the following areas for refinement:

- Explore supplementing the national suite of catch share performance metrics in the Groundfish SAFE with metrics that reflect the bycatch or PSC management or safety objectives that were the primary goals of North Pacific catch share programs.
- The geographic residency of fishing crew and processing workers is an important component for understanding economic linkages between industry and constituent communities, and thus it would be useful to identify whether employees are sourced from Alaska, elsewhere in the United States, or internationally. To the extent data is unavailable to meet this request, the SSC requests the authors to identify critical data gaps.
- Methods describing the price forecasts would benefit from a succinctly articulated description of the “nowcast” method and need for a structural model versus time series method, including the use of timely export data to generate current-year price expectations prior to availability of the COAR data, and the need for future price forecasting.
- Consolidate or better harmonize the presentation of key factors in the global economy (e.g., currency movements, trade sanctions, generational shifts in demand) that affect product markets, and how these factors are integrated into the discussion of different data series.

- Evaluate whether there are standard levels of changes, or changes in trends, in key indices or metrics that should trigger highlighting (e.g., in the executive summary or discussion of a table in the text) the change as an area for attention, action or concern.

Users look to the SAFE as a reference document to understand the broad performance and context of the North Pacific fisheries. The SSC encourages staff each year to highlight major factors that affect the economic, social and community environment in which the North Pacific fisheries operate. To the extent this information is available, these should be treated in the SAFE for the SSC and the Council to better anticipate the future policy environment. For example, this year, dramatic cuts in the Alaska state budget is likely to affect the people and communities regulated by the Council. ADF&G will reduce fishery management activities, likely limiting access to state resources that complement federal fishing activities for many households. Further, the minimum threshold for school enrollment necessary to receive state support may be increased, leaving many fishing dependent communities without a school and potentially threatening their short and long-term viability.

One of the key capacity limitations at the NMFS-AFSC was departure of the human dimensions scientist. The SSC is encouraged by plans to maintain key data collection and organization initiatives, and to fill that position as quickly as is feasible. The SSC emphasizes that data on human dimensions are absolutely critical to meeting the obligations imposed by MSA, for example National Standard 8. The SSC's February 2015 recommendation to explore the feasibility of developing a Human Dimensions SAFE, with specific focus on the social, cultural, and community facets of fishery management impacts, did not receive a satisfactory response. **The SSC recommends convening a workgroup to identify the types of human dimensions data and organizing frameworks that could go into a more comprehensive treatment of the human dimensions of fisheries in the EEZ off Alaska. The workgroup should also evaluate the options for the presentation of human dimensions data and assessments within a separate dedicated SAFE, or integrated into existing efforts such as the Economic SAFEs or the Ecosystem Considerations chapter.**

Climate Science Strategy

The SSC heard a presentation by Anne Hollowed (NMFS-AFSC) on NMFS's National Climate Change Strategy, Alaska Regional Action Plan. There were no public comments.

The SSC appreciates the authors' efforts to develop a thoughtful and useful document on a science strategy for evaluating the present and future impacts of a changing climate on the marine ecosystem of the Southeastern Bering Sea. It is excellent that NMFS is addressing this issue.

Further, the SSC notes that the NPFMC is well positioned to absorb and incorporate this information into its existing management process. As suggested in the document, the new Bering Sea Fishery Ecosystem Plan provides a framework to synthesize and organize this regional effort. Additionally, the existing scientific infrastructure is extensive and the annual stock assessment environment is well established. In particular, the Ecosystem Considerations chapter provides an annual update to the state of the Bering Sea ecosystem.

The document seems optimistic in its descriptions of what can be done now, and what we will be able to do about this challenge in the near future. It is not clear that we will be able to make any quantitative predictions about how present-day climate variability will affect any stock in the near future, let alone out to ten years. There are species for which we can make qualitative statements about how current patterns or timing of sea-ice retreat may affect recruitment, but even for these species, the time series are sufficiently short that the observed relationships need to be accepted with caution. However, the SSC also felt that an ambitious timeframe was advantageous and appropriate for the scale of the challenge ahead, and the SSC looks forward to the new information that will be brought forward.

The document outlines three steps that are deemed important for the NPFMC to take in this region. The first is that NFMS needs to be able to inform the NPFMC of the “winners and losers” of climate change on a 10 year time frame. This goal of predicting “winners and losers” ten years out also seems optimistic. It seems feasible to predict two or three years out based on age-0 or age-1 fish of a stock, and we can at least expect to predict trends 20 -30 years out when average temperatures begin to exceed those high temperatures that appear to have negative impacts on stocks. However, within intermediate time spans, inter-annual variability will probably swamp out the underlying, long term climate trends, thereby making predictions difficult. The second step outlined in the document is the need to identify and monitor ecosystem thresholds that signal the need to adjust management, and finally, the need to continue ongoing ship-based surveys. **The SSC also strongly supports the continuance of all existing ship-based fishery independent surveys and fisheries oceanographic research.**

To identify the effects of climate variability and developing ability to predict the effects of warm or cool periods with impacts on fish stocks requires data that can link climate characteristics in one year with outcomes in that year and subsequent years. BASIS was remarkably successful in demonstrating how conditions in one year affected the survival of age-0 pollock to the next year. The ability to reach this conclusion required several consecutive years of research to develop the necessary insights and to test the resulting hypotheses. If this research had been stretched out over a longer period with surveys every other year, it is not clear that the BASIS scientists would have made the progress that they did. **The SSC strongly recommends that the spring and fall fisheries oceanographic surveys be conducted on a yearly basis while we are trying to identify the effects of climate change and develop the means of making “long-term” predictions of its impacts.**

The research plan says little about focusing research on short-lived prey species that may react very quickly to climate warming (e.g., large copepods and euphausiids on the EBS middle shelf). We need to know more about the prey of species other than pollock, and determine what may limit their prey abundance or availability in the future. It is likely that it is these prey species that will determine the health of stocks that we value.

An additional area of concern is the possibility that warming conditions will lead to more of the primary production going through micro-zooplankton than has been true in the past. Recent research has shown that in the summers of warm years micro-zooplankton play a major role in the transfer of energy to upper trophic levels. By imposing themselves in the food web, they, in essence, add an additional trophic level, and thus reduce the biomass of trophic levels above them by roughly 90%. There is a need to learn about

their roles in times past (possibly using stable isotopes), as this may help us understand what they are or will contribute in the future.

The SSC suggests an exercise to prioritize the most valuable research to collect within this action plan might be helpful, and asserts that a focus on mechanistic explanations for species' responses to climate variability that provides clear hypotheses to test should be a high priority. Additionally, the SSC acknowledges the importance of the FEAST model to the regional action plan, and looks forward to the planned improvements that are already in progress.

The regional action plan is deficient in its explanation of how Alaskan communities will be participating in this process. It was clear from the presenter that feedback from communities on theoretical fishing scenarios is vital for continued model development and vetting during this five year plan. However, this was not made clear in the document or the actual presentation.

Finally, there was a general tone in the document that implied that management is a static entity, and that the science and management recommendations that will be brought forward through this action plan will simply allow for a switch to a new management regime that solves the challenges of climate change. However, this is clearly not the Strategy's intent. Both the national strategy and the regional action plan acknowledge that this will be an ongoing and evolving process as our understanding improves and management adapts as necessary to a changing climate. **The SSC would like to see this concept better reflected in the document.**

Climate Vulnerability

The SSC received a presentation by Anne Hollowed on the efforts of the AFSC to develop an index of the vulnerability of stocks in the Bering Sea to climate change. There was no public testimony.

The SSC appreciates the efforts to develop a thoughtful and useful process for assessing the relative vulnerability of fish and shellfish stocks to the expected impacts of climate change and ocean acidification. The process included the use of expert opinion (ranking), first developed by individual responses to a questionnaire, and then through a revisiting of those opinions in group telephone conferences, to assess semi-quantitative sensitivity and exposure scores. Each level of sensitivity and exposure was specifically defined so that experts were ranking on the same scale. When reporting on this project, these definitions should be highlighted, as they sometimes differ from what a reader might expect. When combined, the sensitivity and exposure scores provide an index of vulnerability. The goal is to identify those stocks most at risk so that managers can be aware of potential vulnerabilities before problems arise. The SSC was supportive of this effort and had several suggestions for this project as it continues.

The current approach averages the expert-derived scores for all sensitivity and exposure features separately, but the SSC notes that a number of these are directly linked (e.g. temperature) while others represent mitigation potential (e.g. mobility). The SSC notes that this approach may be appropriate for the initial goal of highlighting species with relatively high overall sensitivity and exposure, but will not characterize the degree to which these are aligned. It will also not serve to identify species that are sensitive and/or exposed to only a few features, even if such vulnerability is very high. The SSC recommends that the analysts make an effort to identify a subset of sensitivity and exposure features that are linked and can be used to

characterize species-feature-level vulnerability. The SSC notes that the inclusion of multiple (potentially co-linear) factors (e.g. air, surface, and bottom temperature) in the sensitivity and/or exposure feature lists implicitly weights these higher in the overall scoring process.

The SSC appreciated the analysts' approach to characterizing and carrying forward (i.e. bootstrapping) the uncertainties associated with sensitivity and exposure scoring. However, we note that this approach does not include the information support underpinning the scores (the data quality) although this may be reflected in the score variably to some extent. Further, this approach does not address the uncertainties in the spatiotemporal data and interpolation methods used to estimate current and future exposure. The SSC recommends the analysts develop a case-based model validation exercise to examine the asserted sensitivity and exposure dynamics.

In some instances it appeared that the scores for sensitivity shifted from extreme values in the individual scores to more moderate scores when considered by a group. These apparent shifts may reflect the availability of more information or a misunderstanding about scoring criteria that was corrected by group discussion, or they may reflect the hesitation of some experts to take extreme stands in public. The SSC recommends that the analysts explore the potential for experts' scores to collapse to the moderate category, especially where data support is weak, during the second phase of the expert scoring process.

The possibility of using a different approach for developing vulnerability and exposure scores was discussed. In particular, there is an entire science of decision-making devoted to eliciting expert opinions from groups that could be employed to quantify sensitivity and exposure scores. One such example comes from the Analytic Hierarchy Process (AHP, Saaty 1980). The AHP first breaks the decision problem into a hierarchy of sub-problems. Then the decision-maker evaluates the relative importance of its various elements by pair-wise comparisons. The AHP converts these evaluations to numerical values (weights or priorities), which are used to calculate a score for each alternative.

Sensitivity and exposure may vary with life-stage, spawning stage, and location. Thus, it would be useful, and for some species critical, to develop maps of the seasonable distributions of stocks showing the seasonal (and, perhaps, age specific) vulnerabilities of stocks. If it is not possible to analyze multiple distributions for a species, including all places that species inhabit over time would be important.

The methods of compilation of scores to develop rankings were questioned. At present it is required that a species be assessed three scores for high sensitivity (and exposure) to be identified as highly vulnerable. The SSC noted that an extreme sensitivity in a single area could make a stock extremely vulnerable to expected changes. Cold water corals were brought forward as an example of a species group that is extremely vulnerable to ocean acidification. It will be valuable to highlight situations such as this in the narrative. There is also a need for developing triggers that will elevate the assessed level of vulnerability of those stocks which have a combined level of exposure and sensitivity in any one dimension that leaves it highly vulnerable. Presenting the current method of rank compilation along with a method that includes triggers, could be a way to illustrate a range of conclusions.

There was also concern that in data-poor stocks, experts would be reluctant to assess high scores, leaving these stocks likely to be assessed too low on the vulnerability scoring.

The SSC discussed the need for the authors to develop strategies for the use of the vulnerability scores. Given the vulnerability scores, how should they be used to prioritize research or to develop alternate management strategies? It was unclear whether species with extremely high vulnerabilities should be the prime focus of research, even though there may be no viable management actions that would protect them (e.g., deep water corals), or whether efforts be directed more toward species of intermediate vulnerability where management options might be effective for protecting the stock.

The SSC also notes that some species may benefit from climate change. When reporting on this project, it will be important to make note that the scoring system did not provide a means of identifying these species.

Stock Assessment Prioritization

Richard Methot (NMFS) presented an overview of the NMFS stock prioritization document. The stock prioritization plan provides a framework for prioritizing the frequency and type of assessments done for managed resources on a regional basis. The prioritization plan will be informed by the updated Stock Assessment Improvement Plan, which is under development and should be released in 2016. The prioritization framework is a subjective scoring scheme that considers the following attributes:

- (1) Fishery importance;
- (2) Ecosystem importance;
- (3) Biological vulnerability to overfishing;
- (4) Preliminary information on fishery impact level (stock status) and;
- (5) Data availability to determine which of the stocks, if any, are both sufficiently at risk to warrant an assessment and have sufficient data to conduct a fuller assessment.

The baseline frequency of assessments is largely driven by the anticipated interannual variations in recruitment, the inertia of the population (a function of longevity and current average age). The ranking scheme includes scores to prioritize the need for an updated assessment in response to emerging new science that alters the perceived stock status. Given the attribute scores noted above the baseline frequency for assessments are increased or decreased.

The SSC recognizes that the prioritization effort could be used to inform Councils and Science Centers of the tradeoffs and opportunities associated with alternatives to changing the frequency of stock assessment peer review and implementation. A management strategy evaluation (MSE) on a subset of species would be very helpful in elucidating the tradeoffs associated with altering the timing for NPFMC assessments, including the importance and frequency of data collection efforts (e.g., frequency of assessment surveys).

The SSC appreciates the opportunity to establish ranks for stock assessment priorities on a regional basis. The attributes of fisheries around the US are so different that no single ranking system would be informative. However, the SSC cautions against using the results emerging from the prioritization framework to prioritize funding decisions among the regions. For example, the commercial value of some minor fisheries in the Bering Sea may exceed the most valuable fisheries in other regions. Thus, the importance of bringing forward the best available information for commercial species managed by the

NPFMC may justify a regional upward adjustment of scores to provide the information needed to manage resources and provide the greatest net benefits to the nation.

The SSC recognizes that reducing the annual demands on the stock assessment analysts would allow more time for research into alternative assessment methods and/or development of assessments for nodal ecosystem species (e.g., forage fish), data poor stocks, or choke species. For example, some of the flatfish assessments for the Bering Sea have already shifted to biennial basis, despite annual trawl surveys. However, reductions in the frequency an assessment is conducted should not be misinterpreted to mean that assessment scientists could be tasked with duties outside of their areas of expertise.

In 2016, the SSC recommends that analysts explore the implications of using the stock prioritization framework as well as an evaluation of the trade-offs associated with shifting the assessment frequency and type. A key element of the evaluation should consider how delays in the frequency of assessments would contribute to uncertainty in the biological reference points and their associated consequences or risk. In particular, the SSC recognizes that many stocks are managed with fixed buffers between ABC and OFL which do not change in response to an increasing time trend in uncertainty. If possible this analysis should be completed in time for the September crab and groundfish Plan Team meetings.

Dr. Methot recognized that the NPFMC has forged a great deal of trust from its constituents due in part to the frequent evaluations of stock status and associated reference points. The SSC agrees that efforts to elucidate the trade-offs associated with changing the frequency of assessments should consider the potential impact of proposed changes on constituents that are impacted by the quality and quantity of stock specific information.