

# North Pacific Fishery Management Council

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**FINAL REPORT**  
**of the**  
**SCIENTIFIC AND STATISTICAL COMMITTEE**  
**to the**  
**NORTH PACIFIC FISHERY MANAGEMENT COUNCIL**  
**February 5<sup>th</sup> – 7<sup>th</sup>, 2018**

The SSC met from February 5<sup>th</sup> through 7<sup>th</sup> at the Renaissance Hotel, Seattle, WA.

Members present were:

Anne Hollowed, Co-Chair  
*NOAA Fisheries—AFSC*

Gordon Kruse, Co-Chair  
*University of Alaska Fairbanks*

Chris Anderson  
*University of Washington*

Amy Bishop  
*Alaska Sea Life Center*

Robert Clark  
*Alaska Dept. of Fish and Game*

Mike Downs  
*Northern Economics*

Jason Gasper  
*NOAA Fisheries – Alaska Region*

Brad Harris  
*Alaska Pacific University*

George Hunt  
*University of Washington*

Dayv Lowry  
*Washington Dept. of Fish and Wildlife*

Franz Mueter  
*University of Alaska Fairbanks*

Terry Quinn  
*University of Alaska Fairbanks*

Matt Reimer  
*University of Alaska Anchorage*

Heather Renner  
*U.S. Fish and Wildlife Service*

Ian Stewart  
*Intl. Pacific Halibut Commission*

Alison Whitman  
*Oregon Dept. of Fish and Wildlife*

Members absent were:

Sherri Dressel  
*Alaska Dept. of Fish and Game*

Kate Reedy  
*Idaho State University Pocatello*

## SSC Election of Officers

The SSC appointed Anne Hollowed (Alaska Fisheries Science Center) (AFSC) and Gordon Kruse (University Alaska Fairbanks) as co-chairs. Dr. Hollowed will act as chair for the February, April and December meetings, and Dr. Kruse will chair the June and October meetings. Sherri Dressel (Alaska Department of Fish and Game) was re-appointed as vice chair.

## National Scientific Coordination Subcommittee Meeting

Sara Cleaver (NPFMC) provided a summary of the 6<sup>th</sup> national meeting of the Scientific Coordination Subcommittee (SCS) of the Council Coordination Committee, hosted by the Pacific Fishery Management Council in San Diego, California, on January 17-19, 2018. These workshops are intended to address scientific issues of broad interest and importance across the nation's Councils. The theme of the 2018 workshop was "The Use of Management Strategy Evaluation to Inform Management Decisions Made by

the Regional Fishery Management Councils". The North Pacific Fishery Management Council (NPFMC) was represented by Drs. Anne Hollowed, Matt Reimer, Ian Stewart and Farron Wallace.

The workshop was divided into several sessions, including "Use of MSEs in Evaluating and Modifying Harvest Control Rules", "Estimating and Accommodating Uncertainty", and "Adjusting Harvest Control Rules (HCRs) in Changing Environments/Non-Static Maximum Sustainable Yield (MSY)". Sessions included summaries of relevant activities at each Council, with the NPFMC providing case studies for some topics. Extended discussion also included stakeholder input, ecosystem-based fisheries management, and communication of uncertainty and risk in decision-making.

Draft topics for the 2021 meeting were generated, and the SSC looks forward to further input into the planning process to identify and recommend issues of particular interest to the NPFMC process.

## **B2 Alaska Fishery Science Center Report**

Doug DeMaster (Science and Research Director, Alaska Region, AFSC) gave a presentation on AFSC budget challenges, status and impacts. He discussed the implications of projected flat budgets for all National Marine Fisheries Service Science Centers. Flat budgets do not incorporate increasing labor costs, increasing administrative costs and other additional costs, such as deferred facility maintenance. As a result, over the past seven years, the AFSC has had a net loss of over 65 full-time equivalents from > 380 staff to the current level of approximately 315. Delays in passage of annual federal budgets pose additional issues. Owing to the delay in passage of the federal budget last year, AFSC was able to contract only four vessels (two in the Gulf of Alaska) (GOA) for surveys, whereas five vessels (three in the GOA) are normally chartered. One consequence was reduced survey area coverage in the GOA. Carryover funds from last year should allow the chartering the full complement of five vessels again this year. However, the long-term outlook is reduced charters.

AFSC has developed a strategic plan for their programs under reduced funding, including labor cost control, priority-based resourcing and development and use of new technology for more cost-effective delivery of services. This has also led to hard choices in the identification of top priority activities, second tier priorities that are at risk and lower tier priorities that will remain unfunded. Top priorities include onboard observers, stock assessments, Cook Inlet beluga whales, research to reduce salmon and halibut bycatch, and several other research topics.

The SSC appreciates receiving this report on the AFSC budget situation, as well as AFSC's efforts to maintain delivery of top priority services to the Council under current strained federal budgets.

## **B2 Gulf of Alaska Climate Regional Action Plan**

The SSC received a report on the draft version of "A climate science regional action plan for the Gulf of Alaska" from Martin Dorn (AFSC). There was no public comment.

The regional action plan (RAP) is well written and well organized, with sections on the history of human exploitation of the GOA's natural resources, the potential effects of climate change on the region, completed and ongoing relevant research programs and planned activities to address future fisheries management needs in a changing climate. The SSC realizes that the scope of this action plan was limited and appreciates the development and use of an action plan as required by the NOAA Fisheries Climate Science Strategy. We note that the development of the plan would have provided an ideal opportunity to more thoroughly evaluate and, if needed, adjust relevant programs. Therefore, we provide some general recommendations that may need to be addressed separately from the RAP, as well as some suggestions for improving the draft plan.

**First, the SSC recommends that, given the expected limited funding for fisheries-related research and assessments, there should be a systematic evaluation of the current programs.** We recommend

an assessment of how these programs have contributed to our understanding of climate impacts on the population dynamics of managed species and how this knowledge is used to inform decisions regarding biological reference points, TACs or other management actions. The SSC encourages the authors to use the plan to take a thoughtful look at how information derived from ongoing research and monitoring activities contribute to the objectives of the GOA RAP.

The RAP would benefit from an evaluation of whether current monitoring and research provide the data that are needed to understand the mechanisms by which climate changes affect the GOA ecosystem and implications for various ecosystem components. For example, the existing research on the 2014-2016 warm anomaly (“The Blob”), discussed on pages 25 and 28, could be expanded to include a study of the associated multiple unusual mortality events across trophic levels (e.g., Pacific cod, sea stars, seabirds, marine mammals), to assess whether these events might be considered a “preview” of potential climate change impacts. The event provides an opportunity to retrospectively assess whether current monitoring, research, and reporting mechanisms were adequate to provide advance warning of consequential ecosystem changes and to evaluate what information gaps may have hindered decision making. **More broadly, the development of “A climate science regional action plan for the Gulf of Alaska” could include a thorough evaluation of present programs and how they may be adjusted to meet future needs.** Based on such an evaluation of present efforts, it would be appropriate to recommend either extensions of present or new efforts to address the anticipated impacts of climate change and ocean acidification.

The SSC suggests that the document is also an appropriate place to evaluate our present way of assessing the resources of the GOA in light of the apparent spatial heterogeneity. The GOA may be, in reality, four quite different systems - a Southeast shelf and archipelago system, a central northern gulf shelf system, a western gulf shelf system from Cook Inlet to Unimak Pass, and a central, offshore basin. These regions all support different species complements, seem to have very different productivities and may depend on different physical processes for support of their fish resources. These differences may require different types and frequencies of sampling to yield the most information for resource management, given the limited financial resources available to support research.

Likewise, the SSC suggests that the authors consider splitting socio-economic analyses into three GOA sub-regions, consistent with the disaggregation suggested above. While every community is unique in some respects, there are commonalities within these subareas with respect to the specific nature of community engagement in and dependence on federally managed fisheries, and therefore may have similar responses to climate change effects on the ecosystem. When characterizing the different sub-regional community groupings, the SSC suggests that the authors consider incorporation of qualitative and quantitative data characterizing community engagement and dependency contained in recent, readily available Council analyses. This would be a cost-effective way to augment the time series of quantitative indicators being collected on an ongoing basis. As part of these sub-regional analyses, **the SSC recommends the authors make readily accessible for public review a set of indices developed to assess how communities may be affected by the physical effects of climate change (referenced on page 40).**

The RAP had a strong focus on upper trophic levels and should include a discussion of the importance of forage fish and large, lipid-rich zooplankton in mediating climate change impacts on fisheries and subsistence resources. The SSC supports the development of plans for research needed to understand and develop the ability to predict the recruitment, distribution and abundance of macro-zooplankton and forage fish species that are of critical importance to piscivorous predators such as cod, halibut and arrowtooth flounder. Likewise, added emphasis on important prey for pelagic planktivores (pollock and forage fish) over the shelf will be important. Information on the determinants of forage fish populations might provide a year or more of warning, assuming that it is the 1 and 2-year age classes of these fish that are the most important forage. The document indicates that models will be used to evaluate the impacts of climate change on groundfish stocks. But, to this end, new field data and improved modeling efforts may

be needed, especially in regards to zooplankton and forage fish, if the models are to be parameterized accurately.

The section on marine mammals provides comprehensive coverage of current research activities, information gaps, projects requiring funding and threats to marine mammals related to climate change. The authors note a variety of mechanistic ways in which climate change might impact marine mammal distribution and abundance via shifts in prey distribution, storms and ice/habitat loss. To assess these threats, they adopt the criteria of Silber et al. (2016) for identifying species to monitor for climate change impacts. Cook Inlet beluga whale, Steller sea lion, harbor seal and northern fur seal meet the criteria of being of management concern/depleted and having enough data to support climate change assessments. However, by using these criteria, there is no recommendation for the assessment of a species that relies on lower trophic level prey, and how their abundance/distribution may be changing due to climate change.

For each of these species, the authors identify current projects that are underway, and where additional funds would be needed to expand efforts for monitoring, modeling etc. The RAP also identified the threats of disease and harmful algal blooms (HABs) that may increase in severity or frequency due to climate change. It was noted that increased funding was needed to expand efforts to target these threats but not specifically how those efforts would be realized or how that information would be integrated into models. The SSC suggests that this is an area that could be strengthened.

Climate-related threats that were not explicitly noted in the RAP as a focus for research for marine mammals but were qualitatively noted as potential threats in the presentation include anthropogenic noise, and changes in predator-prey relationships (see above). Disentangling top-down vs. bottom-up drivers was a focus of many of the previous efforts to understand marine mammal population changes and shifts. Loss of tidewater glaciers will likely impact harbor seals and possibly other species through changes in freshwater inputs. The SSC suggests that these are important issues that should be addressed in an action plan for assessing the potential impacts of climate change.

Biotoxins from HABs have been suspected to play a role in some if not all of the recent seabird and mammal die-offs. Harmful algal blooms are expected to increase with warming ocean temperatures. The RAP mentions a planned increase in biotoxin monitoring, but mechanistic studies are needed to assess the sub-lethal effects of various doses of biotoxins on forage fish and lower trophic levels and how these effects are manifested in the upper trophic levels. This issue also pertains to potential increase in exposure of subsistence fishers. The SSC suggests that a more comprehensive discussion of biotoxins and HABs be developed in the RAP.

The SSC discussed the need for periodic updates to this plan and suggested that this could be a section of the Ecosystem Status report.

Given that funding levels are projected to be flat or decreasing rather than increasing, the SSC suggests that a caveat be included to indicate that the goals of the climate science regional action plan are not likely to be achieved without a substantial increase in funding.

## **B2 Age Determination Pollock**

The SSC received a presentation from Tom Helser (AFSC-NMFS) that provided an overview of results from a study where Fourier transform near-infrared spectrometry (FT-NIRS) was used to age walleye pollock. This well-established analytical tool for material composition testing bombards a sample with electromagnetic radiation in the range of 780 to 2500 nm (i.e., near-infrared) and quantifies the reflected light spectrum. This method has only recently been applied to fish ageing in Australia and is proposed here as a method to obtain an order of magnitude more age data on an annual basis to support foundational stock assessment science, with considerably less time, labor and cost. Nearly 12,000 pollock otoliths are aged each year by the AFSC using traditional, time- and labor-intensive, break and burn techniques. The need for a high throughput, accurate method for determining age from otoliths is not

unique to pollock and could be used for other species in the GOA and Bering Sea Aleutian Islands (BSAI), as well as on a national level where reading capacity using traditional techniques often fails to keep up with age data requirements.

Staff from the AFSC and University of Washington collected pollock samples (otoliths, fish size, and fish condition) from approximately 1,700 fish annually from the eastern Bering Sea shelf bottom trawl survey over a two-year period. A subset of these otoliths (~650 annually) was processed by traditional break and burn techniques and read twice by independent reviewers. The reconciled age was then used for further comparisons. In 2016, otoliths read using traditional techniques were selected to evenly represent all size/age classes (approximately 100 samples per class), while in 2017 sample selection was random and more closely mirrored the proportion of each size/age class in the sample set.

The second otoliths from the same fish aged by traditional techniques (~1,300 total) were processed using FT-NIRS, and patterns in spectral absorption across a broad range of wavelengths were statistically evaluated to identify portions of the spectrum that correlated with specific organic molecules in the otolith matrix. A series of validation and calibration procedures then tested the ability to reliably use FT-NIRS spectral data to predict traditionally derived age. Models were generated for 2016, 2017, and the two years combined, as well as for northern and southern regions of the survey area in each year and for the two years combined. Geographic delineation was suggested by a northwest-southeast gradient in fish condition along the edge of the shelf, and developing models based on this factor was intended to test how age estimation accuracy is affected by local biological variation.

Validation testing demonstrated that FT-NIRS could predict traditionally derived age within +/-1 yr 92-94% of the time for fish up to age ten. After age ten, FT-NIRS ages showed evidence of being less biased than traditional ages, owing to difficulty in reading tightly spaced annuli at the edge of the otolith using break and burn techniques. Independent models based on each year, and year-geography combination, had high regression coefficients (0.91-0.95), demonstrating a robust ability to accurately reproduce traditional age estimates using FT-NIRS, but also stressing the need for underlying samples used for calibration to be suitably representative of the population under consideration. Efficiency gained by using FT-NIRS as an alternative to traditional aging techniques resulted in a roughly 700% decrease in sample processing time, and a concomitantly substantial reduction in cost.

The authors of the study recommend operationalizing use of FT-NIRS as a production tool for ageing pollock but note that ongoing calibration and validation testing are needed to ensure that annual and geographic variation in pollock demographics are accounted for. This will be especially important in the face of climate change impacts, which are anticipated to affect the growth rate and survival of species throughout the GOA and BSAI.

**The SSC strongly supports the continued development of this ageing method for pollock and other species. In addition to further and ongoing calibration and validation testing of specific research questions (differences between males and females, storage duration for historical collections, etc.), the SSC recommends investigating a “hybrid approach” to production ageing that involves a systematic subsampling of otoliths for traditional aging each year (e.g., 20% of those collected), combined with FT-NIRS analysis of all available otoliths.** The data from the traditionally aged otoliths can then be used, as in this study, to create a year-specific model to generate FT-NIRS-based ages for use in stock assessment. This approach should realize considerable time and cost savings over the traditional ageing of all otoliths while still ensuring that annual and regional variability are adequately accounted for during validation testing. Additionally, **the SSC recommends a modeling exercise to determine the effects of switching ageing methods, which should increase sample sizes available for stock assessment.** This will help demonstrate the putative benefits of using FT-NIRS to obtain substantially more ages for stock assessment, for pollock and other species, while also allowing a careful and thoughtful transition away from the long-standing traditional method.

The SSC also notes that few details are provided regarding the collection and holding protocols for samples used in this study, and factors such as storage temperature, storage media, and time between collection and analysis have been shown to affect specimen composition and FT-NIRS results. Clear protocols for sample collection and storage must be in place to ensure sample utility moving forward.

## **B7 Protected Species Report**

The SSC greatly appreciates the presentations and updates on protected marine mammal species research and trends from the AFSC. John Bengston (NMFS-AFSC-MML) presented an overview of the protected species research at the AFSC. The SSC then heard presentations from the Alaska Ecosystem Program on Steller sea lion surveys and trends, and briefly on foraging studies for northern fur seals (Tom Gelatt); from the Polar Ecosystems Program on harbor and ice-associated seal population trends and research activities (Peter Boveng); and from the Cetacean Assessment & Ecology Program on northern right whales, Cook Inlet belugas, harbor porpoise, and killer whale surveys, trends and ecology (Phil Clapham). At the request of the SSC, Dr. Clapham also provided an update on humpback whale populations and research activities.

The SSC felt the abundance and trend data presented were very informative. A brief summary of the key population trends:

**(1) Steller sea lion (SSL)** surveys indicated that overall, the listed wDPS has been increasing since 2002 (+2%/year non-pups, +1.8%/year pups). However, in the far western Aleutians, counts of pups and non-pups are still declining at rates of -2.9 to -6.8%/y. In the most recent 2017 surveys, counts of pups were lower than predicted range, likely due to declines in pups in the eastern GOA (-33%) and central GOA (-17%).

**(2) Harbor seal** stocks in Alaska are monitored less frequently than in the past. Stocks are mostly stable or increasing but abundance and trends are imprecise for some stocks. ‘At-risk’ stocks such as the Aleutians and Pribilofs require increased monitoring and ecological studies.

**(3) Ice-associated seals** are inadequately assessed at present, but new abundance estimates for at least the breeding populations of ice seals in the Bering and Chukchi seas will be determined from surveys in 2012-2016.

**(4) Northern right whale** abundance was severely impacted by illegal whaling and it is estimated there are only 30 individuals in the eastern population at present. Due to limited funding for research, most monitoring done via acoustic moorings. During the 2017 joint IWC-POWER survey in the eastern Bering Sea, researchers confirmed three new individuals and 1 juvenile—the first non-adult seen since 2004.

**(5) The Cook Inlet beluga** population has declined by 75% since 1979. The subsistence hunt ended in 2005, but population still appears to be declining at -1.3%/year since 1999. Many research activities are being expanded or added due to increased funding from the “Species in the Spotlight” program.

**(6) Harbor porpoise** abundance trends in SE Alaska suggest increasing populations in Glacier Bay/Icy Strait, and a decline followed by an increase in Wrangle/Zarembo. Bycatch in gillnets is greater than potential biological removals for Wrangell/Zarembo which presents a management concern. However, to assess potential impact of bycatch, need to first determine stock structure which is being explored via environmental DNA (eDNA).

**(7) Killer whales in the Aleutians.** Observations were made of Bigg’s Killer whales (mammal-eating) foraging near SSL haulouts but also at depths of 300-400 m, consistent with foraging on squid. Resident killer whales were observed in areas of high abundance of Atka mackerel, and were also observed diving to 400-500 m, which could be exploration dives for other fish such as sablefish,

**(8) Humpback whales.** There is a requirement under MMPA/ESA to do post-delisting monitoring---with no funding, this requires reliance on efforts of local research groups. These groups have indicated via

long-term photo-ID that sightings have been decreasing in Glacier Bay in the last few of years, but it is unknown if this trend is due to reaching carrying capacity or movement to other foraging grounds.

The SSC discussion brought forth a few main points:

A common theme in the introduction and across the following presentations was that “Many important research projects are not being conducted due to lack of funding” and that this funding constraint results in a forced triage. The SSC commended the prioritization of efforts to continue collecting important abundance survey data, but also expressed concerns about the impacts that funding uncertainty or limitations may have on the future ability to conduct surveys at the ideal frequency that is necessary to detect trends and changes in population abundance or distribution, or to assess how trends reflect ecosystem changes.

The SSC noted that diet collection may provide key information, but data are currently lacking for some species. We encourage efforts to continue pursuing these research directions.

The SSC was particularly excited about new technologies and data-sources being used to improve understanding of populations—particularly for remote and difficult to study populations, or populations with potential management concern. This included but is not limited to: passive acoustic monitoring networks for northern right whales in the Bering Sea to determine use of critical habitat, drones for monitoring abundance of SSL in the western Aleutians where populations are declining, drones for assessing condition for Cook Inlet Belugas, life history tags for collecting critical information on harbor seal survival, reproduction and mortality in the western Aleutians where populations are declining, and eDNA for assessing harbor porpoise population structure and impacts of bycatch.

The SSC also wanted to highlight the current efforts and encourage continued progress to bring marine mammals into ecosystem management frameworks. For example, it was noted by Dr. Boveng that new abundance estimates may provide a basis for inclusion of ice seals in ecosystem models and assessments, and Dr. Gelatt described ongoing studies on northern fur seal ecology that aim to spatially and temporally link foraging behavior parameters to prey availability and environmental data. Bringing forward available data/improving data on prey and predation (bottom-up and top-down controls) may provide a way to better integrate the mammal data into the ecosystem context. As this was the first update provided to the SSC by the AFSC on marine mammal research and status, it was very comprehensive and provided extensive information on the trends, distributions, methods and future work planned for many species.

**The SSC felt the information was useful and requests annual updates during the February meeting.**

The SSC suggested the subsequent annual updates consist of any new developments, new findings, and information of note since the previous meeting. It was offered that a list of new publications could be made available, and this would be a good addition to verbal presentations in the future.

## **C1 BSAI Crab**

William Stockhausen (AFSC) presented an overview of the Norton Sound red king crab stock assessment and other agenda items covered during the Crab Plan Team meeting. There was no public testimony.

### ***Norton Sound Red King Crab***

The SSC appreciates the authors’ responsiveness to previous SSC and Plan Team comments. This year’s assessment includes a re-analysis of the ADF&G survey data, which standardized the survey area, standardized the area-swept calculation, and excluded survey re-tows unless the initial tow was unsuccessful.

As pointed out on page 9 of the assessment, commercial buyers started accepting only legal crab of  $\geq 5$ -inch CW in 2005. This action would have been expected to lead to increased discards. Unfortunately, the impact of this change on discards is unknown as discards were not monitored until 2012 when a small-scale observer program was implemented. However, it may be possible to estimate a retention curve with

these observer data for recent years. Success in this endeavor may allow estimation of ABC and OFL in terms of total catch rather than retained catch as is presently the case. For all federally managed stocks the aim is to estimate OFL and ACL in terms of total catch comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch.

This year's assessment was updated to include: catch, catch length composition, discard length composition data from the 2017 summer commercial fishery; 2016/17 winter commercial and subsistence catch; 2017 ADFG and NMFS surveys in Norton Sound; and the standardized commercial catch CPUE indices were updated to include data for 1977-2017.

Five alternative models were presented in this year's assessment:

- Model 0 – base model identical to last year's assessment model (one M for last two size classes, 1-parameter fishery selectivity)
- Model 3 – one M for last two size classes and 2-parameter fishery selectivity
- Model 4 – two Ms for last two size classes and 2-parameter fishery selectivity
- Model 5 – three Ms for last three size classes and 2-parameter fishery selectivity
- Model 6 – one M for last two size classes and 2-parameter fishery selectivity, which also included the summer pot survey data

Model 6, which included summer pot survey data, was rejected by the Plan Team. The Team cited several reasons, including that results were similar to the base model, there was no improvement in fit, and there was no plan to continue this time series. In the SSC presentation it was also stated that these data created some data conflicts. Although the SSC appreciates the need to clean out datasets, brevity of the time series and the introduction of some data conflicts are not good reasons to exclude data that might inform the assessment. So, the SSC does not rule out inclusion of these pot survey data in future model versions. However, the SSC agrees that Model 6 should be rejected this year.

Model 4 included one extra parameter over Model 0, but it did not result in improvement of fit relative to Model 3, so Model 3 was preferred over Model 4 for parsimony. Similarly, Model 5 provided some improvement in fit compared to Model 3 but at the cost of two additional parameters. Moreover, the Plan Team did not think that it was plausible that senescence would lead to higher mortality in the 114-mm CW (modestly large) size bin.

This process of elimination led to the choice between Model 0 and Model 3 for use in this year's assessment. The assessment authors recommended use of Model 3, because of an improvement (10 unit of log likelihood) in overall model fit. Nevertheless, the Plan Team recommended use of Model 0 over Model 3 for several reasons. First, as Model 3 includes a 2-parameter pot fishery selectivity curve (compared to 1-parameter for Model 0), the Team thought that it should have led to improved fits to the pot fishery length composition data. Instead, the overall better fit resulted from better model fits to other data unrelated to the pot fishery, namely tagging data and trawl survey size composition. In addition, the estimated selectivity pattern was a gradually inclining curve (i.e., stepped "linear" increase) that continued to increase for sizes larger than the legal size limit, which the Plan Team found difficult to rationalize. This suggested to the Team that Model 3 used the more flexible two-parameter selectivity curve to account in some unknown way for some other unmodeled process; thus, the Team did not consider Model 3 to be an improvement.

The SSC supports the Plan Team's recommendation to adopt Model 0 for this year's catch specifications. However, the SSC remains unsatisfied with Model 0, for reasons relating to the treatment of the survey, data weighting, selectivity and retention parameterization, and other concerns. Model selection criteria are currently confounded with a data weighting method that is inconsistent with the generally supported approach of the CPT. The SSC's evaluation of model alternatives was also hampered by the presentation of information in the SAFE. From the information presented, it was not clear where the signal for lack of large males is coming from. In addition, it was not clear what was reported in the residual plots shown in



Figure 12 (standardized residuals with a scale for reference on the figure would be helpful). Also, the caption for Figure 4 could be clearer. AIC values were not reported, which also would have been helpful to evaluate alternative models.

The application of  $M$  to the Tier 4 calculation was somewhat debatable in this year's assessment. In January 2017, the Plan Team suggested that the assessment authors should calculate the Tier 4 OFL using values of  $M$  estimated separately for each size bin. However, when applied, the use of  $M = 0.588$  for the largest two size bins resulted in a 74% increase in OFL from last year. The Plan Team did not embrace a change of this magnitude given the recent decline in stock abundance and they also expressed uncertainty about whether such a stage-based  $M$  approach is an appropriate application of Tier 4. This was also a point of some contention for the SSC. **However, given ongoing uncertainty about the veracity of the apparent increase in  $M$  at large sizes (as opposed to other potential explanations) and given that such sharp increases in  $M$  for larger size classes has not been demonstrated in any other king crab stocks in Alaska, the SSC agrees that it is appropriate to stick to OFL calculations based on fixed  $M = 0.18$  (used for all other size classes) in this year's assessment model although this raise some concerns about consistency.**

In keeping with other recent assessments of this stock, the Plan Team recommended calculation of OFL for Norton Sound red king crab using Tier 4 calculations. **Likewise, the SSC also continues to support Tier-4 management of this stock at this time. Given that the estimate of mature male biomass is less than the  $B_{MSYproxy}$ , the stock falls under Tier 4b. The calculation using  $F_{OFL} = M = 0.18$  results in an OFL of 0.20 thousand t (0.43 million lb).** Also consistent with recent calculations of ABC for this stock, the CPT continues to recommend a 20% buffer below OFL. **The SSC concurs with the choice of a 20% buffer, yielding a 2018 ABC of 0.16 thousand t (0.35 million lb). The SSC's adoption of the 20% buffer is based on concerns with model specification, lack of discard data, unresolved issues associated with the apparent high  $M$  for the largest size class, and considerations of other stocks with similar levels of uncertainty.**

The SSC offers the following additional comments on this assessment:

1. SSC members had difficulty in accessing the complete Norton Sound red king crab assessment. The version of the SAFE on the Council's agenda lacked figures, tables and appendices. A different version (dated 12/27/17), linked on the Crab Plan Team meeting agenda for January 2018, included these tables and figures, but it wasn't clear if this was the latest version or if revisions were made at or after the Plan Team meeting. Moreover, the Appendices were all separate documents available only through the agenda for the Plan Team's January meeting. The SSC requests that the author include tables, figures, and appendices in the same (one) document as the text in the future. This SAFE document should be directly accessible through the Council's meeting agenda. If it is absolutely necessary for SSC members to access SAFE or other documents from the Plan Team meeting, at the conclusion of the Plan Team meeting these should be made more conveniently available through a zipped folder. Finally, attention should be paid to clarity of the presentation (e.g., figure captions, labeling) to improve interpretation.
2. The SSC noted the comment on page 9 of the assessment that recent observations indicate that Norton Sound red king crab may demonstrate biennial mating. The SSC requests more information on the evidence for this and some consideration of the implications, if any, on fishery harvest strategy. The SSC notes that blue king crab also thought to undergo biennial reproduction.
3. The SSC greatly appreciates the authors' efforts to standardize the ADF&G trawl survey time series. However, the treatment of unsampled survey stations remains an issue to be addressed. Namely, in years when not all survey stations are covered, it is currently assumed that the catch at unsampled stations would have yielded zero catch. The Plan Team offered some excellent alternative model-based approaches (e.g., VAST) for the authors to consider addressing this problem. Such approaches could make use of the larger data set including all sampling conducted

each year, while propagating the uncertainty associated with missing stations. The SSC supports the Plan Team's recommendations to the authors for further analysis of the survey data.

4. The SSC discussed differences in the ADF&G and NMFS trawl surveys conducted in 2017. It was unclear whether differences in crab catches are attributable to differences in survey methods, gear selectivity, survey timing, survey measurement errors (e.g., high CV in NMFS trawl survey estimates), or other factors. To help sort out the cause(s), the SSC recommends a spatial comparison of the two surveys that were conducted in 2017.
5. The SSC noted on page 9 of the assessment that commercial buyers switched from accepting legal sized crab ( $\geq 4 \frac{3}{4}$  inch carapace width, CW) to larger crab ( $\geq 5$ -inch CW) in 2005. The SSC requests the assessment authors to consider whether this switch may have affected the apparent CPUE. This does not appear to have been addressed in the CPUE standardization presented in Appendix B.
6. For next year's assessment, the SSC supports the Plan Team's suggestion that the authors should quantitatively evaluate the representativeness of the observer data and then attempt to estimate a retention curve with those data, if the observer data are deemed to be representative. This analysis could be useful to move away from a retained catch OFL and move toward a total catch OFL, which is the goal for all crab fisheries. In conjunction with the estimation of crab retention, there should be further consideration of fishery selectivity curves, and the ability of selection and retention processes to address the "missing" large males.
7. The SSC agrees with the Plan Team that Norton Sound red king crab appears to be a candidate for Tier 3 management. Tier 3 requires the estimation of proxies for  $F_{msy}$  and  $B_{msy}$ . A suitable proxy takes the form  $F_{X\%}$  where  $X\%$  refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or a proxy, such as mature male biomass at mating) per recruit equal to  $X\%$  of the equilibrium level in the absence of any fishing. The SSC supports the Plan Team's recommendation that the authors should evaluate Norton Sound red king crab as a candidate for Tier 3 in next year's assessment. In the course of developing a Tier 3 assessment option, the SSC requests the authors to address various model issues identified above in anticipation of potential adoption of an improved model. As always, the base (status quo) model should be included for comparison.
8. The SSC supports the other recommendations to the assessment authors made by the Plan Team.

SSC requests that a quantitative baseline of annual community engagement and dependency for Norton Sound red king crab is developed and requests that it includes the following considerations:

- a) Since this fishery started as a large vessel summer commercial fishery in 1977, it has evolved through the incorporation of multiple community/regional protection/enhancement measures, including transitioning to a small boat fishery (1993); implementation of a super-exclusive designation (1994), a vessel moratorium (1996), and a CDQ allocation (1998; with harvests first occurring in 2000) with significant CDQ-related regulatory changes occurring 2002 and 2008, including shifting fishery spatial extents and annual starting dates.
- b) Additionally, the fishery has changed over time due to area closures to protect crab nursery grounds during the summer crab fishery since 1977 (the boundaries of which have varied over time) and guideline harvest levels that went into effect in 1999. A license limitation program went into effect in 2000. In 2012, a revised harvest strategy was adopted by the state for purposes of GHM specification for the summer fishery and, in 2016, a winter GHM was established and winter fishing season dates were changed. A non-regulatory change that impacted the fishery occurred when the primary buyer changed the minimum size accepted to a 5-inch or greater carapace width (larger than legal size limit) in 2005.

- c) The different fisheries, the summer commercial fishery, the CDQ fishery, the winter commercial fishery, and the subsistence fishery, which has its own summer and winter fisheries, have different characteristics, including differing participation patterns by community.

The SSC discussed whether this information should go into the SAFE but concluded that the best place for this information would be Environmental Socio-economic Profiles (ESPs), if ESPs are developed for crabs. Failing this, these would be appropriate to include in the Crab Economic SAFE. In particular, the SSC recommends incorporating time series data in the future for a limited number of indicators showing a quantitative baseline of annual community engagement and dependency (ideally from 1977 to date) by fishery type (e.g., vessel counts/characteristics and harvest levels by community for the summer fisheries), along with mapped changes in fishery spatial extents over time, where feasible. This information would help in understanding the sustained participation of fishing communities over the longer term relative to the current year's fishery. These data would also help in the understanding of the efficacy of the multiple community/regional protection/enhancement measures that have been implemented for this fishery.

### **Other Crab Plan Team Issues**

The SSC received a brief recap of other items addressed during the Crab Plan Team meeting.

*Bimodality in snow crab reference point estimates:* Although the newly available growth data for snow crab appear to have reconciled a convergence issue in that assessment, convergence in general for crab models remains an important issue. New growth data addressed this issue in the case of one crab stock. Last year, the Plan Team advocated Bayesian approaches and this approach should not be abandoned for jittering-only approaches to evaluate convergence. Bayesian integration remains a very useful tool for exploring model behavior and parameter estimation, in addition to simpler jittering approaches.

*MCMS posterior draws:* Buck Stockhausen discussed several MCMC posterior probability methods. The SSC is supportive of attempts to try out the No-U-Turn Sampler (NUTS) for the Tanner crab assessment. The Plan Team sought advice from the SSC on what statistics should be reported. The SSC notes that basic Bayesian diagnostics and summary methods are widely documented and available. R packages such as CODA, BOA, and r4ss are widely available, and the NUTS implementation for ADMB has an associated GUI with diagnostics, etc. Primary diagnostics commonly applied include autocorrelation in the chain and testing for adequate burn-in and thinning (or use of explicit time-series analysis methods).

*Dynamic  $B_0$ :* A recap of Jim Ianelli's work on dynamic  $B_0$  was presented. The Plan Team recommended that the crab assessment authors should undertake dynamic  $B_0$  calculations for future discussion. The SSC supports developing the dynamic  $B_0$  approach for further comparisons. Jim has developed a spreadsheet approach for easy implementation. The SSC noted that this procedure is reasonably well documented in the literature and is already used for some tuna and other species. The approach accounts for environmental and recruitment variability. As an important note, if a S-R relationship is significant, then it should be included in the analysis; this same comment also applies to current reference point calculations and future projections.

*Tanner crab maturity:* The SSC was pleased to hear about ongoing analyses of recent Tanner crab chela data, collected at 0.1 mm resolution, that appear to be providing improved estimates of size at male maturity. The SSC encourages completion of this analysis and looks forward to presentation of final results. The SSC was also pleased to hear that the maturity information can be directly incorporated into the Tanner crab assessment and looks forward to assessment model alternatives that include these data. It appears that the advent of new maturity data will lead to an important improvement in the Tanner crab assessment.

*Terminal year of recruitment:* The Team discussed multiple methods including dropping the last year, averaging the last three years, and use of retrospective analysis for identifying appropriate time periods to stabilize the recruitment estimates. The SSC supports the Plan Team's recommendation that the

assessment authors should conduct a retrospective analysis for the May 2018 Plan Team meeting. The SSC asks the Crab Plan Team to please check with the Groundfish Plan Teams, as they already have quantitative rules for defining which terminal recruitment estimates to include in reference point estimation based on available data, life history, etc.

*ADF&G golden king crab genetics and harvest strategies:* The SSC received a brief overview of preliminary results of the study of genetics of golden king crab in the Aleutian Islands, which does not indicate isolation by distance. The SSC also heard that changes in the harvest strategy will be proposed that incorporate results from the newly adopted stock assessment model for the Aleutian Islands golden king crab stocks.

*Crab bycatch (legal versus non-legal retained):* The rationale for crab observers to stop collecting information on legal retention status was briefly explained. While the SSC has pointed out the difficulties for observers to make their own judgements about what crabs would be discarded by the crew, there remains some confusion about how estimates of discard mortality can be obtained without such estimates. The SSC looks forward to analyses of future options in this regard.

*Weighting and lambdas in Tier 3 and other assessments:* At the bottom of the first paragraph on page 10 of the Crab Plan Team minutes, it states that “Future discussions also need to consider the necessity of re-weighting after data is jittered when analyzing model convergence.” The SSC hopes that this sentence represents a typo, as it indicates some confusion about jittering; namely, it is not the data that are jittered.

### **C3 Gulf of Alaska Chinook Prohibited Species Catch**

The SSC received a presentation from Sam Cunningham (NPFMC) of the draft EA/RIR for the proposed actions that would revise Chinook salmon prohibited species catch (PSC) caps in the non-pollock groundfish trawl fisheries in the central and western GOA. Public testimony was provided by Julie Bonney (Alaska Groundfish Data Bank) and Beth Stewart (Peninsula Fishermen’s Coalition)

The analysis assembles the available information on PSC rates and regions of origin that describe potential benefits and impacts of proposed increases in the non-pollock trawl PSC caps. The proposed actions will maintain total GOA trawl Chinook PSC below the 40,000 threshold that would trigger Endangered Species Act (ESA) consultation, but it was unable to determine if these actions would or would not impact Chinook stocks that are bycaught in these fisheries. It appropriately emphasizes both variability in Chinook PSC rates, and in the measures of Chinook PSC arising from sampling in fleets with partial observer coverage (particularly those in the non-pollock trawl fisheries). Thus, it adequately characterizes the types and nature of tradeoffs associated with the action, but the data do not support an estimate of the magnitude of those tradeoffs. **The SSC recommends the analysis be released for public review, following some important modifications that should improve clarity to readers and further highlight the necessary tradeoffs to a range of audiences.**

The SSC discussed at length how to balance facilitating an understanding of the likely effects of the proposed action with the multiple sources of uncertainty and variability in the existing data that make any specific number highly speculative. The analysis presents information on PSC rates, trawl-caught Chinook age and region of origin, and Alaska Department of Fish and Game (ADF&G) rates of survival to rivers but is unable to combine them to generate predictions of how an increase in PSC affects the magnitude of spawners in specific stocks of Chinook. It provides information on historic PSC and target fishery harvest rates but does not provide an estimate of how the PSC cap increases would affect the frequency of closures or the associated foregone target harvest value. While the data do not support the implications of any particular calculation, **the SSC recommends the analysis integrate some illustrative calculations to help readers understand functional relationships that determine the potential effects of increased Chinook salmon PSC.**

The clarity of and description of various tradeoffs in the document could be greatly improved by:

- Providing an example of how standard adult-equivalent (or AEQ) calculations can be used to illustrate the chance that a given trawl-caught salmon would have survived to spawn.
- Assess whether there is adequate genetic sampling of Chinook from non-pollock trips to draw inferences about regions of origin of PSC trawl caught Chinook and present what is currently in narrative on page 39 in tabular or graphical form to make it more accessible to readers. Specifically, data from genetic stock identification to region of origin is available for the non-pollock rockfish fishery and should be included in the document.
- Refine vessel dependency information in Tables 54/55 by displaying densities, or quintiles, of the share of revenue across fleet, in addition to fleetwide averages.
- Clearly state the rationale for the thought exercise on western GOA PSC rates, and how it would have affected PSC limits for that fishery under the Council's original retrospectively based allocation.
- Integrate information about functional relationships that are understood but not documented within this specific fishery.
  - Enhance and update discussion of status of Chinook stocks up and down the coast, including those outside Alaska (Canada and U.S. west coast). In particular, updated (through 2017) descriptions of stock-of-concern status, spawner abundances, and trends relative to management objectives (escapement goals), as well as agency management actions taken in directed Chinook fisheries. Much of this material can be gleaned from recent Pacific Salmon Commission reports and contacts with agency staff at ADF&G.
  - Provide a discussion of how southeast Alaska Chinook that are bycaught in these groundfish fisheries are more-or-less likely to be wild-origin than hatchery-origin due to the choices of brood stock, migration behaviors of wild stocks, and relative magnitude of wild versus hatchery stocks.
  - Provide a discussion of the importance of hatcheries in supporting ESA-listed stocks in Puget Sound, including recognition that hatchery-origin fish from this Distinct Population Segment are included in the ESA listing.
  - Clarify the different sources of year-to-year and within-season variability in estimates of PSC in these fisheries, with particular focus on the non-pollock trawl fisheries. The EA/RIR/IRFA for Amendment 97 will likely be a useful reference for this discussion. In particular, a discussion of the effect of basket sampling (within year) and overall abundance of Chinook in the GOA (between year) each differentially affect the requirement for additional tools to manage for PSC.
  - Update the information provided on page 37 concerning the relationship between annual changes in PSC magnitude and changes in abundance of Chinook in the eastern GOA as estimated by the Pacific Salmon Commission. This abundance information is available in Pacific Salmon Commission reports.
  - Update the hatchery release information in Table 22 and provide text explaining that hatchery releases in the U.S. west coast could increase in the future due to actions taken to mitigate southern resident killer whale concerns.

**The SSC requests that, in advance of identifying a preferred alternative, the Council refine the purpose and need statement for this action.** Amendment 103 was developed in an attempt to manage variability in Chinook PSC through in-season management concurrent with plans for cooperative solutions for the non-pollock, non-rockfish trawl fishery. Cooperative solutions are no longer under consideration, and by itself, Amendment 103 may be of limited utility due to the early timing of the non-pollock non-rockfish trawl fishery; it will not be clear whether other fisheries will have spare Chinook

PSC at the time it would be needed to keep the non-pollock non-rockfish trawl fishery open. Therefore, **the SSC encourages examination of whether the current system of hard caps is the best approach or whether other better alternatives and monitoring tools exist for managing chinook PSC in the GOA trawl fisheries.**

## **D1 Arctic Exploratory Fishing**

Steve MacLean (NPFMC) presented a discussion paper that reviews the criteria used in various Regional Fishery Management Organizations (RFMO; North Pacific, North Atlantic, Antarctic, etc.) to provide opportunity for exploratory fishing. There was no public testimony. In its June 2017 motion, the Council specifically requested that the paper identify how these agreements define exploratory fishing, lay out any management measures applied to exploratory fishing under each of these agreements, discuss any problem areas and challenges for management as well as successes, and describe any “best practices” or “lessons learned” that might be applied to the central Arctic Ocean. The motion states that the Council intends to amend the Arctic Fishery Management Plan (FMP) to incorporate guidance on the exploratory fishing that would inform the Council's precautionary approach to opening commercial fisheries in the Arctic.

The area defined by the Arctic FMP is a dynamic and rapidly changing environment that is of considerable scientific and, potentially, commercial interest. Scientific research is ongoing in the Arctic FMP area, and this research provides important understanding of the rapidly changing Arctic ecosystem. Further, as the Bering Sea continues to warm, the distribution of fish stocks is likely to expand into arctic waters, resulting in potential commercial fishing activities impacting stocks historically not in the arctic region. Thus, a precautionary approach to authorizing any commercial fishing activity in the arctic continues to be an appropriate policy.

The SSC appreciates the discussion paper and found the information on the RFMOs informative. The discussion paper covers the scope of the Council request. However, the SSC was unsure how to provide advice to the Council given the document was not an analysis of a specific policy or regulatory proposal, but rather an overview of RFMO activity. The Council has not provided guidance on what constitutes “exploratory fishing” and how this would differ, if at all, from existing Arctic FMP provisions for fishery development. This question is fundamental for determining the types of management measures, beyond those already in the FMP, that would be required to authorize fishing activity.

Should the Council desire to amend the Arctic FMP and change its policy regarding commercial fishing activities in the Arctic, the SSC recommends consideration be given to the following:

- The difference between “exploratory fishing” and the existing FMP provisions for “fishery development” should be reconciled. The Arctic FMP provides a suite of analytical requirements for fishery development (e.g., Section 2.2.2), and these criteria should be heavily considered in future policy development. These provisions ensure a precautionary approach is used in establishing commercial fishing activities in the Arctic. A new policy or change to existing FMP language should not undermine the current management policy, conservation measures, and objectives in the Arctic FMP.
- Detailed information is needed on the approval process and authorities (i.e., who approves) for an entity seeking authorization for fishing in the Arctic FMP area. Specifically, are there existing processes that could be used (such as an Exempted Fishing Permit and/or the process currently outlined in the FMP), or is “exploratory fishing” a completely new process or can the existing language in the FMP for fishery development simply be augmented. Table 2 in the discussion paper may be of use for developing future requirements. For example, if scientific research is part of the approval, then study design issues would need to be addressed (e.g., a Data Collection Plan).

- The discussion paper notes that an international agreement to manage the commercial fishing in the central Arctic Ocean (beyond the Exclusive Economic Zone) (EEZ) has been ratified. This agreement establishes a moratorium on commercial fishing outside of the EEZ for at least 16 years while study occurs on the central Arctic Ecosystem. The Arctic ecosystem is likely connected across jurisdictional boundaries, and any fishing operations that occur in the EEZ may interact with scientific conclusion from research within the moratorium area (e.g., is the effect fishing or a result of natural processes?). To the extent feasible, future Council policy should consider interactions of fishing with scientific research occurring in the moratorium area.
- Should the Council choose to amend the FMP, then the new criteria authorizing fishing activity should consider impacts on fishery dependent communities and subsistence activities, along with an evaluation of the impacts on marine resources.

In addition, the SSC notes the FMP section titled “habitat, fisheries, and ecosystem components” has not been updated since its creation in 2009. Given the rapid environmental changes in the Arctic, information in this section is likely outdated and should be updated for all components. Specifically, if commercial fishing activity is planned for the Arctic Management Area, risk assessments regarding potential impacts to coastal communities would benefit from inclusion of information that has been developed on human ecosystem characteristics and changing environmental conditions. Information on commercial, subsistence, and recreational fishing, along with economic and socioeconomic characteristics of the fishery in the FMP (Sections 4.1.6.1 through 4.1.6.4) is limited; similarly, the information on human ecosystem characteristics (Section 4.2.3) consists of one-paragraph regional summaries each for the prehistoric, historic, and contemporary eras. Additional information will be needed if community or sub-region level socioeconomic impact assessments are to be undertaken.

#### **D4 Economic SAFE**

The SSC received a report from Steve Kasperski (AFSC), Ben Fissel (AFSC), Sarah Wise (AFSC), and Brian Garber-Yonts (AFSC) on changes in the Groundfish and Crab Economic SAFE reports. Overall, the SSC commends the group for its continual progress in creating a set of products that inform both the public and the Council on the performance of the groundfish and crab fisheries. The SSC is also encouraged by the hiring of two social scientists at AFSC and the creation of the Social Science Planning Team, all of which are critical for improving the integration of human dimensions and economic data into the Council process.

Ben Fissel presented an overview of the dashboard metrics in the SAFE, which successfully facilitated a focused discussion of trends in Alaska fisheries. The SSC finds this to be a very useful tool, and suggests a measure reflecting changes in product form, and normalizing some measures to a constant basket sample of species or products. He then introduced a new interactive data visualization tool, which allows users to plot and download several different time series that are included in the Groundfish Economic SAFE document. The SSC finds these tools to be very useful and looks forward to the inclusion of additional metrics and years of historical data in the future. The SSC was also given a presentation on the new Economic Performance Reports (EPRs), which add brief economic overviews to individual species’ stock assessment documents. The SSC agrees that they are a good tool for introducing key economic and community information to stock assessment Plan Teams. Going forward, the SSC encourages the analysts to consider specific ways in which stock assessors might use the provided information to improve assessments, including understanding TAC utilization, the synchrony of market and biological processes, and features of targeting that might not be incorporated in the stock model.

Brian Garber-Yonts gave a brief presentation on the Economic Data Report (EDR) required by Amendment 91. As discussed in previous years, some parts of the EDR are not performing as well as expected. For example, the Compensated Transfer Report is not proving to be useful because there are so few transfers of salmon PSC quota of the type that require reporting. In addition, the long gap between the

fishing year and the survey itself may introduce recall biases in the Vessel Master Survey. Overall, the SSC recommends that the EDRs for Amendment 91 be reviewed in order to make revisions for improving the data collected for management purposes. Further, the data collected in future programs should be consistent with current questions desired to be answered, which may differ from those identified when the EDR data collection program began.

Brian Garber-Yonts also gave a brief presentation on the Crab Economic SAFE report. The major addition to the Crab SAFE is a set of metrics that measure “net earnings”, which provide information on both the financial performance of crab vessel operations and net economic benefits produced by the harvest sector in the rationalized crab fisheries. The SSC commends the effort that has gone into putting these metrics together and recommends that these metrics be developed for the processing sector as well. The SSC also recommends that the Crab SAFE include report card indices that parallel those in the groundfish SAFE. The SSC notes that these indices do not need to be the same as those of the groundfish SAFE but should be informative about the current performance of the crab fisheries relative to past performance. The SSC also recommends that data presented in the Crab Economic SAFE tables be available for download by the public, similar to the data in the Groundfish SAFE.

Sarah Wise gave a presentation on the community metrics within the SAFE, along with an overview of the future directions for programmatic research on human dimensions in North Pacific fisheries. Such research is critical for identifying metrics that capture how important fisheries are to the culture and economy of individual communities, and for identifying communities that are vulnerable to changes in fisheries or fishery management. The SSC is encouraged by the future direction of this research program, although it notes that the research plan is quite ambitious and will require a continuous source of funding. Given the current funding challenges, the program leads will likely need to prioritize research areas.

The SSC recommends that the authors of the Groundfish Economic SAFE reconsider what content should be included in the Community Participation chapter to meet the goals and objectives of the Groundfish Economic SAFE. In their present form, the constituent data of this chapter are not useful for incorporation into community or social impact analyses related to the North Pacific groundfish fisheries, for two primary reasons.

- First, unlike all other chapters in this document, this chapter, despite the title, does not focus on groundfish. It is a compendium of community participation in all state and federally managed commercial fisheries in Alaska, with the result that the participation in federally managed groundfish fisheries cannot be disaggregated/identified.
- Second, the focus of this chapter is exclusively on Alaska communities, to the exclusion of the substantially engaged communities in the Pacific Northwest that are a large and vital part of these fisheries.

To be consistent with, and complementary to, the other chapters in the document, this chapter needs to be refocused on the groundfish fishery and include all communities substantially engaged in the fishery, as required by the MSA for analyses of sustained participation of fishing communities (National Standard 8). The other chapters in the document provide a valuable compendium of economic information on the federally managed groundfish fisheries; the community engagement chapter should do the same, using the same primary economic data sources for consistency and supplemented with non-economic social indicators where relevant.

Further, the demographic data presented in the Community Participation chapter, which focuses exclusively on communities rather than including data on populations as well, impedes the use of the provided information in environmental justice analyses required under Executive Order 12898. Where possible, specific minority populations and low-income populations should be identified within the relevant fishing communities substantially engaged in and/or substantially dependent upon the federally managed groundfish fishery. For the communities in Southwestern Alaska with large shore-based



processing plants, this has been done in multiple recent Council analyses through the use of group quarters population data as a proxy for processing workforce populations that are relatively distinct from the rest of the community.

- Akutan provides one important example of this. Akutan was initially determined as not eligible for inclusion in the CDQ program based on having previously developed processing capability sufficient to support substantial participation in the Bering Sea groundfish fisheries. Akutan, however, successfully challenged that determination. They were able to show that the traditional village of Akutan was, in essence, socioeconomically as well as spatially, distinct from the residential workforce of the local processing plant, with the traditional village and processing workforce populations each having their own, different forms of cultural and social cohesion.
- Similarly, without a focus on populations, it is easy to lose the “communities within communities,” an example of which is the Aleut population within Unalaska. Traditionally an Aleut community, Unalaska has grown into a plural community due to the local presence of the seafood industry. While it is easy to overlook the Aleut minority population as a small percentage of the overall community, the Aleut population of Unalaska is larger than the combined Aleut populations of the five CDQ communities in the region and is a center of gravity for kinship and social networks among the traditional inhabitants of the region (effectively recognized by the CDQ’s action in making Unalaska an *ex-officio* member of the organization).

Use of this type of community information, readily available in multiple Council analyses, is key to better portraying the type of social and cultural cohesion mentioned in the current Groundfish SAFE community chapter. Additionally, when minority status data are presented at the housing type and community level, the SSC requests that the authors take the additional step of calculating and providing “total minority” figures (i.e., total population exclusive of white, non-Hispanic individuals) in addition to the straightforward, standard census groupings to allow for direct inclusion into Council environmental justice analysis.

The SSC also recommends that the Groundfish Economic SAFE disaggregate economic fishery engagement indicator data to the community level to provide a time series record of quantitative indicators of community engagement and dependency where possible within the constraints of data confidentiality and, where individual community data may not be disclosed, to the level of socioeconomically/geopolitically meaningful aggregations (e.g., to the borough level, or to the geographically defined industry sector level where that grouping coincides with a federal fishery management area boundary). Some of the indicators that should be considered are found in the following existing Bering Sea oriented tables (and their GOA analogs) in the existing document:

- Table 8: Number of vessels that caught groundfish off Alaska by area, vessel category, gear, and target, 2012-2016.
- Table 9: Bering Sea & Aleutian Islands groundfish retained catch, by vessel type, gear and species, 2012-2016 (1,000 metric tons, round weight).
- Table 18: Bering Sea & Aleutian Islands number of processors, gross product value, value per processor, and percent value of BSAI FMP groundfish of processed groundfish by processor group, 2012-2016 (\$ millions).
- Table 23: Bering Sea & Aleutian Islands catcher vessel crew weeks in the groundfish fisheries by month, 2012-2016.
- Table 23: Bering Sea & Aleutian Islands at-sea processor vessel crew weeks in the groundfish fisheries by month, 2012-2016.
- Table A.3: Monthly Employment of Seafood Processing Workers in Alaska, 2012-2016.

Given that licenses, rather than vessels, have recently been the focus or “unit” of management action in several recent Council FMP amendment analyses, the SSC further recommends that license data relevant

to groundfish fisheries also be disaggregated to the community level. Similarly, the SSC recommends that the authors look at the types of EDR data that are being collected in relevant groundfish fisheries and consider what variables could be disaggregated to the community level to show the fishery participation “footprint” across communities and region (e.g., crew data that can link the community of crew member residence to the community of vessel owner residence).

### **E3 Social Science Plan Team Nominations**

The SSC reviewed the Social Science Plan Team (SSPT) nominations of Mike Fey (PSMFC-AKFIN), Elizabeth Figus (NPFMC), and Mike Downs (Northern Economics, SSC). The SSC finds these nominees to be well qualified, with appropriate expertise that will assist the SSPT. In particular, the nominees will bring much needed expertise in non-economic social science and knowledge of available social science data and data quality. The SSC recommends that the Council approve these nominations.

### **E4 Draft Agenda for Plan Team Workshop**

Allan Hicks (IPHC) gave an overview of a suggested agenda for a BSAI Plan Team workshop on ensemble modeling and protocols for reducing ABC from the maximum permissible. The SSC endorsed the agenda and agreed with the Plan Team that holding it in June after the National Stock Assessment Workshop would be ideal. The SSC suggested a slight reorganization of Topic 3 (Ensemble Modeling) of the agenda: section 3.4 (Examples) should follow section 3.1 (Introduction), then section 3.3 (Pros and Cons), and then section 3.2 (review of SSC workshop). The SSC also had some other suggestions. First, it would be desirable to get feedback from other fields that use ensemble modeling, such as weather. Second, an overarching goal of the workshop should be to develop protocols and best practices. Third, some discussion about characterizing uncertainty, say with confidence intervals, using ensemble models should be considered. Finally, given the general nature of this workshop, the SSC suggests broadening participation to include the GOA groundfish, crab, and scallop Plan Teams. The SSC recommends that this workshop attempt to identify one or more stock assessments to further test the application of ensemble modelling for presentation to the Groundfish Plan Teams in September 2018.

The workshop should also discuss whether a Plan amendment would be necessary to utilize an ensemble of models. It may also be desirable to obtain one or more datasets with known information to explore during the workshop. The datasets developed by the National Research Council in 1998, and the results of models fitted to those datasets could be used to compare single vs. multi-model approaches. Exercises with known data are often revealing in exploring pros and cons of different methodologies.

The workshop will also address the topic of adjustments made from the maximum permissible ABC to the recommended ABC. The SSC recommends identification of clear and transparent rules for defining the specific criteria to be used when adjusting the recommended ABC. Stock assessment uncertainty relative to levels upon which the Tier system was constructed, atypical data availability or usage (e.g., reliance on only catch-per-unit-effort vs. a survey index), ecosystem considerations, and other factors are potential candidates. It may be helpful for one or more scientists involved with the Ecosystem Considerations report to participate in the workshop.