North Pacific Fishery Management Council

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SCIENTIFIC AND STATISTICAL COMMITTEE
REPORT TO THE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
October 3rd – 5th, 2016

The SSC met from October 3rd through 5th at the Hilton Hotel, Anchorage, AK.

Members present were:

Farron Wallace, Chair
NOAA Fisheries—AFSC

Chris Anderson
University of Washington

Jennifer Burns
University of Alaska Anchorage

Lew Coggins
U.S. Fish and Wildlife Service

Sherri Dressel
Alaska Department of Fish and Game

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

Terry Quinn
University of Alaska Fairbanks

Seth Macinko
University of Rhode Island

Franz Mueter
University of Alaska Fairbanks

Kate Reedy
Idaho State University Pocatello

Matt Reimer
University of Alaska Anchorage

Ian Stewart
Intl. Pacific Halibut Commission

Alison Whitman
Oregon Dept. of Fish and Wildlife

Members absent were:

Robert Clark, Vice Chair
Alaska Department of Fish and Game

B-1 Plan Team Nominations

The SSC reviewed the Plan Team nominations of Ben Daly and Kirstin Holsman to the Crab Plan Team (CPT) and the Bering Sea Aleutian Islands Groundfish Plan Team (BSAI GPT), respectively. The SSC finds both 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.

General Assessment Comments

The SSC reminds groundfish and crab stock assessment authors to follow their respective guidelines for SAFE preparation. The SSC found the model numbering in the eastern Bering Sea (EBS) Pacific cod model extremely helpful and looks forward to having more standardized model numbering across all stock assessment documents. The SSC requests that the CPT discuss the model numbering guidelines presented in Guide to the Preparation of Alaska Groundfish SAFE Report Chapters (July 25, 2016) and provide a recommendation whether that would work for crab stock assessment documents and, if not, provide a recommendation for standardized model numbering. This will better serve not only the SSC, but the public to provide a more transparent process for model tracking.

The SSC requests that stock assessment authors bookmark their assessment documents and commends those that have already adopted this practice.

The SSC recommends that the Gulf of Alaska Groundfish Plan Team (GOA GPT), BSAI GPT, and CPT encourage the continued use of multiple approaches to data weighting (not just the Francis (2011) method, but also including the harmonic mean and others).

C-1 BSAI Crab SAFE and Harvest Specifications

Bob Foy (NMFS-AFSC), Buck Stockhausen (NMFS-AFSC), and Diana Stram (NPFMC) presented the CPT report and sections of the Crab SAFE. Public testimony was provided by Linda Kozac (Golden King Crab Coalition and Aleutian King Crab Research Foundation).

The SSC reviewed the SAFE chapters and information provided by the CPT with respect to the stock status information from 2015/2016 and relative to total catch in that time period (Table 1). In addition, Table 2 contains the SSC recommendations for 2016/2017 catch specifications, with maximum permissible ABCs for 2016/2017 shown in Table 3. **The SSC notes that that Pribilof Islands blue king crab was subject to overfishing in 2015/2016 and remains in an overfished status.**

Table 1. Stock status of BSAI crab stocks in relation to status determination criteria for 2015/16 as estimated in September 2016. Values are in thousand metric tons (kt). Note, diagonal fill indicates parameters not applicable for that tier level.

Chapter	Stock	Tier	MSST	B_{MSY} or $B_{MSYproxy}$	2015/16 MMB[1]	2015/16 MMB / MMB_{MSY}	2015/16 OFL	2015/16 Total catch	Rebuilding Status
1	EBS snow crab	3	75.8	151.6	91.6	0.60	83.1	21.4	
2	BB red king crab	3	12.89	25.78	27.68	1.07	6.73	5.34	
3	EBS Tanner crab	3	12.82	25.64	73.93	2.88	27.19	11.38	
4	Pribilof Islands red king crab	4	2.76	5.52	9.06	1.64	2.12	0.00032	
5	Pribilof Islands blue king crab	4	2.06	4.12	0.36	0.09	0.00116	0.00118[2]	overfished
6	St. Matthew Island blue king crab	4	1.84	3.68	2.11	0.57	0.28	0.05	
7	Norton Sound red king crab	4	1.09	2.18	2.33	1.07	0.33	0.24	
8	AI golden king crab	5					5.69	Conf.[3]	
9	Pribilof Islands golden king crab	5					0.09	0.001	
10	Adak red king crab	5					0.05	0.002	

[1] For stocks 1-6 MMB on 2/15/2016 is estimated using the current assessment in September 2016. For Norton Sound red king crab MMB on 2/1/2016 is estimated using the current assessment in January 2016.
[2] Overfishing occurred in 2015/16.
[3] Confidential under State of Alaska Statute Sec. 16.05.815. TAC not attained.

Table 2. SSC recommendations for 2016/17 (stocks 1-6). Values for stocks 7, 8, 9, and 10 were set by the SSC in February and June 2016. Diagonal fill indicates parameters not applicable for that tier. Values are in thousand metric tons (kt).

Chapter	Stock	Tier	Status (a,b,c)	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	Years[1] (biomass or catch)	2016/17[2] MMB	2016 MMB / MMB_{MSY}	γ	Mortality (M)
1	EBS snow crab	3	b	1.14	151.6	1979-current [recruitment]	96.1	0.63		0.23(females) 0.417 (imm) 0.259 (mat males)
2	BB red king crab	3	b	0.27	25.78	1984-current [recruitment]	24.00	0.93		Variable[3]
3	EBS Tanner crab	3	a	0.79	25.65	1982-current [recruitment]	45.34	1.77		Variable[4]
4	Pribilof Islands red king crab	4	a	0.18	5.51	1991-current	6.98	1.25	1.0	0.18
5	Pribilof Islands blue king crab	4	c	0.18	4.12	1980-1984 1990-1997	0.233	0.06	1.0	0.18
6	St. Matthew Island blue king crab	4	b	0.09	3.67	1978-current	2.23	0.61	1.0	0.18
7	Norton Sound red king crab	4	a	0.18	2.06	1980-current [model estimate]	2.66	1.29	1.0	0.18 (≤123 mm) 0.648 (>123 mm)
8	AI golden king crab	5				See intro chapter				
9	Pribilof Island golden king crab	5				See intro chapter				
10	Adak red king crab	5				1995/96–2007/08				

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

[2] MMB as projected on 02/01/2016 for Norton Sound red king crab and 2/15/2017 for remaining stocks.

[3] Mortality is 0.18 except where noted: Male M = 0.64 (1980-1984); Female M = 0.99 (1980-1984) and 0.27 (1976-1979 and 1985-1993).

[4] Mortality is estimated: Immature M = 0.24 (all years); Male M = 0.27 (1949-1979 and 1985-2015) and 0.76 (1980-1984); Female M = 0.33 (1949-1979 and 1985-2013) and 0.44 (1980-1984).

Table 3. Maximum permissible ABCs for 2016/17 and SSC recommended ABCs for those stocks where the SSC recommendation is below the maximum permissible ABC, as defined by Amendment 38 to the Crab FMP. Values are in thousand metric tons (kt).

Stock	Tier	2016/17 *Max*ABC	2016/17 ABC
EBS Snow Crab	3	23.69	21.34
Bristol Bay RKC	3	*	5.97
EBS Tanner Crab	3	25.57	20.49
Pribilof Island RKC	4	1.44	1.10
Pribilof Island BKC	4	*	0.00087
Saint Matthew BKC	4	*	0.11
Norton Sound RKC	4	*	0.26
Aleutian Islands GKC	5	5.12	4.27
Pribilof Island GKC[1]	5	0.08	0.07
WAI RKC	5	0.05	0.03

[1] For Pribilof Islands golden king crab, this is for the 2017 calendar year instead of the 2016-2017 crab fishing year.

* Not available in stock assessment document.

General Crab Assessment Comments

The SSC noted that there are methodological differences among crab assessments in the selection of years for calculation of reference points. It would be helpful to standardize the approach to the degree possible among assessments (as is done for groundfish), and provide a rationale when the assessment differs from the standard. **The SSC requests that the CPT evaluate this issue in the near future.**

The SSC suggests that the CPT consider developing a prior probability distribution, or distributions, that might be applicable across crab stocks to aid in stabilizing the estimation of natural mortality while still propagating a reasonable amount of uncertainty in this key population parameter.

Snow Crab

Six models were considered in this year's assessment. Model 0 was last year's model, but with down-weighting of size compositions. Model 1 included a set of changes in how F and fishing effort were treated. Model 2 included all changes in Model 1 and also removed priors on the sex/size-specific probabilities of molting-to-maturity. Model 3 included all changes in Model 2, but also increased the weight on the smoothness penalty for the probabilities of molt-to-maturity and estimated the 50%-selected parameter for female discards. Model 3a was otherwise similar to Model 3 but decreased effective sample sizes for survey composition data by applying the Francis weighting methodology. Model 3b included all changes in Model 3, but also increased the weighting in the female growth likelihood component and decreased the variance for the prior on natural mortality.

Model 1 led to contradictory fit to size compositions. Models 2 and 3 were fairly sensitive to the weightings used. Model 3a was unsuccessful owing to lack of convergence, and manual down-weighting led to large changes in survey catchability and maturity. Model 3b was the author's preferred model as it fit the female growth data best and did not hit the bound for natural mortality. The CPT agreed with the assessment authors' preferred model and recommended adoption of Model 3b for status determination and catch specification.

The SSC notes that the snow crab stock assessment has continued to evolve nicely and commends the authors on this year's assessment. **The SSC supports the authors' and CPT's recommendations to use Model 3b for this year's assessment, including use of a Bayesian method to estimate OFL under Tier 3. The SSC also supports the recommended reduction in the buffer between ABC and OFL from 25% last year to 10% this year** owing to reductions in model uncertainty and resolution of convergence issues with last year's assessment.

The SSC offers the following additional comments:

1. The SSC endorses CPT's recommendations for further work on this assessment model are endorsed.
2. The authors are reminded that Model 0 should represent the accepted model from the previous assessment. This year's Model 0 represents the 2015 model with down-weighting of size compositions. It is not possible to determine how these down-weightings affected results

from last year's model version and, consequently, how much of the change from last year to this year are due to the addition of new data and how much is due to changes in the model.

3. The authors are requested to further evaluate the utility of MCMC as an alternative to jittering. While this issue is given much attention in the CPT minutes, a full elaboration of the advantages and disadvantages is desirable. Also, should the stock assessment template be revised to allow or substitute MCMC for jittering?

4. Finally, the northerly distribution of the stock in 2016 elevates the desire for a spatially explicit model. The proportion of the stock available to trawl survey may be greater than the proportion of the stock available to the fishery, given the effects of sea ice on the geographic distribution of the winter fishery. The SSC continues to express concerns that disproportionately higher exploitation rates in the south could exacerbate the northward shift of the stock under warm conditions. The SSC noted that the AFSC is seeking two post-doctoral researcher to study the effects of climate change and ocean acidification on snow crab in the eastern Bering Sea and Arctic. There could be synergy between this position and the SSC's desire for the development of a spatially explicit stock assessment model for fishery management.

Bristol Bay Red King Crab

In 2016, the assessment authors explored alternative ways to incorporate Bering Sea Fisheries Research Foundation (BSFRF) survey data into the Bristol Bay red king crab (BBRKC) assessment. Preliminary results of this approach were reviewed by the CPT and SSC in May and June, 2016, respectively. As recommended by the SSC, the authors considered three models for the final stock assessment:

Model 1: the same as Model 1 in the SAFE report in September 2015 using BSFRF survey data in 2007 and 2008. The BSFRF survey is treated as an independent survey, and no assumption is made about the capture probabilities of the BSFRF survey. In effect, survey selectivity for both surveys was estimated separately in the model.

Model 1n: the same as Model 1 plus additional BSFRF survey data in 2013-2016.

Model 2: the same as Model 1n except for the assumption that BSFRF survey capture probabilities are 1.0 for all length groups. Under this assumption, NMFS survey selectivity was the product of crab availability and NMFS survey capture probabilities.

All three of these models produced very similar results. The author recommended Model 1n for overfishing determination this year. **The CPT recommended using Model 2 and the SSC concurred that this model should be used for estimation of the 2016 OFL and ABC.** The CPT noted the following reasons for selecting Model 2:

- The overall fit to the data (particularly the NMFS survey length compositions) was improved with Model 2;

- The approach was consistent with how the BSFRF survey data have been used in the snow crab model;
- The estimated selectivity/availability curves for the BSFRF survey were considered more plausible.

Recruitment has been low for several years and the stock status is currently in Tier 3b. **The SSC concurs with the CPT-recommended OFL and ABC for 2016/17.** Consistent with previous years, the ABC was estimated using a 10% buffer to account for uncertainty.

The SSC recommends that the authors examine whether the current time period for estimation of biological reference points is indicative of the expected range of recruitment given current environmental conditions. The SSC also notes that although no barren females were observed, a large number of females had ¾ full clutches. This observation may suggest that the population may be undergoing environmental stress. Above average recruitment has not been observed in the last 12 years and the apparent spike in recruitment observed in the 2012 survey did not materialize to the adult population. These observations raise concerns about the future status of the stock. The SSC recommends an examination of mechanisms underlying lack of recruitment to this stock. Specifically, the SSC requests that the author uses the breakpoint analysis applied for Tanner crab to BBRKC to evaluate whether there was a detectable break in production in 2006. This analysis should be conducted as a diagnostic tool to identify possible changes in production of this stock but should not be used to change the time frame used to estimate biological reference points.

The SSC is supportive of continued research on trawl performance. It would be useful to examine temperature and size effects on spatial aggregation of BBRKC and the relationship between these factors and trawl performance. Given the importance of the BSFRF survey in this assessment, the SSC concurs with the CPT that further research should be conducted to assess the potential for herding with the BSFRF net. The SSC supports the CPT request for an exploration of the impact of including or excluding the prior on catchability based on the under-bag experiment.

The SSC received a short report on the progress to date on implementing the BBRKC assessment in GMACS. The process used for SMBKC of first configuring GMACS to match the current model then stepping forward with incremental changes was very helpful and would be appropriate for the BBRKC assessment. The SSC welcomes this development and anticipates reviewing progress in June 2017.

Tanner Crab

Buck Stockhausen (NMFS-AFSC) presented the Tanner crab assessment. This year's assessment was responsive to past CPT and SSC comments and contained several structural improvements to last year's model. Eleven model scenarios were considered; the first five made incremental changes to arrive at the model selected by the CPT in May and the remaining six dealt with various aspects related to fishing mortality and fishery catch. The CPT noted that Models D and higher needed an additional likelihood component, the lack of which resulted in poorly estimated parameters, and did not consider those models further. The author and CPT recommended Model C with no minimum fishing mortality constraints

because it fitted the female fishery data better. **The SSC concurs with the recommended model selection (Model C) and Tier 3 harvest control rules with a standard 20% buffer.** In the future, new growth data will be used and alternative data weightings will be explored. The SSC supports recommendations made by the CPT, including disaggregating bycatch mortality for groundfish fisheries into trawl and pot components. The SSC requested that the author look further into apparent cycles in the coefficients of variation for an explanation of why they occur. The SSC would also like to see Models D and higher brought forward in next year's assessment with the additional likelihood component. Finally, the SSC looks forward to the GMACS version of the stock assessment model, with work scheduled to start next year.

Pribilof Islands Red King Crab

The fishery for Pribilof Islands red king crab (PIRKC) has been closed since 1999, due to uncertainty in estimated PIRKC abundance and concerns about bycatch mortality of PIBKC. Fishing mortality is limited to incidental catches in the directed crab fisheries and prohibited species catch (PSC) in groundfish fisheries. Recent catches have been well below the OFL. Male and female abundance varies widely over the history of the survey time series and uncertainty in area-swept estimates of abundance is large due to relatively low sample sizes. Recruitment for this stock is episodic and has been low in recent years.

Bering Sea trawl survey data indicates large apparent decreases in both male (73%) and female (51%) abundances between 2015 and 2016. However, the CPT noted that this was caused by the decrease of larger older crab at one or two stations. Data from the survey also suggested that the center of the male crab distribution had shifted north, perhaps due to warmer temperatures.

The 2016 assessment is based on trends in mature male biomass (MMB) at the time of mating inferred from 1975-2016 NMFS bottom trawl surveys and commercial catch and observer data from 1973/74 to 2015/16. Four assessment methods were evaluated: (1) an annual index of MMB derived as the 3-yr running average using inverse variance weighting; (2) a random effects model; (3) an integrated length-based assessment model using Tier 3 harvest control rules; and (4) an integrated length-based assessment model using Tier 4 harvest control rules.

The running average method weighted by the inverse of the variance of the area-swept estimate with a Tier 4 harvest control rule was preferred by the CPT, given concerns over the other methods. Specifically, the CPT had concerns about lack of convergence of the random effects model using Francis weighting at low values, the difference in trends over the last decade between the integrated model and the running average method, and the lack of fit of the integrated model to survey abundance data.

The CPT noted that the highly variable survey estimates could be caused by a low density population combined with aggregation behavior of red king crab and/or that a variable portion of the stock is unavailable to the survey each year. The CPT recommended further development of the random effects model using uniform weighting across all survey years (i.e., a process error, a constant CV, or a constant standard error) and the SSC concurs.

The SSC supports the CPT recommendation to use the status quo 3-year running average method with inverse variance weighting the stock status Tier 4a. The SSC supports the CPT recommended OFL and a 25% buffer for the ABC.

Pribilof Islands Blue King Crab

The Pribilof Island blue king crab (PIBKC) fishery began in 1973; landings peaked during the 1980/81 season and were followed by a steep decline leading to fishery closures from the 1988/89 through 1994/95 fishing seasons. The fishery reopened from the 1995/96 to 1998/99 seasons, but was closed again for the 1999/00 season due to declining stock abundance and has remained closed. The stock was declared overfished in 2002 and a rebuilding plan which closed directed fishing was implemented in 2004. In 2009, NMFS determined the stock would not meet its 10-year rebuilding horizon. Subsequently, Amendment 43 to the King and Tanner Crab FMP and Amendment 103 to the BSAI Groundfish FMP were implemented resulting in a revised rebuilding plan. The revised rebuilding plan closed the Pribilof Island Habitat Conservation Zone to Pacific cod pot fishing, which accounted for the highest recent rates of bycatch of this stock. This measure was designed to protect the main concentration of the stock from the fishery with the highest observed rates of bycatch. The area has been closed to trawling since 1995.

The calculation of the 2016/17 survey biomass uses the stock area definition established in 2012/13 that includes an additional 20 nm strip east and 10 nm north of the Pribilof District. Prior to last year's assessment, MMB was estimated from the NMFS EBS bottom trawl survey using a three-year running average weighted by the inverse of the variance of the area-swept estimate. As recommended by the CPT and the SSC for last year's assessment, the author calculates MMB and B_{MSY} using a random effects model to smooth the survey time series for this year's assessment. The presenter cautioned that the survey data were sparse (three tows with a total of three crab) and the assessment was highly uncertain.

The PIBKC directed fishery is closed, so the OFL and ABC apply to PIBKC bycatch in the Bering Sea groundfish and other crab fisheries. Recent bycatch had been well below the OFL, however **catch in 2015/16 was 1.18 t, exceeding the OFL of 1.16 t.** Most catch of PIBKC occurs as PSC in the Bering Sea groundfish fisheries. PSC of PIBKC increased during the 2015/2016 crab fishing year in the hook-and-line Pacific cod fishery inside the Pribilof Islands Habitat Conservation Zone (PIHCZ) and in the non-pelagic trawl fishery outside the PIHCZ. These increases, along with a small amount of bycatch in the Tanner crab fishery, caused overfishing to occur during the 2015/2016 crab fishing year by 0.02 tons. The presenter noted that the center of the survey distribution was farther north than normal,similar to distributional shifts observed in previous warm years. The SSC noted that the increased bycatch this year may be related to this shift.

The SSC supports the CPT recommendation to examine the PIBKC stock boundaries using recent data to see if it is more appropriate to align stock boundaries with Alaska Department of Fish & Game (ADF&G) statistical areas.

The SSC notes that to prevent overfishing in the future, ADF&G will implement closure areas for the western Tanner crab fishery to reduce the PIBKC bycatch. In addition, NMFS recently implemented a

procedure to account for PIBKC PSC in the groundfish fisheries in-season and will take in-season action to prevent overfishing.

Finally, the CPT noted that other king crab assessments use a handling mortality rate of 20% for bycatch in crab fisheries while the PIBKC assessment currently uses 50%. The SSC notes that the bycatch mortality estimate and, therefore, the overfishing status for this species is sensitive to the handling mortality rate assumption. The SSC supports the CPT recommendation to assess and standardize handling mortality across crab stocks including PIBKC for the 2017 assessment cycle.

Given the large uncertainties associated with the survey abundance and biomass estimates for PIBKC, and given the current overfishing status and concerns about future discard levels that potentially invoke restrictions on other fisheries, the SSC highlights the author's research recommendation that the assessment of this species might benefit from additional surveys using alternative gear at finer spatial resolution.

The SSC supports the CPT and author's recommendations to calculate OFL using the random effects model and employing a 25% buffer on OFL to estimate the ABC. The PIBKC blue king crab stock is overfished and overfishing occurred in the 2015/16 fishing year.

Saint Matthew Island Blue King Crab

The SSC received a presentation on the status of the SMBKC assessment and the results of the 2016 trawl survey. Notably, trawl survey results show that mature male biomass is down considerably from 2015, and low relative to the average of recent years.

The SSC recognizes that this stock assessment represents the first application of the GMACS model, an important step forward for crab analyses. The authors provided a very helpful link to previous models by first matching the results of the 2015 model, then re-estimating selectivity in the new model, then incrementally making additional improvements. This 'match-and-go' approach provides a template for future transitions of other stock models to GMACS. The GMACs platform has the ability to explore many alternative factors and assumptions with a more general framework than most models developed for single species. The suite of diagnostics and output, which can be easily reproduced across other applications, should facilitate efficient review by the CPT and SSC.

Although results of alternative models were generally similar, none of the alternatives were able to fit the recent trend in the trawl survey very well: 10 of 11 residuals at the end of the time series were positive. This is not new with the transition to GMACS, but continued exploration is warranted.

The authors and CPT noted that there is an interaction between data weighting and additional mortality in 1998 that affects model results. The CPT recommended continued exploration of models that do not require the large spike in mortality in 1998. Just as the CPT recommended for the AIGKC assessment, the SSC notes that the number of days on which sampling took place would be a suitable starting point for input sample sizes. In general, the CPT should encourage consistency among assessments in the

treatment of input sample sizes prior to tuning or data weighting – all methods need to adequately capture the heterogeneity among years and sources.

The SSC concurs with the CPT recommendation of the base model for use in management and setting ABC and OFL.

Norton Sound Red King Crab

Four model scenarios were brought forward. Model 0 is the default base model. Model 1 includes non-linear growth to address the aspect of crab not recruiting to larger length classes but applies equal M for all lengths. Model 2 includes a random walk on molt probability. Model 3 estimates a high M for the largest (134+ mm CL) group (i.e., kill 'em off approach). Model 4 estimates separate summer commercial fishery selectivities for 1976-2004 and 2008-2015 to determine whether selectivity has changed based on factors such as market preferences. Preliminary results indicate limited improvement of the alternative models over the base Model 0.

The SSC offers the following comments:

1. The assessment authors' responses to previous CPT and SSC comments are appreciated.
2. The SSC supports the CPT's recommendation to bring forward Model 0 and Model 2 and five related recommendations.
3. Lack of fit to Model 3was surprising, given the disappearance of the largest size class from the survey. The SSC expected that the model with the additional parameter could only fit better than the base model. **The SSC recommends that the authors confirm this result.** If an error is discovered associated with the lack of fit, then the SSC encourages the authors to bring forward a corrected version of this model for further evaluation, as well.
4. Finally, the SSC looks forward to full pop-up satellite tag results, which could provide insight on the largest size class which "goes missing" in the assessment.

Aleutian Island Golden King Crab

The SSC received a detailed presentation from Dr. Andre Punt (UW, CPT) on the stock assessment modelling and progress made since June. This assessment will be reviewed again by the CPT in January, and brought forward for potential use in management in June of 2017. The SSC recognizes that the authors have completed a considerable amount of work and addressed many of the previous requests from both the CPT and SSC. This assessment appears to be of similar quality and stage of development as others used for managing crab stocks in Alaska. Moving from a Tier 5 to a model-based approach under Tier 3 or Tier 4 represents an important development for this stock; making use of the data available is a substantial improvement over a constant catch approach. **The SSC recommends that this assessment continue to be developed for use in determining OFLs and ABCs in June 2017.**

Most of the alternative model configurations reported produced a similar time-series of biomass and relative stock size. The SSC appreciated the addition of historical portions of this series to facilitate evaluation of the relative role of catch vs. estimated stock dynamics.

The SSC received public comment (Linda Kozac, Golden King Crab Research Foundation) regarding the developing survey for AIGKC. Concerns raised regarding the potential effects of trawling on the survey, as well as potential confounding of vessel/captain and year effects in the survey design. **The SSC supports the CPT recommendation for additional analyses regarding the spatial and depth distribution of trawl fishing and overlap with the AIGKC survey and fishery.** Recognizing that the survey is only in its second year of sampling, the SSC also recommends that survey planning include consideration of restructuring/randomizing the spatial allocation of vessel sampling such that future changes in vessel participation will not cause a loss of trend information. The survey may be an important source of future information and the SSC is looking forward to seeing the results in the next few years as it begins to become informative for trends in the AIGKC stock.

The SSC generally supports the CPTs recommendations for improvement of the model for the January meeting. Specifically,

- For analyses removing the groundfish length-frequencies, the groundfish catches should not be removed.
- Differences in catch amounts between tables and graph by reconciled.
- The presentation noted the discrepancy in treatment of input samples sizes between the two areas (number of trips vs. number of individual lengths), and that the CPT had recommended using the number of days on which sampling was conducted as a more consistent starting point for both models.

The authors completed an extensive amount of work to reprogram the model such that natural mortality could be estimated for both the EAG and WAG areas simultaneously. As noted by the CPT, likelihood profiles reflected some information on natural mortality and reasonable consistency between the estimates for the two areas. However, the credible intervals remained very broad (<0.2 to >0.3). **The SSC suggests that the CPT consider developing a prior probability distribution for this stock to aid in stabilizing the estimation of natural mortality while still propagating a reasonable amount of uncertainty in this key population parameter (see general request to CPT above).** It is interesting that the point estimates of M for the two areas are so similar (0.23[39] without fish tickets, 0.24[26] with fish tickets; unnecessary decimals reported by the authors are in brackets). Given the small difference, one of the first steps for the authors in the next assessment should be to provide a rationale for whether to use fish ticket data in the likelihood, so that the value of M can be resolved. Further, the authors should provide the rationale for which Tier level should be used (Tier 3 when reliable reproductive information available, Tier 4 based on M if not available).

In order to better understand the outcome of any data-weighting method, the scale of the standardized residual plots must be reported. **The SSC requests again adding this is to the next assessment.**

The SSC noted that this is the only crab assessment that relies solely on fishery CPUE as an index of abundance. The standardization of these data has been well explored, the series is truncated to eliminate

early years (pre 1995/1996) where the fishery was likely changing without respect to population trend, and broken in 2005 due to the changes associated with rationalization. Nevertheless, other factors (such as trawl activity mentioned above) could result in CPUE that is not proportional to abundance. **The SSC recommends the CPT consider use of a larger buffer (greater than the current 20%) from the OFL, given the lack of a standardized survey for this stock.**

C-2 Groundfish Plan Team Report and Harvest Specifications

The SSC received a series of presentations from Grant Thompson (NMFS-AFSC), Diana Stram (NPFMC), Jim Armstrong (NPFMC), and Jim Ianelli (NMFS-AFSC) that included items from the September 2016 Joint, BSAI, and GOA GPT meetings. Public testimony was received from Chad See and Gerry Merrigan (Freezer Longline Coalition); and Jon Warrenchuk (Oceana). **The SSC recommends approval of the BSAI and GOA specifications provided by the Plan Teams.**

The presentation from the Joint GPT included recommendations regarding the Research Priorities, Stock assessment Prioritization Plan, stock-specific ecosystem considerations, halibut fishery incidental catch estimation (HFICE), sablefish CIE review and assessment, squid estimation and potential move to an ecosystem component, Economic SAFE, octopus assessment and discard mortality rates, and the Stock Structure and Spatial Management workshop. The BSAI Team presentation included information on the EBS acoustic-trawl pollock survey results and recommendations on northern rock sole recruitment and stock structure, Pacific cod CIE review, EBS Pacific cod assessment, Aleutian Islands Pacific cod assessment, mid-year review of Pacific cod assessment models, arrowtooth flounder assessment, Alaska skate assessment, EBS pollock assessment, multi-species stock assessment model (CEATTLE), black-spotted/rougheye assessment, Pacific Ocean perch assessment, northern rockfish assessment, Tier-3 rockfish assessments, stock structure template, and 2017-18 harvest specifications. The GOA Team presentation contained information and recommendations on the stock structure template, sharks assessment and research, age-structured assessment for yelloweye rockfish, winter pollock acoustics-trawl survey, pollock assessment, Pacific cod assessment, and 2017-18 harvest specifications.

General Groundfish Assessment Comments

Some assessment authors have started to explore geostatistical approaches to estimating survey abundance or biomass and the SSC is encouraged by this development. The SSC re-iterates its support of the GOA GPT recommendation to form a study group to explore criteria necessary for adopting a geostatistical generalized linear mixed model approach (see December 2015 minutes).

Pacific Cod

The SSC commends the authors for their thorough exploration of modeling options for these challenging assessments.

<u>Eastern Bering Sea Pacific cod</u>

The preliminary suite of models examined for the EBS included all of the models endorsed by the SSC in June, which focused on simplifying the old base model (base: 11.5; new: 16.1) and then evaluating the

impact of including IPHC and NMFS longline survey data individually or in combination. Model 11.5, the status quo model, showed poor retrospective behavior relative to several of the simpler alternatives. The new model 16.1, which does not include longline survey data, resulted in a reasonable fit, was most consistent with the trawl survey estimates, and had a good retrospective pattern with no evidence of bias. The SSC looks forward to the full model results in December for potential adoption of a new base model for this stock. The inclusion of longline survey data revealed inconsistencies between the abundance trends from the longline surveys, in particular the NMFS longline survey, and the bottom trawl survey. While that alone should not be a reason to discontinue the use of these surveys in the assessment, models including these surveys resulted in poor fits and very poor retrospective patterns (large Mohn's rho). Therefore, the SSC agree with the Plan Team recommendation to focus on model 16.1 for this assessment cycle and explore additional modifications as time allows. If time is available, we agree with the Plan Team that examining the incremental effects of empirical weight-at-age data and NMFS longline survey data in the model are reasonable next steps.

Aleutian Islands Pacific cod

The base model for this assessment is the random-effects model that smooths the survey data and the preliminary suite of age-structured models examined is very similar to the models explored for the EBS. We agree with the Plan Team that none of the models produce a satisfactory fit at this point. While the SSC strongly encourages further development of the model, we endorse the Plan Team recommendation to focus on the EBS models for this assessment cycle and not bring forward an age-structured model for AI Pacific Cod stock at this time.

Gulf of Alaska Pacific cod

The SSC commends the new assessment author for re-assembling the model from the ground up to gain a full understanding of the data and model structure. We did not receive a presentation on the preliminary model results and look forward to the final assessment. We re-iterate the request for a model that is close in model structure to the previously approved model for use in comparing the alternative models.

The SSC has a number of other recommendations for the authors, Plan Teams and the Council to consider regarding Pacific cod assessments:

- The observed discrepancies among different models in these assessments are a good - if perhaps extreme – example of the model uncertainty that pervades most assessments. This uncertainty is largely ignored once a model is approved for specifications. We encourage the authors and Plan Teams to consider approaches such as multi-model inference to account for at least some of the structural uncertainty. We recommend that a working group be formed to address such approaches.
- Regarding the mid-year model vetting process, the SSC re-iterates its recommendation from June to continue for now. The process has proven useful for the industry as an avenue to provide formal input and for the author to prioritize the range of model options to consider.
- With regard to data weighting, the SSC recommends that the authors consider computing effective sample sizes based on the number of hauls that were sampled for leng ths and weights, rather than the number of individual fish.

- The SSC notes that, in spite of the concerns over dome-shaped survey selectivity in the survey, there are many potential mechanisms relating to the availability of larger fish to the survey gear that could result in these patterns, regardless of the efficiency of the trawl gear to capture large fish in its path. For example, in the Bering Sea the patterns could be due to larger Pacific cod being distributed in deeper waters or in the northern Bering Sea at the time of the survey. The northern Bering Sea survey planned for 2017 should provide additional information on the latter possibility.
- There were questions whether the treatment of the plus group in the population dynamics (not the plus group for the data), might have a potential interaction with growth estimation in the GOA models. This should be investigated as time permits.
- Although there is genetic evidence for stock structuring within the Pacific cod population among regions, the uncertainty in model scale for all three regions seems to suggest that some sharing of information among the three assessments might be helpful. Over the long term, authors could consider whether a joint assessment recognizing the population structuring, but simultaneously estimating key population parameters (e.g., natural mortality, catchability or others) might lend more stability and consistency of assumptions for this species.

Sablefish

The SSC received a presentation on the recent CIE review of the sablefish stock assessment and the preliminary modelling updates. The SSC notes that the CIE review was very successful and generated some remarkably positive comments from the reviewers along with several important recommendations for model development and apportionment. As the author noted, these recommendations represent a relatively large amount of change for an assessment approach that has been quite stable in recent years. The document and presentation provided the results from a series of developments and proposed an order for these changes to be developed for the November GPT and December SSC meetings.

The SSC recommends a slightly different order of model development than the GPT. Specifically, first addressing the data related issues in an incremental manner (adding each to the previous):

1) Update spatial areas for the longline survey.
2) Add the analytic CVs for the longline survey (instead of the average value obtained from the historical bootstrap analysis).
3) Add both the survey corrected for whale depredation, as well as the additional whale depredation estimated to be associated with the fishery. This change will require adjustment of subsequently calculated ABCs (by area) to account for predicted future whale depredation. Predictability of whale depredation may be problematic, as it may depend on apportionment, total magnitude of effort/catch, whale abundance, and other factors. The SSC noted that although the corrections for whale interactions with both the survey and fishery are reasonable, they represent an approximation for a process that cannot be unambiguously measured – inferring what was not caught in a particular place and time. For this reason, it will be important to note there will be additional unquantified uncertainty in the results, even after these corrections have been applied.

Subsequent to these changes, the SSC recommends evaluating the approaches for incorporating additional uncertainty into the assessment. These alternatives could include tuning the standard deviations of the normalized residuals (SDNRs) for the longline survey, estimating natural mortality, estimating the maturity schedule in the assessment model, and the treatment of dome-shaped or time-varying selectivity for the fishery.

The CIE review concluded that among reasonably distributed catch apportionment approaches, there was unlikely to be a biological concern given the high rates of movement among areas estimated for sablefish. This finding reinforces the strong need to elicit specific fishery objectives for apportionment and examine the performance of alternative approaches, preferably via MSE. Such work is underway by a UAF student working on a collaborative project between UAF and TSMRI/AFSC. Such an analysis may also need to consider the differential effects of whale depredation among regions. In the meantime, the SSC agrees with the proposal to use the recent constant apportionment percentages again for 2017.

BSAI Black-spotted/ Rougheye rockfish

The SSC received the Plan Team report on BSAI blackspotted/rougheye (BS/RE) rockfish stock structure and spatial harvest, including a status update on maximum subarea species catch (MSSC) management that started in 2014. Under MSSC management, NMFS informs industry about what the ABC would be for the western Aleutian Islands subarea, and industry members attempt to keep BS/RE catch below the MSSC target amount. The fishery exceeded the MSSC in each of its first two years of implementation (2014-2015); however, increased outreach from NMFS improved MSSC management in 2016, and the fleet improved coordination, which likely helped the fleet maintain catch below the MSSC. **The SSC recommends continued use of the MSSC for 2017 given its apparent success in 2016. However, the SSC remains concerned about the implications of MSSC management as it is outside of the regular harvest specification process (TAC/ABC), noting that the specification process has regulatory framework in place, whereas the MSSC is based on voluntary compliance and requires additional outreach by the NMFS Alaska Region.**

Related to the concerns about the MSSC being outside of the ABC/TAC setting process, the SSC received a report from the Plan Teams concerning the use of MSSC in other spatial management situations. **The SSC supports the Plan Team recommendation for the NMFS Alaska Region to provide a discussion to the Plan Team on the details of the management and regulatory implications of subarea ABCs/TACs using BS/RE and other relevant case examples.** It may take a few years to gauge the performance of MSSC management.

GOA Demersal shelf rockfish

The SSC was briefed on model development, which the SSC finds encouraging. The SSC noted that the determination of effective sample size using DIC resulted in unrealistic negative values. The authors should investigate this result and provide additional explanation or correction.

Other rockfish assessments The SSC was briefed on developments concerning BSAI Northern, POP, and BS/RE rockfish assessments. The SSC looks forward to seeing the results of these efforts in December.

BSAI Arrowtooth Flounder

Last year, the BSAI assessment model was modified slightly to accommodate a flexible number of surveys so that it can be applied to both the GOA and BSAI assessments. This year, the assessment author examined two potential further improvements to the model: (1) alternative data weighting, and (2) an improved length-age conversion matrix.

Alternative ways were explored to weight data associated with the three survey indices and size composition data from the surveys and fishery. Models A-E represented five different data weighting approaches. Each involved a two-step process described by Francis (2011), whereby step 1 uses information about the data and step 2 tunes the weights based on model fits. The author's preferred model was Model A, which involved an ad hoc approach to step 2.

Previously, the age-length conversion matrix was based on three years of age data from the Bering Sea shelf survey. Now, there is an additional year of age data from the shelf, one year of data from the Aleutian Islands, and additional data from other surveys in the BSAI region. Additions of these new data onto the model led to modest changes to the male and female size-at-age relationships. Models that incorporated these updated relationships provided reasonable fits to the surveys.

The SSC appreciates the addition of new length-at-age data and supports the Plan Team's request that the author verify sampling protocols (e.g. random or length-stratified) associated with the new data to validate their representativeness before finalizing their inclusion in the updated assessment. The SSC also appreciates the data weighting analysis and supports the Team's recommendation to bring forward the status quo 2014 model, as well as Model A with the new weightings, for this year's stock assessment.

BSAI Northern Rock Sole

Reliable information on year-class strength of BSAI northern rock sole is not available until age 5 or older. An analysis was undertaken to examine the utility of environmental correlates to predict year-class strength at younger ages based on relationships uncovered by previous research. Regression models with both onshore winds in spring and a cold pool index performed better than models including wind or cold pool alone. It was also found that auto-regressive models based on previous year's recruitment worked well for out-of-sample prediction. Interestingly, models that included a Ricker stock-recruit relationship performed poorly.

The SSC appreciates the author's' exploration of environmental correlates of rock sole recruitment and looks forward to seeing full results in an appendix of the upcoming stock assessment. In the future, it may be beneficial to pursue similar predictive recruitment models for other flatfish stocks. For instance, lagged recruitment of yellowfin sole and walleye pollock were found to be significantly correlated (See: Mueter, F.J., Boldt, J., Megrey, B.A., Peterman, R.M., 2007. Recruitment and survival of northeast Pacific Ocean fish stocks: temporal trends, covariation, and regime shifts. Can. J. Fish. Aquat. Sci. 64, 911-927). As it

happens, the yellowfin sole correlation declined after updating with more recent data (F. Mueter, pers. comm.). However, stronger statistical relationships may exist for models that incorporate multiple environmental correlates as in the case of northern rock sole.

Squid

The Joint GPT was provided with an update of the draft analysis to move squid to an Ecosystem Component. In the June 2016 review of this action item, the SSC had recommended that the analyst develop biomass-based estimates for squid, for which no such estimates currently exist. The SSC also suggested, as an alternate approach, that consumption-based estimates might be used. Both the author and the Plan Team deemed a consumption-based estimate to be too unreliable given the many species of squid, the great variety of squid sizes, and the many predators involved and their often poorly delineated diets. The author is exploring the development of an estimate of squid biomass, but the success of this effort is uncertain given unsuccessful attempts during past specification cycles and that other squid fisheries elsewhere in the world have had a difficult time assessing squid. The SSC is supportive of both dropping any consumption-based approach, and the proposed attempts at developing a biomass estimate.

BSAI Octopus

The Joint GPT were provided with an update to the estimated consumption of octopus in the BSAI by Pacific cod using updated stomach data collected through 2015. The new estimate shows an increase in the long-term average consumption rate from 3,452 tons to 4,770 tons per year. It was not clear whether the average was a geometric mean (according to the Joint GPT documents), or a harmonic mean, as was suggested during the Plan Team presentation. The SSC supports the Plan Team recommendations to bring the new consumption rates forward in December, but requests clarification on how the long-term average consumption rate was calculated.

Additionally, the Joint GPT was also provided with a summary of recent octopus research, including results from a discard mortality rate (DMR) study. The Plan Team recommended maintaining the discard mortality at 100% instead of pursuing implementation of these updated DMRs. The SSC accepts the Plan Team's recommendation, but feels that the Team's rationale for not employing an updated discard mortality rate estimate is not appropriate. While octopus isn't currently a concern in terms of catch mortality, the default should be to employ the best available science for estimating total catch mortality including DMRs for octopus.

BSAI Alaska Skates

A follow-up analysis of the Alaska skate age-structure model as last presented in 2014 resulted in an increased estimate of ABC/OFL, while both estimated spawning biomass and F35% decreased. The Plan Team and the SSC asked that this result be investigated and two changes in the assessment (SS) and the projection model were explored: 1) Adjusting the dome-shaped selectivity, and 2) correcting the age-length parameters reduced it even further. Correcting the age-length parameters reduced biomass estimates in the SS model, and with the projection model. The weight misspecification skewed the proportion of older skates, which aren't available to the fishery. Substituting the alternative selectivity resulted in a higher OFL, but did not dramatically affect biomass estimates. The mismatch between spawning biomass and ABC/OFL was resolved when the old model was run with the corrected age-length

parameters. It was also apparent that the higher OFL was due to higher productivity, and the SSB was skewed by older skates unavailable to the fishery. The PT recommended that model 14.2 be brought forward in November with the analysis included as an appendix. The SSC supports these recommendations and also recommends revisiting recommendations from the PT and SSC in past years to see if anything was missed.

GOA Shark

The SSC greatly appreciates the research on sharks in the GOA, and sees that these research efforts will directly contribute to assessment improvements in the future. Spiny dogfish catchability in the survey was evaluated using data from satellite tags. Two methods were used to determine availability: 1) light levels at noon were used to infer a geolocation, which could be matched with bathymetry to determine bottom depth, 2) the maximum depth of a tag over 24 hour period was used as the bottom (as per Nichol et al.) The two methods had poor agreement but essentially provide bookend estimates. Both methods contained uncertainty (0.04 to 0.55), though the Nichol et al. method produced the largest q. Encouragingly, values from both methods, pooled across years, had good agreement with the NWFSC catchability values on the west coast. The SSC agrees with PT recommended binning tag data by depth into the bins used for the survey, possibly homogenizing the results from the two methods. The SSC recommends that the precision of satellite derived locations and it's implications on inferred depth should be further considered in future analyses.

The PT also received a presentation on a spiny dogfish demographic model (Tribuzio and Kruse 2011; *Marine and Freshwater Research* 62(12): 1395-1406) that could potentially be used to assess GOA spiny dogfish. The model is a female-only Leslie matrix with two versions based on age class and life stage. A sustainable F was estimated at 0.02 and 0.04 for the age- and stage-based models, respectively, which are lower than the status quo F of 0.097. The assessment author suggested that the maximum F from the demographic model could be used as an alternative to the status quo (F=M) in the 2017 cycle. The PT recommended continued work on this alternative approach for estimating F for the next cycle and noted that improvements to the biomass estimate are also needed, as the survey likely underestimates dogfish biomass The SSC concurs with these recommendations.

C-3 EM Integration

The SSC received a presentation by Diana Evans (NPFMC), Jennifer Mondragon (NMFS AKR), Gretchen Harrington (NMFS AKR), and Sam Cunningham (NPFMC) of the draft EA/RIR/IRFA document for the proposed actions that would allow electronic monitoring (EM) to be used for monitoring partial coverage fixed-gear groundfish and halibut fisheries. Public testimony was provided by John Jaskoski (SOART) and Dan Falvey (ALFA).

The analysis is not a traditional EA and RIR because the proposed action is not a program; rather, it is an adjustment to the process for monitoring at-sea fixed gear groundfish. The scale, scope, and many other design elements of EM are yet to be determined and will likely change and evolve over time according to the Annual Deployment Plan (ADP). Thus, the analysis does not seek to evaluate the net benefit of an EM program of a given size and scope. Instead, it provides the information necessary for establishing a baseline that can be used for ongoing deployment decision-making for the EM at-sea monitoring process.

The SSC appreciates the work of the EM Workgroup and the analysts' very thorough EA and RIR assessment. The analysts have done an excellent job characterizing the potential tradeoffs involved with allocating Observer Program fees between observer and EM at-sea monitoring and the implications for both data collection and monitoring costs. Overall, the information provided in the EA and RIR is sufficient for the Council to make a decision regarding the use of EM in at-sea monitoring. **The SSC recommends that the RIR/EA/IRFA be released for public review.**

Should the Council move forward with Alternatives 2 or 3, there are many decisions yet to be made regarding how EM will be integrated into the at-sea monitoring process. **The SSC requests the opportunity to review such decisions in their annual review of the ADP.** Furthermore, additional analytical and statistical tools need to be developed and refined before including EM into the ADP (e.g., an optimization tool that is able to quantify the cost and informational tradeoffs between human observer and EM coverage). **The SSC requests the opportunity to review these tools during their development and before they are integrated into the ADP.**

The SSC supports the analysis regarding the costs of integrating EM into the at-sea monitoring process. The analysts rightfully acknowledge that the costs of critical program elements are highly dependent on program design choices that are either yet to be made, or are designed to be changed from year to year through the ADP process. Thus, it is not possible for the analysts to forecast what the costs of the alternatives will be until more information regarding the scope and design of the EM program are made. Further, unit costs from EM programs in other regions cannot easily be extrapolated to this particular setting. In particular, unit costs from other EM programs conflate various start-up, fixed, and variable costs that are not expected to be consistent with the alternatives under consideration. Thus, the analysts estimate the costs of EM integration in two different ways. First, they estimate the unit cost of the 2016 pre-implementation EM program under different "information scenarios" to serve as a useful baseline for measuring the cost effectiveness of future EM program implementations. While the unit costs from the 2016 pre-implementation EM program will not likely be the same as the unit costs for a more mature—and potentially different—EM program, the SSC agrees that these unit costs are the best information available for the analysis. Further, the unit costs from the 2016 pre-implementation program will become clearer once the pre-implementation program is complete. Second, the analysts create an EM "expenditure function" by estimating the unit costs of particular program elements, and then construct hypothetical costs under several potential program designs. This is very useful for extrapolating program costs into various potential program designs, and will serve as a useful tool for integrating the costs of EM into the ADP process.

The annual deployment process will need to consider costs associated with program elements and how these expenses impact at-sea coverage, noting that human at-sea coverage will still be required for some data elements within the EM pool and fisheries outside of the EM pool. Along these lines, the analysis indicated vessels in the EM pool would be determined after the release of the draft ADP. This process would require analysts to estimate the size of the EM pool and its interactions with the at-sea deployment strata in the draft ADP. However, costs and vessel involvement in the EM pool will likely fluctuate during the initial years of the program, creating uncertainty in the sampling plan presented in the draft

ADP. To reduce this uncertainty, **the SSC recommends the EM pool be defined prior to public release of the draft ADP.**

Should the Council move forward with Alternatives 2 or 3, **the SSC recommends that the Council develop a plan for monitoring and evaluating the success of incorporating EM into the at-sea monitoring process.** Such evaluations are important for making future adjustments to the program and for learning lessons that can be transferred into the design of other related programs. The Council should develop a set of objectives that are measurable, establish a baseline against which the objectives will be evaluated against, and develop a data collection procedure that is necessary for measuring the program objectives.

Finally, the SSC wishes to highlight the comments provided by the Office of Law Enforcement regarding the need for timely information to support enforcement of EM participation as it is included in the Observer Program.

C-4 Observer Program 2017 Annual Deployment Plan

The SSC heard a presentation by Craig Faunce (NMFS-AFSC) providing an overview of the draft 2017 ADP for observers in the BSAI and the GOA to support the estimation of groundfish catches, discards, and related biological attributes. No public testimony was received. The SSC commends the author of the draft ADP for the thoroughness and clarity of the plan, and note the progress of program development that has nicely balanced the use of statistical theory and pragmatism.

The draft ADP includes a useful evaluation of the performance of alternative partial coverage trips stratification and sampling allocation schemes based on simulated observer deployment. The evaluation considered two performance metrics. The first is the proportion of trips that are observed within each stratum (coverage rate) and the second is a gap analysis that considers the probability that the design will result in either greater than 1 or greater than 3 samples within each NMFS area stratum.

Key NMFS recommended characteristics of the 2017 ADP include:

- The sampling strata are defined to include 3 gear type (hook-and-line, pot, trawl) vessels and 2 delivery methods (tender and no tender), resulting in 6 total strata.
- The strata sampling rates (observer deployment rates) are determined using an optimization procedure bounded by cost and based on minimizing the variance of estimated discarded catch.
- The no-selection pool is composed of fixed-gear vessels less than 40 ft LOA and with vessels fishing with jig gear (handline, jig, troll, and dinglebar troll gear) and the electronic monitoring (EM) selection pool.

The SSC endorses all NMFS recommendations contained in the 2017 ADP.

The SSC offers the following comments and recommendations:

- The draft 2017 ADP is responsive to many of the SSC comments and recommendations on the 2015 Annual Report and the 2016 ADP. The SSC appreciates the authors' attention to past SSC input.
- Following past concerns expressed by the SSC regarding differences in fishing behavior and sampling difficulty associated with tendered trips, **the SSC endorses the recommendation to redefine sampling strata to include both gear type and delivery method.**
- **The SSC endorses trip-based assignment of observers and the allocation of sampling rate based on optimizing to reduce variance in discard estimates.**
- As described in the SSC minutes of the June 2016 meeting, the SSC recommended that the analysts consider survey design performance related to estimation of quantities informing key program goals such as management for PSC. **The SSC continues to recommend developing performance metrics related to PSC management.** In addition to suggestions on how to develop performance metrics provided in past SSC minutes, analysts might consider evaluation of allocation schemes considering variance in the estimation of PSC for high profile species and those that have historically triggered major fishery closures. A summary of the top species contributing to the total discard would be helpful to understand where implicit priority exists in the current ADP.
- **The SSC recommends that ongoing work to improve the estimation of catch/ discard and associated variances be given a high priority.** Further, with Electronic Monitoring (EM) Integration moving forward, the SSC notes that the inclusion of EM-derived data into this work is essential. Of particular interest are how 1) to include sufficient biological information when such information will no longer be available on trips observed with EM methods, and 2) how the low level of participation in the current voluntary ODDs reporting of eLanding report IDs will impact assessment of data from the EM strata.
- **The SSC recommends that EM be integrated into the ADP as soon as possible so that trade-offs associated with EM deployment and observer coverage can be incorporated into the survey design optimization and planning.** The SSC notes that our support for moving the EM Integration EA/RIR/IRFA forward for final review assumed that future observer survey design would be informed by both the human and electronic observing methods.
- The overall observer deployment rate during 2017 is substantially lower in 2016 because there has been a reduction of funds available to support the observer program. The SSC understands that the outlook for future funding for the observer program is to remain at a level below recent years. With this reduced funding, the observer sampling rates will continue to be sustained at reduced levels and **the SSC is very concerned about spatial coverage gaps and the potential for bias in estimated discards, and associated impacts to fishery management. The SSC strongly recommends that the Council and/or NMFS seek additional funding sources for the observer program.**
- The SSC notes that evaluation of observer survey design alternatives would be facilitated by reporting additional details on catch/discard variance and sampling cost by stratum and

overall. Additionally, comparisons of survey designs based on techniques that employ optimization methods for sample allocation should be compared to those designs assuming proportional sample allocation in terms of total variance of the estimated discard. This addition will show the degree of improvement in precision measured by total variance. As such**, the SSC requests that future ADPs include summaries of the cost and catch/discard variances used for optimization for each stratum and allocation design alternative.**

- While NMFS and the SSC continue to strive for best survey designs, the SSC understands that changes in observer survey design impact not only direct costs to the observer program, but also indirect costs associated with modifications to catch accounting and estimation programs. Impact on catch accounting staff and funds must be sufficient to make the necessary changes to incorporate alternative estimation strata. This should be evaluated and incorporated into the ADP.
- The SSC heard a proposal from the NMFS observer program to consider biennial reviews of the observer deployment plan. While the SSC recognizes the value of carefully considering survey design changes to maintain a maximum amount of consistency, with EM integration imminent there are multiple major design changes anticipated in the next 2-3 years. Thus, while the SSC does not believe transition to a biennial deployment plan review is currently necessary, it may well be appropriate following EM integration. **However, the SSC recommends that all changes to survey design should be considered carefully and that design consistency through time is highly desirable.**

C-6 IFQ Program Review

The SSC received presentations from analysts Marysia Szymkowiak (NPFMC) on the 20 year review, and from Steve Kasperski (AFSC) on the community indices. Public testimony was provided by Linda Behnken (Alaska Longline Fisherman's Association).

The SSC commends the analysts for a well thought-out and structured assessment of the halibut/sablefish IFQ program. The SSC particularly thanks the analysts for carefully following the work plan, responding to the SSC's suggestions regarding the work plan in the February 2016 meeting, and being responsive to the general discussion of program reviews the SSC conducted in the June 2016 meeting. The resulting review identifies a dashboard of clear metrics for many of the stated objectives of the IFQ program. While these metrics do not by themselves indicate the effects of the program, the review draws on the peer reviewed literature for appropriate counterfactuals, when they exist. Further, the analysts convened a crew workshop to cast some light on crew impacts, where the data collection necessary to support monitoring and evaluation was not implemented at the outset of the program. **The SSC finds the analysis synthesizes the best available information to characterize whether the IFQ program may or may not be achieving each of its stated objectives.**

The analysts did an excellent job consolidating existing information and previous analyses. However, **the SSC is concerned that metrics of several key objectives of the IFQ program are not being adequately tracked**. For instance, Objectives 1, 5 and 6 of the IFQ Program focus on the distribution of

benefits among the groups and sectors who participate in the fishery. While the document tracks the division of revenues between processors and vessels with wholesale and ex-vessel prices, this is not equivalent to tracking the extent to which fishery rents accrue to processors, vessel owners, crew, and quota owners, which is critical to monitoring the extent to which business relationships are maintained, and to which those who are directly involved in the fishery benefit from the IFQ program. In addition, while the document clearly shows that the reduction in vessels has led to a reduction in crew jobs, the jobs that remain are much different: they are longer-term, more stable, and offer more total pay per job. Understanding the crew and community effects of this change requires identifying whether work is being compensated at a higher or lower rate than pre-IFQ, and tracking whether that rate is going up or down as the program matures.

Objective 1 identifies economic stability as a problem for the IFQ to address, and Objective 8 focuses on ensuring that the fishery provides benefits and economic stability for communities, especially Alaskan coastal communities. A key mechanism for capturing fishery rent is through the employment and earnings in the processing sector. While the document describes changes in the timing and location of the processing sector, understanding the number and structure of processing jobs is critical to monitoring whether and how the fishery is supporting its communities. The SSC appreciates the AFSC's effort to track Objective 8 with indices of community level dependence on fisheries. A local quotient and a regional quotient are used to assess the locally-landed proportions of landings and revenues across the entire fishery. This leads to the conclusion that larger communities with more landings and vessels are more engaged in the IFQ fishery. The SSC interprets the objectives of the program as emphasizing the importance of the fishery to the community, rather than the community to the overall fishery. As the index approaches evolve, the SCC recommends refining the indices to reflect the role of both fishing and specific fisheries within the context of culture and employment opportunities within each community. The analysts should ensure that the terminology used to discuss the present indices cannot be misconstrued, as measures of revenue, for example, are not equivalent to measures of "importance" or "engagement. The reporting category of "other" community should be decomposed so as not to mask effects in smaller communities

In some cases, data to populate appropriate metrics for these objectives have not been collected historically, and are not being collected presently. In the absence of available data, the SSC recommends leveraging local case studies to illustrate changes and contextualize the metrics used. These are an important complement to aggregate metrics as, for example, the regional quota share holdings is used to measure community stability, but the aggregate level of this metric masks shifts in holdings away from some small rural communities. The SSC recommends that the analysts include graphics and maps that show the changes over time across the state so that the Council and the public can better understand the effects of this program.

The SSC notes that the IFQ program is inextricably linked to the CQE and CDQ programs. The circumstances of the Eyak case presented in the review highlights features of the program that are not being assessed adequately, for example, the effects on communities left out of both the IFQ program and CDQ program. The SSC recommends that future reviews integrate, rather than defer, consideration of the effects of the CDQ program.

The SSC also considered the content and format of this document as a potential model for future program reviews. **The SSC emphasizes that this review does not identify program impacts separate from other causes and trends**. This fishery exemplifies the importance of such analysis, as understanding the effects of the IFQ program requires constructing proper counterfactuals that reflect changes in market conditions, other fisheries, and the significant reductions in TACs since program implementation, especially for halibut. Such analysis is important for accountability and transparency for the IFQ program, supporting future Council action in refining the IFQ program, and informing the development of other catch share programs in the North Pacific and elsewhere.

As the first catch share program, the IFQ was implemented without expectation that it would be reviewed, and as a result no data collection program was designed. With this perspective, the SSC is understanding that data supporting any short-term program evaluation is likely not possible at this stage. **However, within the context of newer requirements for program reviews, the SSC recommends taking action to insure these information gaps do not persist in ensuing five-year reviews.** The SSC welcomes the invitation in the Council's June motion to "develop a proposal to establish a Social Science Plan Team and to outline the scope of its work."

The SSC believes the structure of the IFQ review could play a constructive role within a broader institutional process of continual improvement of the data, measures and models used to monitor catch share programs. Specifically, the systematic effort to develop metrics for each stated objective provides opportunities for SSC feedback on the structure of metrics. Highlighting data gaps allows the SSC to suggest additional existing information, or recommend consideration of feasible data programs on high priority metrics. Identifying potential research questions for more thorough or causal analysis facilitates the SSC's contribution to the scoping, structure and prioritization of issues for evaluation. However, these features are meaningful only within an institutional process which has the capacity to follow through on these recommendations. In developing this proposal, the SSC recommends considering how such a Plan Team would evaluate, prioritize and respond to the suggestions of the analysts, SSC and Council to improve the data, metrics and analyses available for subsequent reviews.

C-7 Area 4 Halibut IFQ Leasing

The SSC received a presentation by Sarah Marrinan (NPFMC) of the draft RIR/IRFA document for the proposed actions that would allow Community Development Quota (CDQ) groups to lease commercial halibut individual fishing quota (IFQ) from quota share (QS) holders in times of low halibut catch limits in Area 4B and Area 4CDE. Public testimony was provided by Clem Tillion (Aleut Corp.) and Heather McCarty (Central Bering Sea Fishermen's Association).

The SSC commends the analyst for the thorough analysis and careful description of the different elements of the proposed action. Overall, the information provided in the analysis is very helpful for understanding the tradeoffs and the potential net benefits involved with the proposed action. The SSC notes that the objectives of the proposed action may be conflicting with some of the goals of the IFQ program. In particular, while leasing commercial halibut IFQ to CDQ groups has the potential to create additional harvesting opportunity for CDQ groups, it could also compromise the goal of having a predominantly

owner-operated fleet. Thus, the Council will have to consider this tradeoff and the precedent it could set for future leasing opportunities in the halibut IFQ fishery.

While most areas of the analysis are comprehensive and complete, some areas of the analysis are deficient in providing information for the Council on this issue. **The SSC therefore recommends that the RIR/IRFA be released for public review once the following items have been addressed:**

- The analysis does not adequately capture the fishing opportunities of CDQ participants outside of the CDQ/IFQ halibut fisheries. In particular, the analysis would benefit from summarizing the fishing activities of CDQ vessels in years when they do not land CDQ halibut. There is an significant decrease in the number of vessels participating shown in Figure 6, and those vessels that left may provide an important sense of other opportunities. This could perhaps be captured by reconfiguring Table 2 to include ex-vessel revenues from vessels that did not land CDQ halibut in a particular year, but have landed CDQ halibut in previous years.
- The analysis would benefit from providing some context for the "cooling-off" years in Option 4. As it stands, it is not possible to infer whether or not the alternative years in Option 4 are overly restrictive—i.e., could the cooling-off years choke off any potential leasing to CDQ, thereby negating the purpose of the proposed action? Summarizing the average and/or distribution of QS holder tenure is one possible option for providing some context for Option 4.
- The analysis would benefit from additional explanation as to why potential "market effects" are bad and to be discouraged. In particular, the discussion regarding market effects seems to conflate two separate issues: 1) concerns regarding the owner-operated nature of the fleet, and 2) concerns regarding entry opportunities into the halibut QS market. These issues should be discussed separately and at greater length, with more emphasis on both the benefits and costs associated with potential market effects.
- The fifth column in Table 2 appears to be incorrect and needs to be fixed. In its present condition, the heading of the fifth column is interpreted as "the number of vessels that landed both halibut CDQ and IFQ." But in some cases, the number presented in column five is larger than the number presented in column three, which is the "number of vessels that landed halibut CDQ". This is not possible, and thus the numbers presented in column five need to be corrected.

The SSC recommends that future versions of the document also address the following item:

- The analysis would benefit from strengthening the case that the proposed action would actually provide additional harvesting opportunities to halibut CDQ vessels beyond the current capabilities of CDQ groups. In particular, it should include a discussion of whether current CDQ allocations are being harvested by resident vessels this program is intended to support. While this information may be included in Figures 7 and 8, it would be useful to separate IFQ utilization from CDQ utilization.

D-1 BSAI Halibut Abundance-Based PSC

The SSC received reports about a discussion paper and a workshop on efforts to develop abundance-based Prohibited Species Catch (PSC) limits for BSAI halibut from Diana Stram (Council staff), Allan Hicks (IPHC), Jim Ianelli (AFSC) and Kotaro Ono (AFSC). Public testimony was provided by John Neilson (AMCC and CBSFA), Linda Behnken (ALFA) and John Gauvin (Alaska Seafood Cooperative).

The Council, as per its Purpose and Needs statement, "is considering abundance-based PSC limits to control total halibut mortality, provide an opportunity for the directed halibut fishery, and protect the halibut spawning stock biomass, particularly at low levels of abundance". At the request of the Council, the discussion paper lays out some options for developing indices and control rules to meet these objectives. The discussion paper included an additional objective to ensure stability in the PSC rates to avoid large year-to-year variations if they are not warranted. The Council should clarify whether this is an explicit objective as it could be seen to be in conflict with the desire to "provide a responsive management approach at varying levels of halibut abundance" and will affect the choices for appropriate indices and control rules.

The Council requested that the analysts first develop an index or indices as the basis for determining PSC limits. However, the SSC emphasizes, as noted by the analysts, that indices of abundance can only be considered and evaluated in the context of a control rule. The SSC found it difficult to comment on the utility of specific abundance indices in the absence of an analysis to evaluate their performance in the context of meeting multiple, and sometime conflicting, objectives. Therefore, the SSC stresses the importance of maintaining flexibility and evaluating a suite of potential indices and control rules in the analyses before selecting the best index or combination of indices to meet the Council's objectives. The SSC agrees with the analysts that candidate indices and control rules should be transparent and easily understood, and that they need to be available in advance of the December meeting.

The SSC appreciates the analysis and discussion of a number of candidate indices that were presented in April and at this meeting. The discussion paper and public workshop held at the AFSC in September recommended an integrated abundance-based management (ABM) index. While the ABM index could be one potential candidate for setting PSC limits, the SSC pointed out some serious shortcomings of the ABM index and requests that a broader suite of options for candidate abundance indices and control rules be examined together in subsequent analyses, rather than restricting analyses to a single index like the ABM at this stage. With respect to the ABM index, the SSC notes that combining three indices with different types information is not transparent in that the index is not easily interpreted and it is unclear how it would trade off multiple, potentially conflicting objectives. As pointed out in public testimony, the index would likely have been ineffective at constraining PSC during the recent period of decline in coastwide halibut biomass. The ABM index combines a coastwide abundance index of large halibut from the IPHC survey with trawl survey indices of smaller halibut caught in the EBS and GOA trawl surveys. The SSC notes that equally weighting the two trawl-based indices may implicitly put more weight on a halibut in the GOA because the majority of smaller halibut occur in the GOA.

The SSC suggests that different indices may need to be considered to meet different objectives, which could then be combined in a control rule or decision making framework that allows the Council to evaluate the tradeoffs between protecting spawning stock biomass, constraining PSC, and providing opportunities for a directed fishery. Importantly, an abundance-based index should have a biological basis and be interpretable as a plausible link to BSAI halibut abundance. The SSC has the following suggestions for developing indices and control rules that address Council objectives and can be evaluated in subsequent analyses. We provide examples of an approach that is amenable to analyses with one of the

proposed modeling options, is transparent and simple to implement, and can be used to evaluate trade-offs among competing objectives. We emphasize that these are examples only and decisions about appropriate control rules for halibut PSC have both biological and allocation implications, are responsible for providing bycatch-avoidance incentives to the commercial groundfish fleet, and are subject to National Standard 9 requirements to minimize bycatch "to the extent practicable" and to conservation considerations at low levels of spawning halibut biomass.

With respect to protecting halibut spawning biomass, a control rule to limit total mortality at low levels of spawning biomass is needed. Since PSC mortality in the Bering Sea reflects a substantial portion of total mortality, particularly of younger halibut, this requires a rule to limit PSC when coastwide halibut abundances are low. Since the concern is at least in part a conservation concern, a rule similar to our standard harvest control rule for groundfish species should be considered that would reduce PSC to zero at very low halibut abundances (see example below). As a measure of coastwide spawning biomass, the analysts selected a survey-based index of the biomass of halibut over 32 inches (O32). The SSC supports this pragmatic choice, although a model-based index that takes into account additional sources of information should be considered, if it is available in time.

Because halibut PSC in the EBS largely consists of smaller fish, an obvious drawback of linking PSC to an index of coastwide spawning stock abundance is the delay between changes in PSC, once a decline in spawning biomass is detected, and their effects on future spawning biomass. Therefore, it is desirable to consider an index that quantifies the strength of incoming year classes well before they contribute to spawning biomass. For this reason, the analysts explored the use of size ranges corresponding to age-2, age-3 and age-4 halibut in the NMFS bottom trawl survey. However, while there is some consistency in these indices in that individual cohorts can be tracked over time, a clear relationship between these cohorts, as sampled by the survey, and future recruitment to the adult stock is not evident. The SSC encourages additional analyses on a survey- or model-based juvenile halibut index that can be evaluated under a chosen control rule for its effectiveness in protecting future spawning biomass. However, we realize that a suitable index of juvenile abundance may not be available at this time. A potential drawback of linking PSC to a juvenile index is that any juvenile index is likely to fluctuate considerably from year to year, therefore some smoothing of the index or a control rule that results in a smoother change in PSC may be desirable in that situation. If a reliable juvenile index can be identified, it could be used either instead of or in addition to the index of coastwide spawning stock abundance.

Evaluating the other objectives, which relate to trading off PSC against opportunities for a directed halibut fishery, ideally requires indices that quantify the portion of the halibut stock that is encountered by the groundfish fleet (as an index of the ability of the fleet to avoid PSC) and the portion that is available to the directed halibut fishery. Candidate indices for the former were evaluated in the April document and the most suitable index was determined to be based on halibut catch rates in the EBS trawl survey, which has a similar footprint to the groundfish fleet and catches a similar size range of halibut. However, this index is not sufficient to evaluate trade-offs between PSC and the directed fishery because of the limited overlap between the size range encountered by the trawl survey and the size range in the directed halibut fishery, and because these two portions of the population display different trends. For example, in some years small fish may be abundant in the EBS survey and coastwide abundances may be high, but the

exploitable halibut biomass in the EBS that is available to the directed fishery can be very low because of differences in spatial distribution of halibut. We suggest that an index for the portion of the stock available to the directed halibut fishery could be based on IPHC analyses of the setline survey and other data sources that are used to determine exploitable biomass in different regions, which are readily available.

The SSC suggests that the multiple objectives of this action may require multiple indices and could be met by formulating control rules for each type of index (reflecting coastwide spawning biomass, encounter rates with the fleet, and availability to the directed fishery, respectively) that allow an evaluation of the tradeoffs between PSC, protecting the stock at low abundances, and providing opportunities for a directed fishery. For example, control rules for setting PSC at different levels of the spawning biomass index and different levels of EBS trawl survey abundance can be combined into a simple two-dimensional decision table to set a PSC level. Adding a third dimension may be necessary and would be straightforward. For example, a simple approach could associate low, intermediate and high levels of the spawning biomass with low, intermediate and high levels of PSC (similarly for the abundance index in the EBS trawl survey or the exploitable biomass index). PSC could then, for example, be determined based on the level of the index that is most constraining as illustrated below:

Example decision table to set PSC based on the level of two indices. PSC is set at the level of the index that is most constraining. For example, at low levels of spawning biomass, PSC is set at a low level regardless of the value of the trawl survey index.

		EBS exploitable biomass index		
		Low	***Medium***	***High***
Coastwise	***High***	Low	Intermediate	High
spawning biomass index	***Medium***	Low	Intermediate	Intermediate
	Low	Low	Low	Low

However, it may be preferable to formulate continuous control rules like those presented in the discussion paper that would avoid abrupt changes in PSC. These control rules could similarly be combined in a 2- or 3-dimensional framework for setting PSC as illustrated below and represent a simple extension of the decision table.

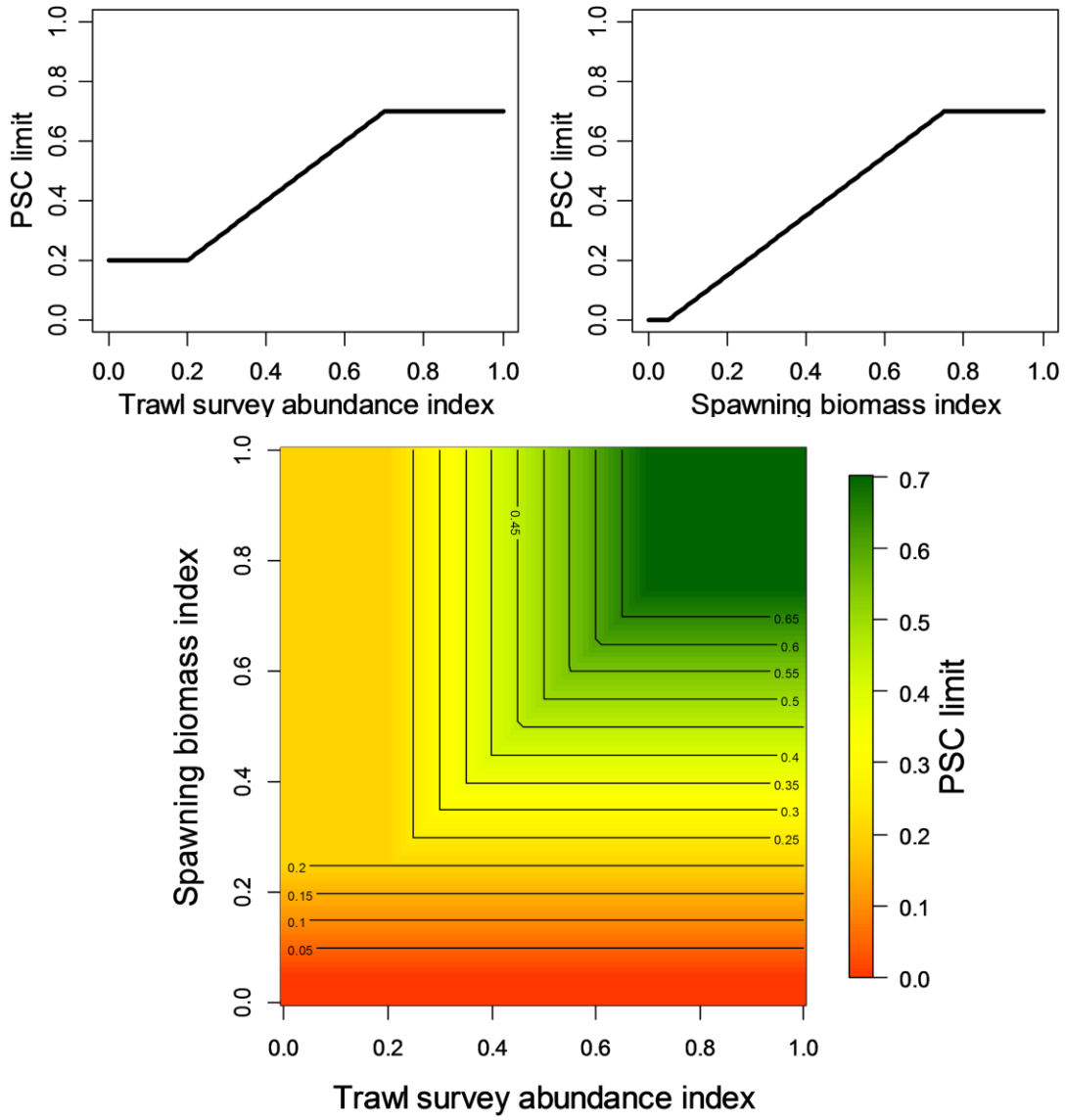

Figure illustrating PSC control rules. *Top panel illustrates potential control rules linking PSC to a trawl survey abundance index and to a coast wide spawning biomass index, respectively. The control rules are combined in the bottom panel by setting PSC to the value for the index that is most constraining at a given combination of index levels. In this example, PSC limits are set to zero (red) at very low levels of spawning biomass, regardless of the level of the trawl survey abundance index. In contrast, at high values of the spawning biomass index, PSC increases with the trawl survey index according to the rule in the upper left panel and is not constrained by spawning biomass.*

This framework allows different control rules to address different objectives. For example, control rules that reflect allocation decisions would have a different shape, as determined by the Council, than a control rule to protect spawning biomass.

The SSC is encouraged by the continuing development of the technical interaction model (AFSC) and the Management Strategy Evaluation model for halibut (IPHC), both of which provide suitable frameworks for evaluating the consequences of different bycatch control rules for the directed halibut fishery, for groundfish fisheries, and for the halibut stock. We did not have additional comments on these models at this point and look forward to their further development.

For additional comments on other aspects of the analysis we refer to our April 2016 minutes.

D-3 EFH Descriptions

Drs. Steven MacLean (Council Staff), John Olsen (AKRO), Scott Smeltz (Alaska Pacific University), and Brandee Gerkee (AKRO) presented the current information on EFH descriptions. John Gauvin and Lori Swanson (Marine Conservation Alliance) and Jon Warrenchuk (Oceana) all provided public testimony.

The current information available for defining EFH for marine fish and crab stocks managed by the NPFMC is the product of a large group of analysts. The SSC commends this team for their progress to date.

The SSC has reviewed proposed methods for defining EFH at several meetings, with the most recent review occurring in April 2016. The new methods provide a quantitative depiction of the spatial distribution of EFH based on selected environmental co-variates in 4 seasons. Summer distributions were based on bottom trawl CPUE (GAM models) while fall, winter and spring distributions were based on presence/absence data from fisheries (Maximum Entropy, MaxEnt). The SSC considered EFH mapping driven by environmental co-variates instead of catch distributions to be a major step forward and supported the use of species' distribution modeling for predicting their distributions. In April, the SSC recommended that revisions to EFH definitions in the FMPs were warranted and the fishery management plans should be amended to bring them up to date.

In April, the SSC encouraged the analysts to examine the use of acoustic data as input to the EFH description for walleye pollock and perhaps capelin. The SSC also recommended that sediment type be considered as a co-variate in the GAM models. These requests were not addressed, although sediment type is a considered in detail in the Fishing Effects estimations. Members of the EFH workgroup noted that the acoustic data were not considered because the analysts were trying to identify a common method that applied to all species. The SSC acknowledged that there is value in the application of a common methodology. However, they noted that when considering EFH for a species whose life history includes a pelagic phase in the life history, the inclusion of acoustic data could provide useful insights. In the case of GOA and EBS pollock it appears that the bottom trawl data did provide a representative depiction of EFH.

Since April, seasonal spatial maps have been reviewed by stock assessment authors. With only a few exceptions, stock assessment authors recommended that EFH definitions should be updated. **The SSC agrees with the authors that existing definitions of the EFH for crab and groundfish should be amended to incorporate the results of new analytical methods.** When considering EFH definitions, the SSC does not recommend combining surfaces based on GAM and MaxEnt methods into a single EFH

map. If a single map is desired, the CPT recommended and the SSC agrees that MaxEnt methods should be applied to summer survey data to allow for the construction of an annual map based on seasonal output derived from common methodology. The SSC noted that when considering fishing effects on EFH, there may be value in considering ontogenetic or seasonal shifts in spatial distribution. The time line for revising EFH definitions would target a review by the Joint GPT March 2017 with SSC review during the April 2017 meeting.

The GPTs noted that depictions of EFH are only as good as the data used to derive the maps. With this in mind, the SSC discussed the need for continued validation experiments to assess the predictive skill of the models beyond the out-of-sample statistical analyses that have already been performed. Continued evaluation of the predictive skill of the models (especially in the fall, winter and spring) is encouraged.

The SSC requests the inclusion of the methods used to define EFH in the body of the amendment package rather than in the appendices, and that the data used to derive the maps is clearly stated in the figure legends.

D-5 Fishing Effects Criteria

Steve MacLean (Council Staff) presented the white paper on impact assessment.

In April 2016, the SSC recommended the formation of a sub- committee to develop criteria for evaluating the impact of fishing effects on EFH. This sub-committee was formed with membership including SSC and Plan Team members as well as the leads for the EFH work-group and scientists from Alaska Pacific University. The sub-committee met during the summer and developed a white paper describing impact assessment methods. This white paper was presented to the CPT and GPTs in September.

The proposed methods outline a hierarchical impact analysis framework that utilizes the availability of time varying estimates of fisheries effects. This framework provides an evidence based impact assessment to assess the potential effects of fishing on EFH for crab and groundfish resources. The goal of the framework is to assess whether there is a fishing effect on EFH that is more than minimal and produces significant and temporary impact(s) on the growth-to-maturity, spawning success, breeding success, and/or feeding success of species managed by the NPFMC. The improved analytical products allow analysts to evaluate linkages between time trends in fishing effects on EFH and independently determined time trends in size-at-age, recruitment, spawning distributions and feeding distributions. It will be important to develop a mechanistic tie between the effect on EFH and the impact on the fish.

The SSC discussed the white paper to provide guidance to questions posed by the sub-committee.

The SSC responses were as follows.

1. Are the assessment cutoffs correct?

The white paper proposes that analysts identify a core area for each species that represents the upper 50th percentile of predicted abundance or suitable habitat. The rationale for the 50th percentile cut-off was that analysts wanted to find a balance between an area that represented a high likelihood of the species being present and an area big enough to include adaptive movement options for the species. The SSC recommends that in addition to the 50th percentile cut-off, the analysts consider including use of higher (larger region, 95th percentile) or lower percentiles (smaller region, 25th percentiles). The SSC recognized that inclusion of a larger region would dampen the fishing effects and thus, if a threshold effect of habitat disturbance was not detected at the 50th percentile it was unlikely that it would be detected at the 95th percentile. To test this hypothesis, the SSC requests that the sub-group examines the relationship between impacts assessed using the core area cut-offs of 50% and 95% for a sub-set of species with a range of distributional attributes.

The SSC discussed the merits of the proposed impact threshold of 10% of EFH being in the disturbed state. The SSC recognizes that the selection of the impact threshold is critical because if habitat reductions are below the threshold, then no further assessment would be needed. The SSC saw the merits of the 10% threshold but asks the sub-committee to examine the frequency that other cut-offs (say 5% and 20%) would be reached for the same sub-set of species for which the different core area definitions are assessed.

The SSC noted the "curse of dimensionality" when analysts conduct exploratory correlation studies, especially when using a relaxed p – value of 0.1. To address this issue the SSC recommend that P-values be corrected for multiple comparisons, or that guidelines be established for the number of comparisons to evaluate.

The SSC considered the data sets available for the evaluation of fishing effect impacts on the growth-to-maturity, spawning success, breeding success, and feeding success of species. The SSC agrees that the proposed time series of recruitment, spawning biomass and size or weight-at-age should be considered. For stocks in the Bering Sea, the SSC recommends that the sub-group explores the possibility of examining indices of stomach fullness as another factor related to feeding success.

2. Should assessments be based on regional boundaries for the stock/species?

The SSC discussed the pros and cons of utilizing stock boundaries to conduct the impact assessments. They considered alternative options such as evaluating GOA for only those regions open to trawling. The SSC recognized that many rockfish and flatfish species in the Bering Sea are managed as a single BSAI wide stock yet the topography in the AI differs substantially from the EBS shelf. After considerable discussion, the SSC recommends that the authors use their best judgement on the boundaries for their impact assessment. The SSC did not support the concept of dropping the eastern Gulf of Alaska from the analysis simply because no trawling occurs in this region. The possible benefits of habitat protection

realized by the trawl closures in the EGOA should be considered in the impacts assessment of mobile species.

3. Management response

The SSC reviewed the proposed framework for pursuing next steps if an analyst identifies a potential fishing effect impact concern. The SSC agrees with the plan for the analyst to bring his or her concerns to the Plan Team(s) and SSC for review, comment, and evaluation. The GPTs recognized that a process will need to be developed that addresses how to move forward if an adverse impact is indicated. The SSC noted that these next steps may include focused research projects to verify the proposed cause and effect relationships between habitat disturbance rates and stock demographics.

4. Comments on Fishing Effects model

The SSC supports the use of the Fishing Effects model in the EFH analysis with the following additions. The SSC received public testimony on the methods used to estimate recovery in the model indicating that there was concern regarding the ability of the model to track the effects to long-lived corals and sponges due to the averaging of recovery rates among all taxa. The recovery rates used in the model were provided to the SSC in April 2016 but were not included in this review packet. Given that these values play a crucial role in the estimation of fishing effects used in the assessment, the SSC requests that the sub-committee include these values in the next iteration of the EFH impacts review. The SSC recommends that the sub-committee include an additional biological feature category for long-lived corals/sponges and develop a white a paper describing the expected fishing effects to this group.