SCIENTIFIC AND STATISTICAL COMMITTEE
draft report to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
October 2nd – 4th, 2017

The SSC met from October 2nd through 4th at the Hilton Hotel, Anchorage, AK.

Members present were:

Farron Wallace, Chair *NOAA Fisheries—AFSC*	Sherri Dressel, Vice Chair *Alaska Dept. of Fish and Game*	Chris Anderson *University of Washington*
Robert Clark *Alaska Dept. of Fish and Game*	Jason Gasper *NOAA Fisheries—Alaska Region*	George Hunt *University of Washington*
Gordon Kruse *University of Alaska Fairbanks*	Dayv Lowry *Washington Dept. of Fish and Wildlife*	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:

Jennifer Burns *University of Alaska Anchorage*	Lew Coggins *U.S. Fish and Wildlife Service*	Brad Harris *Alaska Pacific University*
Anne Hollowed *NOAA Fisheries—AFSC*	Terry Quinn *University of Alaska Fairbanks*	

B-1 Plan Team Nominations

The SSC reviewed the Plan Team nomination of Dan Lew (NMFS-AFSC), to the GOA Groundfish Plan Team. The SSC finds this nominee to be well qualified, with appropriate expertise that will assist the GOA Groundfish Plan Team. The SSC recommends that the Council approve this nomination.

General Comments

The SSC notes that it is extremely important that documents are provided two weeks in advance to ensure a complete and thorough review. The SSC recommends the Council explore alternatives to the Plan Team schedule to improve our review process.

C-3 BSAI Crab Specifications

Buck Stockhausen (NMFS-AFSC) presented the Crab SAFE sections on EBS snow crab, Bristol Bay red king crab and EBS Tanner crab. Toshihide (Hamachan) Hamazaki (ADF&G) presented recent modelling efforts for Norton Sound Red King Crab. Bob Foy (NMFS-AFSC) covered the other stocks in the Crab SAFE and presented the CPT report. Public testimony was provided by John Hilsinger (Aleutian King Crab Research Foundation).

General SSC Comments to Crab Plan Team

Model numbering convention

The SSC appreciates the CPT's consideration of model number convention and their recommendation to move forward with the modelling convention adopted by the Groundfish Plan Teams. The SSC endorses this approach and looks forward to standardization of model numbering in all future crab stock assessments.

Crab bycatch

The SSC appreciates the presentation by Ben Daly of ADF&G on sources of crab bycatch data to the CPT and the ensuing discussion, as described in the CPT meeting minutes. The SSC has some concerns about the procedure by which non-retained legal crabs are estimated aboard vessels by observers. The current procedure involves a discussion by the observer with the skipper to determine the criteria by which the "vessel" intends to discard while fishing (such as a preponderance of barnacles or other fouling on the carapace). The observer then tries to apply this procedure to unsorted crab to classify retained versus non-retained crab. The problem with this procedure is that it is very subjective and the skipper's descriptions of legal crab discarding criteria may differ markedly from actual discarding practice by the crew. The crew may not only discard some legal-sized crab, but they may inadvertently retain some sublegal-sized crab; classifications that the observer may not make as s/he carefully measures each crab in the sample. Rather, the following procedure may be an improvement. When a pot designated to be sampled comes aboard, the crew could be instructed to sort crabs into baskets designated as those intended to be retained and those intended to be discarded (non-retained). The observer would then sample these two classes of crabs to determine their legal status, shell condition, etc. as per usual. The SSC recommends that the CPT further consider this issue, including this suggestion, and work with ADF&G to suggest improvements to the at-sea data collection process concerning crab bycatch. As bias estimates of retained crab is an issue with some crab stock assessments (e.g., Tanner crab), it is critical that procedures are implemented to generate unbiased estimates from catch samples. Understandably, logistics aboard a commercial crab vessel may dictate the practicality of alternative observer sampling protocols. The SSC appreciates ADF&G's willingness to review and change how bycatch data are collected, and the CPT's attention to this important issue.

Introspection on Stock Assessment and Management

The SSC had a brief discussion about the generally poor status of BSAI crab stocks. It was noted that, despite excellent progress to develop state-of-the-art stock assessments, there has been little improvement in the status of many stocks. While environmental factors play a pivotal role in crab recruitment, poor environmental conditions should, in turn, affect perceptions of stock productivity and, therefore, appropriate harvest levels. Changing environmental conditions also have profound effects on the geographic distribution of stocks, including the more northerly distribution of snow crabs as evident by significant densities of snow crab observed in the latest survey in the northern Bering Sea. It is unclear to what extent juvenile snow crab in the northern Bering Sea migrate south to be recruited to the EBS stock. Increases of snow crab evident from recent surveys in the Chukchi and Beaufort seas also raise questions about source-sink dynamics and definitions of stock boundaries. As another example, northward extensions of red king crab outside the Bristol Bay management area (state of Alaska Management Area T) raise questions about whether these crabs represent the same Bristol Bay stock, and about whether management area boundaries should be revised. Similar questions have been raised about the geographic distributions of

king crabs associated with the Pribilof Islands. The SSC recommends that the CPT consider a wide-ranging "brainstorming" discussion session with creative thinking about BSAI crab stock units, stock status, and productivity under environmental change and their potential implications on stock assessments (e.g., need for spatially explicit assessment models for snow and Tanner crab), and fishery management strategies (e.g., boundaries of management units, harvest strategy).

BSAI Crab SAFE and Harvest Specifications

The SSC reviewed the SAFE chapters and information provided by the CPT with respect to the stock status information from 2016/2017 and relative to total catch in that time period (Table 1). In addition, Table 2 contains the SSC recommendations for 2017/2018 catch specifications, with maximum permissible ABCs for 2017/2018 shown in Table 3. **The SSC endorsed all OFL and ABC recommendations of the CPT except that the SSC has selected a 25% buffer for the ABC calculation for St. Matthew Island blue king crab instead of the 20% buffer recommended by the CPT.** The rationale for this change is reported in the St. Matthew Island blue king crab section of this SSC report (below). **The SSC notes that the Pribilof Islands blue king crab stock was not subject to overfishing in 2016/2017 but remains in an overfished status**. None of the other crabs stocks were subject to overfishing, nor are they overfished or approaching overfished status.

Table 1. Stock status of BSAI crab stocks in relation to status determination criteria for 2016/17 as estimated in May and September 2017. 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[1] MMB	2016/17 MMB / MMB_{MSY}	2016/17 OFL	2016/17 Total catch	Rebuilding Status
1	EBS snow crab	3	69.7	139.4	94.40	0.68	23.70	11.00	
2	BB red king crab	3	12.53	25.06	25.81	1.03	6.64	4.28	
3	EBS Tanner crab	3	14.58	29.16	77.96	2.67	25.61	1.14	
4	Pribilof Islands red king crab	4	2.30	4.60	4.79	1.04	1.49	0.00049	
5	Pribilof Islands blue king crab	4	2.05	4.10	0.23	**0.06**	0.00116	0.00038	**overfished**
6	St. Matthew Island blue king crab	4	1.97	3.94	2.23	0.57	0.14	0.05	
7	Norton Sound red king crab	4	1.03	2.06	2.66	1.29	0.32	0.24	
8	AI golden king crab	5					5.69	2.83	
9	Pribilof Islands golden king crab	5					0.091	0.00024	
10	Western AI red king crab	5					0.056	< 0.001	

[1] For stocks 1-6 MMB on 2/15/2016 is estimated using the current assessment in September 2017. For Norton Sound red king crab MMB on 2/1/2017 is estimated using the current assessment in January 2017

Table 2. SSC recommendations for 2017/18 (stocks 1-6). Values for stocks 7, 8, 9, and 10 were set by the SSC in February and June 2017. Diagonal fill indicates parameters not applicable for that tier. Bold indicates where SSC recommendations differ from Crab Plan Team recommendations. 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)	2017/18[2] MMB	2017/18 MMB / MMB_{MSY}	γ	Mortality (M)	2017/18[3] OFL	2017/18 ABC	ABC Buffer
1	EBS snow crab	3	b	0.89	139.40	1979-current [recruitment]	99.6	0.71		0.23 (females) 0.417 (imm) 0.259 (mat males)	28.41	22.70	20%
2	BB red king crab	3	b	0.24	25.10	1984-current [recruitment]	21.31	0.85		0.18 default; estimated	5.60	5.04	10%
3	EBS Tanner crab	3	a	0.75	29.17	1982-current [recruitment]	43.31	1.48		0.34 (females) 0.247 (imm m & f) 0.25 (mat males)	25.42	20.33	20%
4	Pribilof Islands red king crab	4	b	0.18	4.60	1991/92-2016/17	3.36	0.73	1	0.18	0.48	0.36	25%
5	Pribilof Islands blue king crab	4	c	0.18	4.11	1980/81-1984/85 & 1990/91-1997/98	0.23	0.06	1	0.18	0.00116	0.00087	25%
6	St. Matthew Island blue king crab	4	b	0.08	3.93	1978-current	2.18	0.55	1	0.18	0.12	**0.09**	**25%**
7	Norton Sound red king crab	4	a	0.18	2.10	1980-current	2.33	1.11	1	0.18	0.30	0.24	20%
8	AI golden king crab	3	a	EAG (0.75) WAG (0.68)	12.09	1987/88-2012/13	14.21	1.18		0.22	6.05	4.54	25%
9	Pribilof Islands golden king crab	5				See intro chapter					0.09	0.07	25%
10	Western AI red king crab	5				1995/96-2007/08					0.06	0.01	75%

[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

[2] MMB as projected for 2/1/2017 for Norton Sound red king crab, 2/15/2017 for AIGKC, and 2/15/2018 for other stocks.

[3] AIGKC OFL and ABC calculated by author outside the chapter for using the Approach 2 combination of EAG and WAG and 25% buffer between OFL and ABC

Table 3. Maximum permissible ABCs for 2017/18 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. Bold indicates where SSC recommendations differ from Crab Plan Team recommendations. Values are in thousand metric tons (kt).

Stock	Tier	2017/18 *Max* ABC[2]	2017/18 ABC
EBS Snow Crab	3	28.4	22.70
Bristol Bay RKC	3	5.60	5.04
Tanner Crab	3	25.57	20.33
Pribilof Islands RKC	4	0.39	0.36
Pribilof Islands BKC	4	0.00116	0.00087
Saint Matthew BKC	4	0.12	**0.09**
Norton Sound RKC	4	0.30	0.24
Aleutian Islands GKC	3	6.02	4.54
Pribilof Islands GKC[1]	5	0.08	0.07
Western Aleutian Islands RKC	5	0.05	0.01

[1] For Pribilof Islands golden king crab, this is for the 2018 calendar year instead of the 2017-2018 crab fishing year.

[2] For Tier 5 stocks this is 0.90 while all other stocks P*.

EBS Snow Crab

The year's stock assessment uses the same basic model structure as last year's assessment. Eight model runs were conducted to address five scenarios that were suggested by the CPT in May 2017. The eight models based on these five scenarios are:

- M16.D16 – Last year's accepted model fit to last year's data (i.e., the September 2016 final model)
- M16.D17 – Last year's accepted model fit to this year's data
- M16.D17a – Last year's accepted model fit to this year's data, but dropping all survey data before 1982
- M17A.D17a – Split survey selectivity periods in 1987, based on distribution of survey stations
- M17Aa.D17a – Estimate survey availability parameters for BSFRF survey in logit space with a penalty
- M17B.D17a – Remove data in length bins below the kink in growth and fit a straight line for growth
- M17C.D17a – Estimate M for females, males, and immature, change prior to be suitable in log space with zero mean and appropriate standard deviation. Retains all changes to this point
- M17BC.D17a – Combines 'M17B.D17A' and 'M17C.D17A'

The CPT noted that changes reflected by models M16.D17, M16.D17a, and M17A.D17a included minor "fixes" that should be implemented into future base models.

The author and CPT recommended use of model M17C.D17a. This choice was clear, as this model demonstrated a large improvement in likelihood estimates and all of the other models had significant bimodal posterior distributions in estimated reference points. For instance, correctly-jittered runs for model M17Aa.D17a converged to several distinct objective function values. The two best values represented global and local minima, which were within a likelihood unit or two of each other. Similar likelihoods indicate that the data provides nearly equal support for either solution. Unfortunately, these two alternative solutions yield large differences in OFL and other management quantities. While this bimodal feature was common to all models except the preferred model, some of the models had additional problems. For instance, models M17B.D17a and M17BC.D17a yielded unrealistic estimates of survey selectivity and maturity probability.

For these reasons, the SSC supports the author's and CPT's recommendation to use model M17C.D17a for this year's assessment. Although this was the best model, there are concerns with this accepted model that should be addressed in next year's assessment. As pointed out by the CPT, estimated catchability q=1 for females and q=0.72 for males are unrealistic based on field trials using side-by-side comparisons of the NMFS trawl and the BSFRF Nephrops trawl, the latter of which is assumed to have catchability near unity.

Given the concerns about estimates of q, the SSC offers two suggestions. First, it may be prudent to consider the validity of the assumption that the BSFRF trawl has a q=1 for crabs. As reported in the SSC report from October 2016 for Bristol Bay red king crab, it may be helpful to investigate the reactions (if any) of crabs with respect to the approaching trawl. If some crabs can run away or are herded toward the trawl, this would violate the q=1 assumption. Behaviors could vary by species, sex, and crab size. The SSC understands that some trawl videos have been collected from the BSFRF trawl, although sediment plumes associated with the footrope may compromise many of the videos. A selection of best videos could be perused for potential herding or avoidance effects. In addition, new gear studies could be conducted with the BSFRF trawl. One approach may be to develop some forward-mounted camera design whereby the camera sits ahead of the sediment plume. Another approach could involve the use of ADF&G's CamSled to develop independent estimate of crab density immediately ahead of trawl tows. Yet another approach could involve the use of use savings gears that could, for instance, be affixed to each side of the BSFRF trawl to examine egress and ingress from/to the trawl path. Undoubtedly, there are other experimental designs worth considering.

Second, the SSC briefly discussed the importance of estimates of natural mortality (M) as q and M are confounded in stock assessments. The mean for the prior for M used in this assessment is based on the assumption that longevity is at least 20 years in a virgin population, based on studies largely conducted on males, as well as studies conducted in the Atlantic on a different stock of snow crabs. Based on this longevity estimate, mature male M was estimated in the base model with a prior constraint with a mean of 0.23/yr. Likewise, for immature males and females, M was estimated in the model with the prior estimate of M. Individuals from different stocks often display differences in vital statistics and care should be taken when extending parameters from one stock to another. Different growth parameters for Bristol Bay and Norton Sound red king crab give a striking example even within the Bering Sea, just as growth parameters

from Kodiak Tanner crab may not apply to the EBS. Given these considerations, the SSC suggests that it may be prudent to revisit assumptions about M, particularly for females.

The experience with bimodal posterior distributions of some key parameters in most alternative models in the EBS snow crab assessment suggests that care should be taken to distinguish between local and global minima in estimates of other parameters, like M and q. Studies by Brad Stevens and colleagues showed high incidence of limb loss and mortality after Tanner crab mating events in Womens Bay, Kodiak. As just one approach to address such concerns, the SSC recommends some experimental model runs with higher (and lower) priors on M to confirm the generality of model convergence to the reported model-estimated values of M and q.

The SSC notes that Figure 20 shows traces for parameters from each model that yield some evidence that even the recommended model may have convergence issues. To explore this further, the SSC encourages additional work on the MCMC diagnostics and jittering work. The SSC also expresses some concern that the model may now be getting too complicated and it may be prudent to simplify the model and/or investigate reparameterizing some relationships to improve convergence and other issues before adding new complexities to the model.

The SSC supports other recommendations of the CPT concerning presentational issues of the SAFE report, as well as their specific advice concerning future research.

The EBS snow crab is a Tier 3 stock. The SSC supports the CPT recommendation to increase the buffer between OFL and ABC from 10% used last year to 20% this year for setting the 2017/18 ABC. The CPT's rationale included considerations of model uncertainties and contradictions between model trends and survey and fishery observations. In addition, model uncertainty is greater for 2017/18 because the chosen model had questionable estimates of q, and the SSC noted that there may be some convergence issues, even with the recommended model. The SSC further noted that the ABC buffer was 25% two years ago and was reduced to 10% last year owing to reductions in model uncertainty and apparent resolution of convergence issues with last year's assessment, which have reemerged in this year's assessment. As a result, an increase in buffer size to 20% is prudent and falls well within the range of recent practice.

Bristol Bay Red King Crab

The SSC received a presentation on the modelling progress for Bristol Bay Red King Crab (BBRKC) during 2017 as well as the Tier, OFL, and ABC recommendations. Model development resulted in nine alternative configurations representing models that are consistent with the model used in 2016 (2a), disaggregate bycatch in the groundfish fisheries by gear type (2b), include a prior on trawl survey catchability and are reparameterized to a logit scale (2d), use the Francis weighting on extended size composition distributions (2a1, 2b1, and 2d1), as well as use Francis weighting on sex-specific size composition distributions (2a2, 2b2, and 2d2). These nine alternatives all provided similar fits to the NMFS trawl survey index, as well as to the BSRF survey time series.

The alternatives using iterative reweighting approaches led to model convergence issues and were not recommended by the author or the CPT. The SSC recommends further exploration of this issue with a focus on objectively determined weighting for this and other crab assessments.

The author supported the use of model 2b; however the CPT disagreed, due to concerns that the catchability for the NMFS trawl survey was estimated to be too close to 1.0, despite preferring the approach of disaggregating the groundfish discard data by gear type. Results from the BSFRF side-by-side tows suggest the catchability for the NMFS trawl survey is closer to 0.6. On this basis, the CPT recommended using model 2a, including the prior on catchability from the 'under bag' experiment, for the time being; this model resulted in a current mature male biomass of 21.31 thousand t. **The SSC agreed with this choice and recommends model 2a, placing the BBRKC stock in Tier 3b, and using a 10% buffer for the ABC.** The SSC noted that recent trends and biological information for this stock do not look positive for future stock sizes. Specifically, only very large crab have been observed in the trawl survey in recent years, with no evidence of incoming year-classes. In addition, survey trends have been declining for around 15 years, both of which are concerning and may warrant additional caution in the future.

The SSC supports all of the CPT recommendations, and also offers the following recommendations:

- The SSC reiterates its request from June 2017 for the BBRKC author and CPT to objectively define the terminal year of recruitment to include in reference point calculations in this and other crab assessments, and again requests that the author use the breakpoint analysis applied for Tanner crab to BBRKC to evaluate whether there was a detectable break in production in 2006. The SSC looks forward to the outcomes of a more comprehensive discussion on this topic at the January 2018 CPT meeting.
- This assessment uses the number of lengths measured as a starting point for input sample sizes. The SSC recommends following the approach of other crab and groundfish stocks in using the number of stations or pots sampled as a better proxy for statistical sample size given the frequently very high correlation among individuals within a single sample.
- More research on catchability is needed, including review of existing camera work from BSFRF surveys that may shed light on crab behavior in response to trawl gear. The SSC provided some comments on new research using modifications of the BSFRF Model under the subsection "Crab Bycatch" earlier in this report.
- The CPT suggested that large catches that drove the stock down in the early 1980s could drive the fits, resulting in an estimate of q near 1.0. On this basis, other evaluation of q could include investigating the effect of the period of historical decline (perhaps by down-weighting it) on more recent estimates of catchability, or fitting a research model fit to BBRKC with only data after the stock collapse in the early 1980s.
- The SSC noted that historical modelling was conducted using relatively simple catch-survey analysis (Collie and Kruse 1998; Can. Spec. Publ. Fish. Aquat. Sci. 125: 73-83). This might provide another tool for exploring why current estimates of catchability are so close to 1.0.
- The SSC is also looking forward to continued development of the Gmacs model for BBRKC during 2018.

EBS Tanner Crab

The SSC endorsed the new modelling framework, TCSAM02, in June 2017, which represents a significant improvement in the Tanner crab stock assessment. The current assessment includes 11 alternative model runs (including the base model) that address model scenarios suggested by the CPT in May. These models: (1) improved parameterization of the growth increment model; (2) incorporated recently collected EBS growth increment data into the assessment and dropped the growth priors that were previously based on GOA Tanner crabs; and (3) re-parameterized selectivity parameters for bycatch in the RKC fishery so that they do not hit bounds (Models B0, B0a, B1, B1a, B1c). The CPT noted that assessment results were not strongly affected by these changes and regarded all of them as model improvements. The SSC concurs.

The SSC supports the recommendation by the assessment author and CPT to use model B2b for this year's assessment, because it represents a good balance between allowing retention curves some flexibility to change over time without adding many annual parameters for retention. This model allowed for three retention periods where both the asymptote and the size at 50% selection were allowed to vary. Although there were model improvements with the transition to the TCSAM02, model results are not substantially different from the 2016 model and several concerns remain, such as parameters hitting bounds and consistent over-estimation of large male crab abundance, which should be investigated further next year. The SSC recommends a careful diagnosis of all parameters still hitting bounds in this model with specific attention to whether those bounds are biologically meaningful, whether a reparameterization might help, whether there is prior information or auxiliary data that could be informative, and whether the parameter is even estimable given the data and model framework.

In alternative model B1c, the weight placed on growth increment data was greatly increased, and Model B3 split out the bycatch in groundfish fisheries by gear type. These two models were not successful and resulted in large numbers of parameters hitting bounds and poorer fit to other data components. The assessment author expressed interest in pursuing other options for increased weighting on the growth increment data, perhaps to a lesser extent, in a future assessment.

For Tanner crab, a 20% buffer has been used for ABC. Therefore, the CPT recommends retaining the 20% buffer for ABC. A relatively strong recruitment was estimated for 2017, but this estimate is very uncertain.

Chronic overestimation of large males in the stock assessment was again discussed by the SSC. In this regard, the SSC was intrigued by model runs that evaluated alternative ways to model potential temporal variation in the retention curve, which had previously been assumed to be time-invariant. Specifically, the SSC wonders whether retention could be related to temporal changes in size at maturity, as shell condition may affect the marketability (and thus retention) of crabs with a preference for clean, newshell individuals. The SSC further noted that there may be some evidence for differences in size at maturity for Tanner crabs in Bristol Bay versus the Pribilof Islands areas; Tanner crabs may occur deeper in the Pribilof region and different environmental conditions at depth may influence growth and size at terminal molt. As the relative proportion of Tanner crabs from Bristol Bay in the overall Tanner crab stock has declined over time, this may manifest itself as a time trend in size at maturity and, therefore, retention rates. If data provide evidence of spatial or temporal changes in size of maturity, this feature should be explored in the assessment model. Moreover, industry preferences may have changed over time and may have been affected by recent changes in the EBS Tanner crab size limit. Discussions with industry on this topic may be informative. Presumably observer data should shed light on the topic of retention rates, however the SSC expresses some concern about the representativeness of apparent retention rates given current protocols to estimate retention by the onboard observer program (see SSC comments in the previous subsection on crab bycatch).

The SSC expressed some concern about the apparent poorer reproductive condition of female Tanner crab in the east compared to the west. Females in the east and characterized by greater proportions of old and very old shells; eyed egg, barren, and empty case egg condition; and less than full clutches. The SSC wondered if timing could be an issue in that females in the eastern district may have been sampled after egg hatch and larval release but before new egg clutches were extruded and fertilized by stored sperm. An alternative concern is that female-biased sex ratios may leave too few males to mate with available females. The third possibility is that females are old and approaching the end of their reproductive life owing to senescence. The SSC would appreciate some analysis/discussion of the evidence for or against these alternatives in next year's assessment.

The SSC supports continued development of the TCSAM02 model, in coordination with the Gmacs model, in order to avoid redundant approaches and to make development and testing as efficient as possible. The SSC looks forward to a common modelling platform including all of these developments in the future.

The EBS Tanner crab stock falls under Tier 3a. The CPT recommended a 20% buffer to account for model uncertainty and stock productivity uncertainty. The SSC concurs and notes that this is the same buffer that the SSC recommended for harvest specifications last 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 that could occur in a directed red king crab fishery. 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 and ABC and the stock is not overfished, nor is overfishing occurring. The 2017 survey results show that abundance declined by 12% for mature males, 73% for mature females, 83% for juvenile males, and no juvenile females were collected. There was no evidence of juvenile recruitment in the 2017 survey.

In addition to last year's model, three new assessment methods designed to smooth survey results were evaluated in this assessment. The 2016 assessment method used a three-year, inverse variance-weighted rolling average of male biomass (≥120mm carapace width). In this assessment, new random effects models were investigated: 1) fixed process error estimated from an exponential model; 2) a prior likelihood component, with the CV for the prior derived from a bootstrap on the distribution of the exponential model smoothing parameter, resulting in a CV=2.24; and 3) a prior likelihood component with an arbitrary CV=4.0. In addition, a model failed to converge with a prior CV=5.0. Increasing the CV in the specification of the prior will increase smoothing.

The SSC concurs with the CPT-recommended Tier 4b stock status determination and selection of the random effects model with a prior estimated using the bootstrap method. The SSC also supports the CPT-recommended OFL and a 25% buffer for the ABC. The random effects method is preferred over the status quo inverse variance method since it uses information from throughout the time series to smooth extreme estimates that are likely caused, at least in part, by low sample sizes. The bootstrap method was preferred over the arbitrary CV=4.0 because it used the time series to empirically derive a CV for the prior.

In addition, the SSC has the following comments for the assessment author:

- Table 5 seems to imply no female crab are caught since the total male bycatch is the same as the total catch. The authors should explain why females are not reported.
- The bootstrapping method in the document is poorly described. A more detailed explanation would improve the document.
- Details on the model performance were difficult to evaluate. The SSC concurs with the CPT recommendation for the assessment to include a table of parameter values. In addition, a figure showing the distribution of the alpha parameter should be included in future assessments (e.g., figure 15).

Pribilof Islands Blue King Crab

The survey continues to show stock abundance to be at extremely low levels without sign of recovery. Spatial distributions of both males and females were similar to previous years, as were length frequency distributions. The stock remains in an overfished condition.

During the 2015/2016 crabs season, discard mortality from the crab and groundfish fisheries resulted in catch mortality exceeding the 1.16 t OFL and hence overfishing occurred. Overfishing did not occur during the 2016/2017 crab season, with total catch mortality at 0.38 t, well below the OFL of 1.16 t. The SSC notes that in response to overfishing in 2015/2016, AKRO now publishes an online weekly report to inform the public about the in season catch of blue crab.

The Pribilof island blue king crab assessment uses a random effects model to smooth the survey biomass time series under Tier 4 for status determination, but the OFL and ABC are calculated using a Tier 5 approach. The projected MMB-at-mating for 2017/18 decreased slightly from that in 2016/17 but remained below the MSST. Consequently, the stock remains overfished and a directed fishery is prohibited in 2017/18.

The SSC concurs with the CPT's recommended OFL based on average catch and a 25% buffer between the OFL and ABC (same as previous years).

Saint Matthew Island Blue King Crab

The St. Matthew Island blue king crab assessment examined six different models:

1. 2016 model
2. 2016 model revised to include trawl survey data
3. 2016 model, referred to as the "reference case," which includes both the 2017 trawl survey and 2017 pot survey data
4. Model sensitivity: VAST – a geo-spatial delta-GLMM application to the trawl survey data (exploratory model)
5. Model sensitivity: fit to survey – run involving up-weighting by 1.5 of the trawl survey data and up-weighting of the pot survey by 2.0 to try to force fit to trawl and pot surveys (exploratory model)
6. Model sensitivity: Francis' weighting, similar to the reference case, but with Francis' iterative re-weighting of the size composition data

This is a rather data-limited stock assessment. There are several significant issues concerning all model scenarios. These include a spatial mismatch between the survey locations and the geographic distribution of females and juveniles, which results in poor model estimates of recruitment. Moreover, survey sample sizes are small and highly variable. Additionally, the high precision of recent trawl survey estimates of very low abundance may be having an overly strong influence on the overall estimated trend.

The SSC noted that fits to trawl survey data fail to capture an apparent increase in biomass during 2008-11 and a subsequent decline over 2014-17. Fits to pot survey data don't respond to apparent declines in pot survey CPUE during 2013-17. Given the lack of fit to trawl and pot survey data in recent years, it is unclear

what data (size composition data?) are driving recent model results. The SSC recommends that the assessment authors consider whether there is a data weighting issue. The SSC appreciates the author's responses to previous CPT and SSC comments.

The SSC supports the author's and CPT's recommendation to use the reference case model for this year's Tier 4 stock assessment. The author and CPT recommended the use a 20% buffer on the OFL to determine the ABC. The SSC disagrees. **Rather, the SSC recommends use of a 25% buffer to determine this year's ABC** for the following reasons: (1) spatial mismatch between trawl and pot surveys, distribution of recruit crab, and the commercial fishing grounds; (2) very large confidence intervals in survey biomass, which are in part due to the large contribution of survey catches from one hotspot station (53% of crab collected in 2017 were collected at station R24); (3) the model is insensitive to recent declines in both trawl and pot survey CPUE, resulting in concerns about data-weighting and stock status; (4) sharp declining trends from trawl and pot surveys raise concerns about approaching the overfished condition in the not-so-distant future; and (5) this is a data-limited stock assessment compared to the relatively data-rich EBS snow crab and EBS Tanner crab stocks, both of which use a buffer of 20% for calculations of ABC.

Norton Sound Red King Crab

The SSC received a presentation from Toshihide Hamazaki (ADFG), on the status of modelling for Norton Sound Red King Crab (NSRKC). This presentation represented an update on progress in preparation for the 2018 specification process. One of the more perplexing modeling issues for NSRKC is that the abundance of large (>123 mm CL) crab is overestimated by the model. The current default model attempts to reconcile this by assuming that M is higher for the last 2 length bins (crab >123 mm CL). The authors reported on alternative approaches to estimating mortality, and also considered examined effects of changing fishery selectivity from a one-parameter to a two-parameter logistic function.

Six model scenarios were evaluated:

0. One mortality for the last 2 length classes - this is the default model.
1. Two separate mortalities for the last 2 length classes
2. Three separate mortalities for the last 3 length classes
3. One mortality for the last 2 length classes, 2-parameter fishery selectivity
4. Two separate mortalities for the last 2 length classes, 2-parameter fishery selectivity
5. Three separate mortalities for the last 3 length classes, 2-parameter fishery selectivity

The authors recommended model 5 due to improvement in the likelihood resulting from use of the 2-parameter logistic function and three estimated parameters for M. The CPT noted that improvement in the likelihood is mostly associated with the 2-parameter logistic curve (Models 3, 4 and 5). There was a relatively small improvement in the likelihood from model 3 to model 5 with two mortality parameters added, and not much difference between alternative models fits to MMB biomass.

The SSC agreed with the CPT's recommendation **to bring forward the default model, model 3, model 4, and model 5 for the January 2018 assessment, and to continue to investigate the information (via likelihood profiles and other methods) in the model on natural mortality parameters.** The SSC encourages future efforts to use tagging and other data to evaluate the fate of the largest crab.

The SSC also supports the CPT's request to include the four years of available pot survey data in the next round of model development, and also looks forward to inclusion of the 2017 NMFS trawl survey northern extension including Norton Sound. The treatment of trawl data in this assessment has focused on a standard core area; however, the SSC supports further exploration of methods to better interpolate/extrapolate missing stations and areas outside that core.

The SSC noted that it would be helpful for the CPT to clarify the default procedure for selecting the time period over which to calculate average biomass for calculating the B_{MSY} proxy for Tier 4 stocks.

Aleutian Islands Golden King Crab

The SSC received a presentation of modelling efforts in preparation for the next Aleutian Islands Golden King Crab (AIGKC) stock assessment for June 2018. Fifteen alternative model configurations were investigated, exploring the treatment of data weighting, the maturity relationship, CPUE treatment, initial abundance assumptions, and natural mortality.

The SSC supports the CPT's extensive list of recommendations for data and model development, as well as specific models to bring forward for their May 2018 meeting.

In addition, **the SSC offers the following recommendations:**

- Although the use of chela height-carapace size regression lines has been validated for *Chionoecetes* crabs (snow, Tanner), the SSC expressed concern that the use of this approach to determine maturity may not be appropriate for lithodid (king) crabs. The SSC recommends that efforts be made to verify this relationship in lab or field experiments, as well as to review the available literature and application of this approach for other non-*Chionoecetes* species.
- The SSC supports the exploration of the VAST geospatial model for investigation of fishery catch rate data, but cautions that the nonrandom nature of fisheries data adds an additional challenge to the standard assumptions of independence between the underlying density and the process of observation beyond that of standard statistically-designed survey programs.
- The SSC encourages the author to explore observer data and to discuss with the participants in the fishery potential changes in fisher behavior that may influence the relationship between fishery catch rates and crab abundance.
- The SSC reiterates previous concerns that this stock assessment relies solely on fishery data, and therefore carries a higher degree of uncertainty than other model-based assessments for crab stocks. The SSC encourages recent and future efforts by the industry to include survey pots in their fishing activity in order to generate additional data to inform this analysis. The SSC extends its appreciation to the industry for their generous cooperative research efforts on this important crab stock.

C-4 Groundfish Plan Team Report and Harvest Specifications

The SSC received a series of presentations from Grant Thompson (NMFS-AFSC), Jim Armstrong (NPFMC), Jim Ianelli (NMFS-AFSC), and Steve Barbeaux (NMFS-AFSC) that included all items from the September 2016 Joint, BSAI, and GOA Groundfish Plan Team (GPT) meetings. Public testimony was received from Chad See (Freezer Longline Coalition), Julie Bonney (Alaska Groundfish Data Bank), and John Gauvin (Alaska Seafood Cooperative).

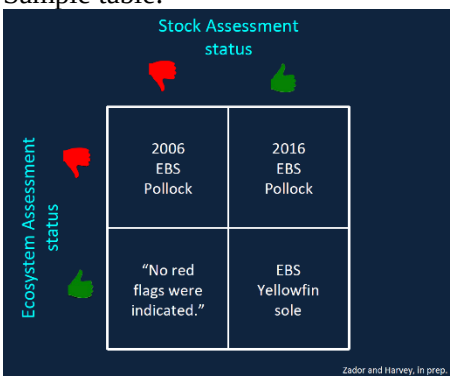
The SSC recommends approval of the BSAI and GOA specifications provided by the Plan Teams except for GOA and BSAI Pacific cod. Items where the SSC had comments or recommendations in addition to, or different from, the Plan Teams are listed below.

General recommendations

When a major stock declines precipitously, it is potentially extremely costly in terms of fishing revenues, and the impacts on the fishing communities dependent on those catches. These costs are exacerbated in the Gulf of Alaska fisheries because much of these fisheries consist of small entities (as compared to the eastern Bering Sea fleet), with comparatively limited financial resources. Had there been a Gulf-wide survey in 2016, the impending decline in the Pacific cod stocks would have been identified, and measures could have been taken to lessen the impact of this decline on the industry. **The SSC strongly recommends that full surveys be conducted annually in the Gulf of Alaska and Bering Sea given the huge monetary and social costs of having a major, unexpected decline in a fishery.**

There were signs of the impending decline in the condition of many fish species in the Gulf of Alaska in the 2015 and 2016 Ecosystem Considerations reports for the Gulf of Alaska, but they were more easily detected in hindsight, in part because there was so much information to digest. Sets of ecosystem data that indicate there may be problems not accounted for in the assessment models need to be brought to the attention of the SSC and the Plan Teams as early in the process of setting specifications as possible. Procedures need to be developed for integrating this information into the process of setting ABCs and OFLs early enough in the fall to permit the modification or implementation of model output. Thus, **the SSC recommends that, for those sets of environmental and fisheries observations that support the inference of an impending severe decline in stock biomass, the issue of concern be brought to the SSC, with an integrated analysis of the indices involved.** To be of greatest value, to the extent possible **this information should be presented at the October Council meeting** so that there is sufficient time for the Plan Teams and industry to react to the possible reduction in fishing opportunity. **The SSC also recommends explicit consideration and documentation of ecosystem and stock assessment status for each stock, perhaps following the framework suggested below, during the December Council meeting to aid in identifying areas of concern.**

Sample table:



GOA Pollock

The GOA pollock stock assessment underwent a CIE review in May 2017 and the SSC received the resulting peer review reports from three independent experts. Reviewers generally agreed that the model in its current form was appropriate to assess stock status, but also had a number of suggestions for possible improvements. These included adding more details, such as a seasonal time step, adding time-varying mortality, adding time-varying catchability for the acoustic surveys, including spatial & temporal variability in life history parameters (length/weight/maturity-at-age), and improving the survey design of the acoustic and trawl surveys (e.g., simulation studies, continued development of moored acoustics, incorporating habitat considerations).

While the reviews did not raise any issues of great concern that would require immediate action, the Plan Team requested that the author summarize the main recommendations and provide responses to recommendations at the November Plan Team meeting. **The SSC agrees with this request. More generally, we recommend that a summary of recommendations from any CIE review be provided at the Plan Team meeting following the CIE review (typically September) to ensure that any issues of concern are reviewed by the Team at that meeting and relevant recommendations for changes to the data or model can be vetted for possible inclusion in that year's assessment.**

BSAI and GOA Pacific cod

BSAI Pacific Cod

The SSC received a detailed presentation from Dr. Grant Thompson (NMFS-AFSC) of the model development for the Bering Sea Pacific cod stock assessment during 2017. Dr. Thompson provided a brief history of modelling efforts including 174 vetted models and response to 238 comments over the last 11 years leading to the current assessment models. He then described a series of models ranging from the model adopted for last year updated to the newest stock synthesis code (model 16.6), through incremental changes and alternative configurations for models suggested by the Pacific cod subcommittee (models 17.1-17.5). He also presented a seventh model, which included a small number of additional changes made to address aspects of model fit and/or performance (model 17.6).

The results of all of these models were generally correlated in terms of historical biomass and the time series of recruitment, but diverged substantially in both scale and trend in the last ten years of the time-series.

The SSC appreciated the creation of a prior for natural mortality based on a review of other cod stocks in the Pacific. **The SSC supported the Plan Team's recommendation to use the lognormal prior distribution from this review, and further recommended removing all estimates from the prior that contained an appreciable amount of the data that is currently used in the stock assessment model,** and would therefore be included in the likelihood function. This would avoid including the same information twice (Minte-Vera, C.V., Branch, T.A., Stewart, I.J., and Dorn, M.W. 2005. Practical application of meta-analysis results: avoiding the double use of data. Can. J. Fish. Aquat. Sci. 62: 925-929).

The SSC appreciated the extensive efforts made toward developing a model-averaging approach for Bering Sea Pacific cod. It noted that selecting a single model in light of the larger sensitivity to structural changes observed in the models presented was challenging, and could result in a large underestimate of the credible range for the current stock and recent trend. **The SSC disagreed with the Plan Team recommendations to bring forward only models 16.6 and 17.6, and not use model averaging for 2017, and instead suggested the following refinements to the approach presented:**

- **Drop models 17.4 and 17.5 from the set under consideration.** Model 17.4 showed convergence and plausibility issues, and model 17.5 represented a sensitivity analysis with which to evaluate the results when an arbitrary weighting hierarchy was imposed on the fishery and survey length and age data sources.
- **Perform further diagnostics and evaluation on models 16.6, 17.1-17.3, and 17.6 in order to determine whether all five may be candidates for inclusion in a model averaged result in December.**
- The approach for model weighting using a measure of effective sample size vs. effective number of parameters was interesting and logically consistent with the maximum likelihood approach employed in fitting the models, but may not capture all of the relevant considerations in weighting models for use in model averaging. **The SSC encourages the author to consider a broader method for model weighting (perhaps subjective in nature)**

that includes model fit and also retrospective performance, model convergence behavior and general plausibility.

- **Bring forward for consideration in December one or more alternatives for model averaged results (based on models 16.6, 17.1-17.3 , and 17.6), which may include equal weighting, individual model averaged results using some other weighting developed per above, and a distribution fit to the model results (similar to the preliminary approach).**

In light of the large drop estimated for the Bering Sea bottom trawl survey Pacific cod biomass (37%), combined with concerns that similar ecosystem dynamics to those observed in the GOA during recent warm events may have affected portions of the EBS stock, the SSC adopted an approach for the proposed OFL and ABC identical to that used for GOA Pacific cod. Specifically, the SSC set the proposed OFL and ABC for 2018 based on the average of the OFL/ABC values from 2017 specifications and the Tier 5 calculation provided by the author (only because this value was readily available in advance of the actual stock assessment, and with no intention of changing the tier designation for Pacific cod). This approach resulted in **a preliminary recommended OFL of 258,687 and an ABC of 208,265 mt.**

		2018 as specified		2019	
Species	**Area**	**OFL**	**ABC**	**OFL**	**ABC**
Pacific cod	BS	**258,687**	**208,265**	**258,687**	**208,265**
	AI	28,700	21,500	28,700	21,500

The SSC did not support the Plan Team's recommendation to provide further bridging analysis between models 16.6 and 17.6, but instead suggested a focus on model evaluation and diagnosis of 16.6, 17.1-17.3 and 17.6 for potential inclusion in a model-averaged approach in December.

The SSC also offers the following recommendations:

- Following on the December 2016 recommendation, continue **exploration of the treatment of weight-at-age using both internally and externally estimated values, and the treatment of ageing bias in the stock assessment. Further, conduct an exploratory analysis of recent weight-at-age data for evidence of patterns resembling those seen for GOA Pacific cod.**
- **Clarify, with the joint Plan Teams, the preferred measure of central tendency (e.g., median or mean) for assessments reporting probabilistic results either via Bayesian posteriors or model-averaged distributions.**
- **For models where iterative reweighting is applied, if the initial input sample sizes have been derived based on a boot strapping approach or using the number of hauls, strongly consider tuning these inputs only in a downward direction in order to avoid placing implausibly high weights on certain data sets to the effective exclusion of others.** This appeared to have been a specific problem for preliminary model 17.4.

<u>GOA Pacific Cod</u>

The SSC received a presentation from Dr. Steven Barbeaux (NOAA-AFSC) on the results of 2017 surveys and preliminary modelling for the 2018 Pacific cod stock assessment. The data for this effort had only become available several days before the meeting, and the SSC appreciated the rapid and extensive investigation by Dr. Barbeaux (as well as contributions from Drs. Stephani Zador and Kirstin Holsman).

The most salient survey result was a 71% reduction in the GOA bottom trawl survey Pacific cod biomass estimate from 2015 to 2017. This drop was observed to occur across the GOA, and was particularly pronounced in the central Gulf. Dr. Barbeaux also presented additional data sets that appeared to corroborate the trawl survey results, including a large drop in the NMFS 2017 longline survey (53%), and low estimates in recent years by the ADFG large mesh trawl survey. Pacific cod fishery data from 2017 indicated slower rates of catch accumulation and lower CPUE over the season, at least in the central GOA, compared to other recent years, as well as a change in depth distribution toward deeper waters. Bycatch rates in the Pollock fishery were lower in 2017 than in recent years. Size information from both the trawl survey and Pacific cod fishery were consistent with a large drop in abundance of the 2012 year-class which has for several years been estimated to be an important component of the stock. Dr. Barbeaux presented a summary of the condition factor for Pacific cod, showing that the 2012 year-class had low weight-at-length during 2015.

Available temperature records indicate very warm temperatures across a broad range of depths during the years 2014-2016. These warm temperatures were associated with low forage fish amounts in Pacific cod diets, which likely resulted from low prey availability in 2015/2016 that was evident in a number of ecosystem indicators (e.g. seabird mortalities due to starvation, 2016 GOA Ecosystem Assessment). When temperature information was used in a bioenergetics model, the results suggested that energetic demands may have been very high in 2015. In tandem with low forage availability, the increased temperature was predicted to have resulted in low growth. In aggregate, these observations suggest that the 2012 year-class may have experienced a higher rate of natural mortality in these years than that used in the models.

Dr. Barbeaux also presented some preliminary model runs using model 17.08.25, which represented the model adopted for management advice in 2016. Results indicated a large decrease in the estimated magnitude of the 2012 year-class, but some lack of fit to the size data. He also presented an alternative model configuration allowing a separate estimate of natural mortality for 2015-2016. This alternative resulted in a much higher estimate of recent natural mortality (0.78) and a very steep stock decline at the end of the time series. Although preliminary, these results were brought to the SSC in an effort to avoid surprises during the December specifications process.

The SSC did not formally review a preliminary stock assessment, but did feel it was necessary to provide a strong indication in advance of the final specifications in December that there could be a large reduction in the GOA Pacific cod OFL and ABCs for 2018 relative to the levels in 2017. Therefore, the SSC opted to set the proposed OFL and ABC for 2018 based on the average of the OFL/ABC values from 2017 specifications and the Tier 5 calculation provided by the author (only because this value was readily available in advance of the actual stock assessment, and with no intention of changing the tier designation for Pacific cod). This approach resulted in a **preliminary recommended OFL of 67,486 mt, and an ABC of 54,930 mt. The SSC noted that because the large potential change in model results could result in a status determination (B/B40%<1, Tier 3b) that falls on the slope of the harvest control rule, the final specifications could be even lower than the preliminary values adopted here.**

Species	Area	2018 as specified OFL	2018 as specified ABC	2019 OFL	2019 ABC
Pacific Cod	W	n/a	22,565	n/a	-
	C	n/a	27,471	n/a	-
	E	n/a	4,894	n/a	-
	Total	67,486	54,930	67,486	54,930

The SSC also provided the following recommendations:

- **The SSC recommends further investigation of a model that accounts for the recent drop in survey biomass via a change in recent natural mortality in addition to existing models for consideration in December.**
- **In light of the large drop in GOA trawl survey biomass estimated for 2015 and 2017, the SSC echoes the Groundfish Plan Team's concerns that the primary survey for the Pacific cod stock assessment was reduced by 1/3rd (two boats rather than three) in 2017.**
- **The SSC was informed that efforts to complete ageing of fishery samples from 2015-2016 were underway, and strongly supports the prioritization of this work for inclusion in the final stock assessment.**
- **The SSC noted that it did not review other aspects of the preliminary stock assessment, but looks forward to responses to recommendations from December 2016, including: the treatment of ageing bias in the assessment model, addition of fishery ages to evaluate the abundance and relative selection of older cod, use of a prior on natural mortality, and others (additional detail on some of these issues is provided in the Bering Sea Pacific cod section of this report).**
- **The SSC agrees with plan team recommendations to not use the geostatistical model estimates of biomass at this point and to further examine temperature-dependent catchability during the pending CIE review.**

GOA Skate Models

The SSC received a Plan Team report about ongoing work to develop length-based stock assessment for longnose and big skates in the GOA. The work is being done by Thomas Furrugia, a PhD student at the University of Alaska, Fairbanks. This report was largely informational, noting possible use of the newly developed models for setting 2019 specifications. The 2018 specifications will continue to use a Tier 5 approach.

The SSC looks forward to seeing a formalized version of model results in the future. We thank the authors for their work on the development of this model. The SSC recommends future work include examination of selectivity assumptions, likelihood profiles on natural mortality, sensitivity analysis on key parameters, and a full suite of diagnostics.

Based on the slides presented to the Plan Team, the SSC noted a few additional items for consideration:

- Selectivity is modeled for four fleets (two fisheries and two surveys). For the fishery, the slide indicated that size composition samples are for retained catch, but given sizes are sampled by observers in an aggregate species composition sample at-sea, the disposition of the individual fish may be unknown. Future iterations of the model should be clear about the origin of length composition information.
- Model-estimated natural mortality was higher than the 0.1 currently estimated. Future work might consider life history invariant methods for estimating M for comparison with assessment results, specifically methods appropriate for elasmobranches (e.g., max age, maturity curve, growth rate).

GOA Other Rockfish

A discussion paper presenting several alternative groupings for the GOA Other Rockfish complex was presented. The authors and Plan Team recommended Alternative 3a of the discussion paper, which unlike Alternative 2, would not change the current jurisdictional structure of rockfish management, but would change the species belonging to the consistent GOA-wide Demersal Shelf Rockfish (DSR) and Other Rockfish groupings. This would result in a GOA-wide DSR OFL, and a split in the ABC with one grouping specific to the Western/Central GOA+West Yakutat and another specific to the Eastern GOA (eastern GOA and Southeast Outside).

The authors provided a good rationale for their preferred species groupings. The rationale is based on similarities in life history, geographic distribution, vulnerabilities to fishing pressure, and shared management/jurisdictional issues. The authors considered placing redbanded rockfish into the DSR complex, but ultimately did not recommend this based on life history and harvest characteristics, noting that >70% of the catch in recent years has originated from trawl vessels. The GOA-wide OFL and area breakout of the ABCs as described under alternative 3a attempts to provide a balance between spatial management, rockfish biology, and in-season difficulties in managing small limits. This spatial scale is a reasonable approach for setting specifications.

The SSC concurs with the authors and Plan Team that the groupings and spatial specifications described under Alternative 3a are an improved description of structure and a reasonable approach to spatial management.

The GOA Plan team requested clarification from the SSC and/or Council regarding whether the Stock Structure and Spatial Management Policy applies to the proposed changes. **Given the scope of this action and potential impacts to the fishery, the SSC recommends that the Council's Stock Structure and Spatial Management Policy is followed.** This action could represent a large change in rockfish management with potential impacts on industry and management, including a required regulation change. The SSC also notes, due the need for a regulatory change, that this action could not occur in time for the setting of 2018 harvest specifications.

An important component of the Council policy is for the Plan Team to determine a level of conservation concern (see December 2015 Council meeting minutes). Depending on the level of concern, certain actions of the Council policy are triggered. **The SSC recommends that the Plan Team, during its November 2017 meeting: 1) provide guidance on the level of conservation concern for this stock; 2) evaluate whether the proposed breakout is appropriate given the level of concern; and, as appropriate 3)**

determine whether other measures would adequately address conservation needs. The stock structure template would be an appropriate tool for determining the level of conservation concern.

Under the assumption of a breakout moving forward, and Alternative 3a still being the preferred management option, the SSC has the following comments regarding tier-specific calculations:

- The Tier 6 method used in the analysis is based on maximum catch for the post-observer restructure period, which is a short period: 2013-16. This period corresponds to the post-observer restructure period and thus includes rockfish discard from the halibut IFQ fishery that is not available prior to 2013. However, the time series of harvest shows higher harvest levels than those realized in 2013-16. In addition, with the exception of EY/SEO yelloweye, the IPHC longline survey RPNs for several of the DSR species have also been stable over this time period (figure 4). Given the longevity of this species and relatively stable catch series, the SSC recommends Tier 6 methods be evaluated using a longer historical time series (2003-16), and whether there are important biological reasons for selecting the recent period (2013-16).
- Rockfish species in the DSR complex are not estimated individually in catch accounting system (CAS). The CAS produces an aggregate estimate for the entire Other Rockfish complex. The SSC recommends the author work with AKRO to make adjustments to CAS to better reflect estimation methods used for management under the proposed breakout.
- The revised NS1 guidelines allow carry-over ABC control rules. Future analysis should consider whether this provision is appropriate for GOA Other Rockfish management (including DSR).
- The SSC recommends investigating Tier 5 methods for redbanded rockfish given it appears to be well represented in the trawl survey.

Flatfish CIE Reviews

The Center for Independent Experts (CIE) reviewed the BSAI assessments of Kamchatka flounder, arrowtooth flounder, and flathead sole. It appears that they provided some excellent comments and suggestions. The SSC agrees with the Teams' recommendations that the authors should provide a document that lists the CIE reviewers' comments along with the authors' responses. Moreover, the SSC also looks forward to the authors' attempts to address these comments in updated assessments. The Plan Teams recommended scheduling this review at either the November 2017 (if there is time in the busy agenda) or September 2018 Plan Team meeting.

Stock Structure Templates

The SSC agrees with Plan Team recommendations and conclusions based on the stock structure analysis that a rating of "little or no concern" is warranted for the BSAI Sculpin complex. The BSAI Plan Team recommended that the stock structure analyses be presented for Bogoslof pollock, Greenland turbot, and northern rock sole in September 2018. The GOA Plan Team recommended that the stock structure analysis be completed for octopus and flathead sole in 2018, northern rockfish and Pacific cod in 2019, and sculpins and thornyhead rockfish for 2020. The SSC agrees with this timetable of future stock structure analyses.

Halibut Discard Mortality Rates

The Plan Team reviewed changes to estimation of Halibut DMRs with the use of combined groupings to accommodate small sample sizes. The Plan Team recommended moving forward with the estimated DMRs as presented for 2018 and the SSC concurs.

Geostatistical modeling of survey data

The SSC was pleased to see that geostatistical approaches for estimating survey biomass are being considered for the Gulf of Alaska survey to improve on the design-based estimates. Preliminary analyses suggest that accounting for zero catches and for spatio-temporal autocorrelation through a geostatistical approach with zero-inflated distributions can result in more precise estimates of biomass for many stocks. The SSC strongly encourages further development of these approaches, which could be extended to include covariates such as depth or other habitat features to increase precision. Care should be taken to estimate biomass over the same area when comparing results between the design-based and geostatistical approach. The SSC also suggested that, when considering anisotropy in the model, that the most appropriate approach for the Gulf of Alaska may be to allow for differences in spatial correlation scales in the along-shelf and cross-shelf directions, respectively, rather than by latitude and longitude. It was suggested that modeling survey data could be a topic for the workshop in February 2018 to discuss options for moving from design-based estimators to geostatistical estimators across stocks.

C-6 Observer Program 2018 Annual Deployment Plan

The SSC heard presentations from Craig Faunce (NMFS-AFSC) and Chris Rilling (NMFS-AFSC) providing an overview of the draft 2018 Annual Deployment Plan (ADP) for observers in the BSAI and the GOA to support the estimation of groundfish catches, discards, and related biological attributes. Public testimony was provided by Howard McEldery (Archipelago), Dan Falvey (self), Malcolm Milne (self), Jon Warrenchuk (Oceana) and Molly Zaleski (Oceana).

The SSC thanks the analysts and authors of the draft 2018 ADP for their hard work and diligence in preparing the report. It is concise and well written. There is direct correspondence between the results section and the various tables and analyses supplied in the appendix. The provided comparisons between allocation strategies were helpful in understanding how changes in the allocation of sampling effort affected gaps in coverage. Since initiation of the restructured observer program, the analysts have been very responsive to SSC comments and recommendations for improving the ADP and the observer program.

The restructured observing program has been refined over time so that the Council can now largely focus on what estimation objectives they would like to prioritize and how to achieve these objectives within the constraints of cost, coverage, and accommodation of different gear types and operational modes.

Based on results obtained since 2015, the merits and efficacy of using trip-based selection have been conclusively demonstrated and should remain the mode of selection in 2018. However, based on this draft and prior ADP and Annual reports, the SSC notes that continued evaluation of how to incorporate the use of tendered trips by gear type into the stratification scheme is needed. This issue is especially relevant given that the observer program has not been able to achieve its objective of tracking chinook bycatch from these trip types, since catch from multiple vessels may be included in a single tendered offload and the at-sea observer has no access to these fish. For some gear types such as trawl vessels, more study is needed before stratification by tendered vs. non-tendered trips is deemed successful or not. For other gear types, further evaluation may be unnecessary.

The SSC notes that more work is needed to better assist the Council in a comprehensive evaluation of the effect of different allocation strategies on addressing the needs of fishery managers. While these needs include accurate estimation of discards and halibut and Chinook PSC, they also include, for example, the need to understand the precision of discard and PSC estimates, and the need for biological samples. Consideration of these additional fishery management needs should be made as allocation strategies are developed and reported on.

Given no apparent increase in available funds for observer days after 2019, the SSC continues to agree with the analysts that a minimum level of sampling of each stratum is necessary to ensure adequate coverage, particularly given factors that have yet to be assessed (e.g. precision of estimates, necessary number and distribution of biological samples), and is precautionary with respect to avoiding bias. However, the

minimum allocation necessary to meet a sufficient level of coverage may differ between strata and should be investigated further by the analysts. Results from the fully optimized allocation strategies clearly show that gains in precision of discard and PSC estimation could be achieved by higher than the minimum 15% sampling rate for some strata and lower than minimum 15% sampling rate in other strata.

Tradeoffs between the level of coverage for a stratum and expected precision of discard and/or PSC estimation, beyond the three strategies presented in the draft ADP were difficult to evaluate given the current summary of results. For example, it was difficult to see what the actual difference in precision of discards or PSC would be given the 15% minimum + optimization strategy versus the fully optimized strategy for the various strata. Said another way, it was difficult to know what the loss of the 3 trip minimum (i.e., needing to borrow information from another gear or stat area) would have meant to the overall bias and precision of estimates of discard or PSC, especially for those fisheries within a stratum that are potentially constrained by these quantities. The SSC suggests that the addition of summaries of variances outputs used in the analysis or other sampling metrics would help to give the reader a better view on what the various tradeoffs might actually be.

The SSC also had the following additional comments:

- The hurdle threshold should be re-evaluated. For example, in each sampling strata the threshold could consider both spatial bias for estimation (e.g., the >= 3 trip threshold) and important gaps in biological data that may develop at low sampling rates (e.g., length compositions). Specifically, the low sample threshold ('hurdle') could be set such that these two needs are not severely compromised.
- We look forward to seeing the analysis of deployments based on the 2017 ADP, with specific attention paid to the potential impact low sampling rates may have had on estimation of discard and PSC, as well as addressing the issues with providing observers on trips delivering to a tender.
- We suggest that crab PSC should also be considered in optimization of an allocation strategy.
- Integration of EM into the observing program in 2018 will bring with it additional analytical tasks to the evaluation of the overall observer program. The SSC anticipates that these analyses will begin to address the performance of EM as a tool for estimation in situations where a human observer cannot be practically deployed. Specifically, we would like to see data collected from the voluntary EM fleet during 2017 analyzed to look at EM-based catch estimates as compared to those taken by a human observer, and the effect image quality may have had on accuracy of estimation of catch. Additionally, we would like to see a summary of deployment details for EM gear, including equipment failure rates and periods of inoperability, such that system reliability and true cost effectiveness can be evaluated with regard to ability to deliver critical data.
- The SSC is concerned that future reliance upon EM to obtain catch data may limit capacity to collect physical samples for some species or size classes, especially those that are rarely encountered. The SSC recommends that biosampling needs be taken into account when planning future EM and observer deployment strategies. However, the SSC notes that since participation in EM is voluntary results may be speculative.
- The SSC supports the NMFS recommendation to use ODDS to close each EM-based trip. This will ensure the quality control necessary for the video data available for review.
- We also support the NMFS recommended dual-pronged approach for Chinook sampling of offloads of observed trips and for those delivered to tenders.
- The SSC also supports the OAC subgroup tasked with looking into ways of increasing sampling rates in the partially observed fleets. Increased sampling rates could potentially

mitigate the need for some of the tradeoffs in stratification and allocation strategy that we see the analysts and OAC making.

- Information regarding future plans for funding and implementation of EM in the no-selection stratum (particularly the less than 40' LOA vessels) is lacking. The SSC has frequently requested development of EM for this stratum. It is critical to obtaining data from this portion of the fleet for which carrying an observer in place of a crew member may represents a burden to vessel operators.

C-7 GOA Rockfish Program Review

Program Review

The SSC perceived a presentation from Darrell Brannan (Brannan Inc.) and Mike Downs (Northern Economics). Public testimony was received from John Gauvin (AKSC) and Julie Bonny (Alaska Groundfish Data Bank).

The SSC commends the analysts for a well-organized, easily navigable program review document. They were attentive to comments the SSC has made on previous program reviews, which made for an accessible document that clearly links analysis to the rockfish program's stated objectives. The table in the executive summary is an effective addition to help readers identify the succinct claims about the effects of the program on each of its performance metrics, and the summary of data gaps at the end is useful in identifying what is not known. The SSC feels that its input into the work plan for this document contributed to the quality and accessibility of the analysis in this report, and **recommends SSC evaluation of program review work plans be standard practice.**

The review presents a persuasive picture that the rockfish program is achieving its most important goals in the trawl fishery, and that industry and the substantially engaged communities find the program to be working well. **The SSC recommends the rockfish program review be accepted**, excluding Chapter 18, subject to some minor revisions.

The major effect of the program on the catcher vessel (CV) sector has been to move from a three-week derby fishery in July to a longer, slower season with most harvest in May and June. This has allowed harvesters to land when there is slack processing capacity, and participate in salmon tendering in July. This has led to higher quality fish landings at shoreside processors in Kodiak. However, hopes that processors could increase margins with higher-value products have not been realized; global trends have instead seen Kodiak plants shift to less intensive, lower margin products to be exported for reprocessing Asia.

The CVs in the rockfish program have seen a dramatic decrease in halibut PSC. This change may be associated with an unrelated concurrent shift in the flatfish fishery, in which many of these vessels participate, to a semi-pelagic gear which is then used in targeting rockfish. Alternatively, it may be driven by the explicit allocation of high valued species like sablefish, rather than allowing capture as an MRA, implemented as part of the rockfish program. The SSC recommends further analysis, if understanding whether associating this effect with the rockfish program is desired. The Catcher-Processor (CP) sector has seen a smaller decrease in halibut PSC. Any conclusion about program effects on Chinook PSC is sensitive to the inclusion of a single basket-sample observation.

The analysis provides insight into the effectiveness of the program at achieving its clearly implicit objective of providing additional economic opportunities in the Gulf of Alaska, and in particular in Kodiak. This is achieved through the CV landing requirement in Kodiak, which supports the community through three mechanisms. First, earnings by Kodiak-based vessel owners, which constitute about half the fleet, spend much of their income in the Kodiak economy. Second, Kodiak-based crew, which recent data indicate are about half of all crew, spend much of their earnings in the Kodiak economy. Third, payments to Kodiak-based processing workers, which recent data suggest are over 90% to non-housed Kodiak residents, spend

much of their income in Kodiak. The SSC finds these recent snapshots evidence that this program is supporting people in the Kodiak community.

However, there is insufficient data to track whether the extent of the rockfish program's impact on the division of rents among fishery participants. Absent data on processing and harvesting costs, it is not possible to establish whether the program altered bargaining power between harvesters and processors. Bargaining power was a focus measure and the ability of vessels to change processors was a major difference between the current program and the Rockfish Pilot Program that preceded it. Similarly, there are no data to assess shifts in rents between vessel owners and hired crew, and in particular whether the rockfish program has led to changes in working conditions or the structure of the share system, in particular sharing the costs of QS leasing. Onshore, there are no data to establish whether the rockfish program has altered the share of wholesale value paid to labor, particularly as the rockfish program seems likely to have diminished July overtime payments, and a lower-margin, lower-skill product mix may have reduced labor's share of product value. The SSC recommends that, in advance of any review of the successor to this program, an approach to measure these important outcomes be developed.

Before finalizing the Program Review, the SSC recommends the following changes:

- The extremely useful table in the executive summary could be improved by clearly linking each statement to the section/table with the supporting analysis. This would also temper some results that are not well supported, or restate regulations.
- While better data are necessary to understand the division of rents between processors and harvesters, Table 10-1 tries to approximate this. However it is confounded by changes in product form and composition. A more useful figure would develop a constant basket of species-form products and track changes in it across time
- Bring forward key measures of community performance from the SIA Appendix into the main document, in particular information on how many vessel crew and processing workers are residents who spend money in Kodiak.
- Several additional types of information that would be useful should be added to the data gaps table. These include information on crew pay and conditions and processing overtime.
- The analysts did not estimate the gain in A80 groundfish catches from additional halibut rollover provided by the rockfish program. While any feasible calculation would be fraught with assumptions, the SSC requests the Council provide guidance on whether this measure is of interest.
- On page 124, the document states "The balance of power between the two groups should not swing too far in either direction to maintain ex-vessel prices that are fair for both parties." It is not clear whether the document is quoting the Council in this sentence. The SSC cautions that this is a normative statement that should be reserved for the Council, not analysts, to articulate.
- The document contains several speculative statements that should be rephrased in the absence of actual supporting data. For example, it is speculated that the decline in village participation in the rockfish fishery is due to high diesel prices. There may be many factors involved and we won't know the causal explanation without conducting focused research. Similarly, it is speculated (p. 127) that processing workers have reduced their reliance on unemployment relief programs. If this conclusion is based on data, those data should be referenced.
- The term "efficiency" is applied throughout the document, and it can be a loaded term. Analysts are encouraged to distinguish uses of economic and technical efficiency, and note that efficiency is only one component of the multi-objective problem fisheries management attempts to solve.
- The SSC also requests that the references to indigenous populations in the regional profiles of the three regions be removed or adjusted so as not to create the false impression of indigenous roots in the rockfish program.

With specific reference to the Social Impact Assessment (SIA) Appendix, the SSC appreciates that funds were located so that this assessment could be conducted following our request in April. However, funding was limited such that no fieldwork, survey work, or other systematic data collection could be conducted in a sample of the communities themselves except for phone calls to processor managers and some others involved in the fishery. The SSC thanks the analysts for willingly taking on these contacts for their important contribution to the process, and also knowing that the product will be less than optimal because of funding and time constraints.

The SIA follows a familiar methodology of quantitative assessments, community profiles, and order of magnitude impacts to those communities. As we have seen in previous SIAs, the analysis focuses on those fishery participants who are the "most substantially engaged in" and "most substantially dependent upon" the Rockfish Program and demonstrates the positive effects on fishery participants communities from the three main regions involved in the fishery, with special attention to Kodiak. This methodology is of concern because, by emphasizing the impacts on the substantially engaged, fishery participants from smaller communities, such as CV owners and crew, are largely hidden in the document and appear primarily as numbers shifting in tables. The SSC stresses that the connections between low levels of involvement and therefore low *dependency* are falsely drawn as even small numbers of vessels fishing and crew jobs are critical to communities with chronic unemployment. In this report, the loss of entry-level longline participation in ten small communities is documented (page 92) with inadequate explanation of whether this is linked to the rockfish program. The SSC encourages new methodologies be explored that better capture impacts on the diversity of engaged participants through a range of dependencies and vulnerabilities in future SIAs.

Fishery Allocation Review

Chapter 18 of the document presented a Fishery Allocation Review for rockfish. This is a new requirement, which generated significant productive discussion with the analyst and among the SSC. Ultimately, while the SSC views this process as straightforward for rockfish, it is also recognized that future required Allocation Reviews, such as that for halibut, will be more complex and will benefit from a clear and well thought-out process. Therefore, **the SSC recommends that the Allocation Review be severed from the Program Review pending further guidance from the Council, and revised for evaluation and acceptance at a later date.**

The SSC's discussion identified a need for clarity on the policy question that the Allocation Review is designed to address, and the standard for the analysis which the SSC is being asked to assess. First, the SSC is unsure of the scope of the review. It is not clear whether the Council's implicit policy alternative is a reallocation of QS among participants within the rockfish program (which would sensibly fall within the scope of the rockfish program review) or whether it is to reallocate GOA rockfish TACs across fisheries that use it, in this case including the rockfish program, the small longline fishery discussed in the program review, fisheries that have an IAC for rockfish bycatch, and the Amendment 80 fleet. Guidance on scope in NMFSPD 01-119-02 includes "Factors should be compared between groups for which an allocation decision is relevant," (p.5), but the SSC concluded arriving at an interpretation of "groups" was beyond the scope of its mission.

NMFSPD 01-119-02 also provides guidance on "factors" (e.g., target species and habitat impacts; fairness) to consider when evaluating an allocation to a group, but does not identify specific measures. Appropriate measures will depend partly on the scope of the review, and the implicit policy alternative. **The SSC recommends that the Council develop a standard baseline set of metrics to apply to all Allocation Reviews**. If the scope of the Review is within a particular allocation program, then content of quinquennial LAPP reviews would be a natural source for these measures. If the scope is to evaluate allocation of stock-specific TACs across these programs, and other user groups, then the SSC suggests a uniform set of measures to compare how different "identifiable user groups" use their allocation to provide net benefits to the nation. The SSC suggests consideration of measures of the size of the allocation; revenue from catching

the allocation; revenue from catching jointly harvested species; ecological fishing impacts (which may vary with gear impact or age-length profiles targeted; protected species impacts; participation (including the number of vessels, vessel owners, and US and foreign crew members supported); and community impacts in localities with substantial engagement or dependence.

C-9 Halibut Abundance-based PSC Limits

A discussion paper on halibut prohibited species catch (PSC) abundance-based management (ABM) was presented by an inter-agency workgroup with members Diana Stram (NPFMC), Jim Ianelli (AFSC), Allan Hicks (IPHC), and Sam Cunningham (NPFMC). Public testimony was given by Dan Falvey (ALFA), Mark Fina (US Seafoods), Heather McCarty (CBSFA), Steve Martell (Sea State), and John Gauvin (Alaska Seafood Cooperative).

The discussion paper provides a comprehensive overview of all relevant information presented to date that is pertinent to the development and analysis of ABM alternatives. The SSC commends the authors on doing an excellent job in putting this document together. Overall, the discussion paper meets many of the requests that the SSC made in the previous meetings, and will be very useful for formulating ABM alternatives in the future.

The document provides a full description of each abundance index that has been considered to date, and for each index, the description includes the segment of the halibut population it is meant to represent, a discussion of the characteristics of the index, a qualitative evaluation of the index, and a recommendation for or against using the index to form ABM alternatives. The analysts recommend that two indices be moved forward to serve as proxies for halibut abundance in a PSC control rule: the EBS trawl survey and the IPHC Area 4ABCDE setline survey. **The SSC believes that the document satisfactorily investigates all the indices considered to date and supports the recommendation that the EBS trawl survey and the IPHC Area 4ABCDE setline survey indexes be used to develop ABM alternatives.**

The document also provides a discussion of potential control rules for setting halibut PSC limits, including: sloping control rules, with possible floor, ceiling, and stair-step modifications; multi-dimensional control rules, which integrate several one-dimensional control rules (sloping and/or stair-step) by basing the PSC limit on the control rule that is most constraining; nonlinear control rules, which would allow PSC limits to be more or less responsive to halibut abundance over certain ranges; and control rules that would set several PSC limits, one for each groundfish sector (i.e., trawl and fixed gear). In addition, the document also includes: a discussion of other control rules currently in use for other PSC species (e.g., crab and herring), a draft of alternative elements and options for establishing ABM PSC management alternative sets for analysis, and an illustration of a sloping control using four strawmen draft ABM alternatives. The SSC finds the discussion of harvest control rules is improved over previous iterations of the discussion paper. However, **the SSC recommends that additional description and some simple modelling on control rules be conducted in a new summary paper before a set of alternatives is chosen by the Council.** The goal of the next iteration would be to narrow down the set of control rules for future consideration and to help the Council form a set of ABM alternatives using recommended features of a control rule. **For the next paper, the SSC recommends:**

- The document should describe desirable features of a control rule as it pertains to the Council's objectives for ABM. For example, if the goal is to protect spawning stock biomass at low levels, should the control rule have a floor or cliff? If the goal is to not unnecessarily constrain the groundfish fishery at high levels of halibut abundance, should the control rule have a ceiling?
- The document should provide a full description of the different types of control rules (e.g., linear, nonlinear, decision table, etc.) and potential modifications (e.g., ceiling, floor, cliff, breakpoints, etc.). For each type of control rule, the description should include a discussion of the characteristics and desirable features of the control rule, a preliminary analysis of the performance of the control rule, a qualitative evaluation of the control rule, and a recommendation for or against considering the control rule to form ABM alternatives. If a control rule is recommended for consideration, a

range of "parameter values" (e.g., starting point, breakpoints, etc.) and modifications should also be provided.

- Preliminary modelling of a control rule's performance could be conducted using the age-structured simulation model presented in Appendix B of the April 2017 discussion paper. Comparing control rules using historical data is useful to a degree, but it limits our understanding of how control rules work over the range of abundance indices observed in the past. In contrast, the simulation model can be used to evaluate how well a control meets Council objectives (e.g., PSC limit stability/variability, provision of a directed halibut fishery, protection of SSB when it's low, etc.) over a greater range of abundance index values and in response to environmental shocks, such as recruitment events. Further, the model can simulate forward the halibut population under different control rules, accounting for the age- and size- selectivities of the groundfish and directed halibut sectors. It will be important to include alternative configurations that result in a range of *outcomes* (regardless of the complexity in the specific elements included), such that there are contrasting results for examining the trade-offs among the potential final alternatives.
- The document should also explore separate control rules for each groundfish gear type (trawl and fixed) using both the EBS trawl and IPHC setline survey indices, since it might be the case that PSC limits for each gear type should be responsive to both indices, but in different ways.
- The document should also explore how the coastwide stock status could be entered directly into the control rule, perhaps as a threshold at low status that would trigger a discontinuity in the control rule.
- Evaluation of control rules should consider the more direct link between O26 bycatch and the directed halibut fishery, in addition to the aggregate relationship.
- If industry members have particular control rules in mind for consideration in ABM alternatives, they should provide examples of these control rules to the Council for evaluation in the document.
- If both indices are being used in the control rule, each index should be placed directly into the control rule, as opposed to combining them first through some sort of "combination" rule—for example, the multiplicative rule in Appendix 9.1. This would make it clearer how each index enters (and influences) the control rule.
- If PSC limits will be in terms of biomass, then the indices for halibut abundance should also be in biomass, as opposed to numbers.

The document also provides an extensive section on incentives in the document, as requested by the SSC in the June meeting. The discussion provides an excellent summary of how incentives have been used in other North Pacific bycatch management plans, the potential for using performance standards as part of the ABM program, and potential incentives created by an ABM program. While the SSC believes some of the discussion on incentives may overstate the effect of the groundfish fleet's influence on halibut abundance, in terms of their ability to game the abundance index, the SSC supports the general message from this section that incentives are important for the Council to consider when formulating alternatives.

The SSC has the following recommendations regarding incentives under an ABM program:

- Flexibility is important—the industry will know best how to reduce halibut mortality and can adjust and experiment with different fishing practices as external factors change over time. The Council should avoid placing unnecessary restrictions on fishing practices, as they could have unintended consequences. For example, a presentation on the deck sorting EFP highlighted that industry is still trying to figure out how deck sorting and halibut excluders interact. Thus, requiring halibut

excluders to be used at all times, for instance, could actually worsen halibut mortality in the groundfish trawl sector if excluders reduce halibut viability.

- If the Council wants to ensure halibut avoidance at all times, incentive measures must be in place to encourage halibut avoidance even in times when the PSC limit from the control rule is not binding. However, it may be premature to consider additional performance standards alongside a control rule at this time. The A80 sector currently has a Halibut Avoidance Plan that sets internal rate-based performance standards at the vessel level for each key groundfish target. The A80 sector presents this plan and their performance to the Council on an annual basis. This may provide enough incentive for the A80 sector to avoid halibut at all times. If it is found, perhaps during the preliminary analysis of control rules or after the first few years of the program, that the Halibut Avoidance Plan does not work as desired, additional incentive measures or performance standards could be considered at that time.

The SSC also has the following recommendations for moving forward with developing ABM alternatives:

- There is currently an underlying assumption that the allocation of the PSC limit between groundfish trawl sectors would remain the same. If this allocation were to change, this could affect industry impacts and behavior under certain control rules. If a change in allocation between sectors is being considered, the Council should make note of that so that future analysis of control rule alternatives can account for this.
- As highlighted in public testimony, and supported by the SSC, the control rule should be transparent, understandable, and as simple as possible.

D-1 Halibut Deck Sorting EFP and Halibut Genetic Sampling EFP

Halibut Deck Sorting EFP

This Exempted Fishing Permit (EFP) application was submitted by the Alaska Seafood Cooperative to examine the efficacy of decksorting halibut aboard non-pelagic trawl catcher/processors (Amendment 80, TLA, and CDQ vessels) to reduce incidental fishery mortality. It builds on, and refines methods developed during, research conducted under EFPs issued in 2009, 2012, and 2015-17. The permit application was developed in consultation with the Alaska region of NMFS and has also undergone additional agency review. The proposed work would begin in January of 2018 and continue through December of 2019. While prior permits have authorized decksorting activities only in the BSAI, this permit will expand efforts into the GOA.

In addition to the proposed geographic expansion, which will bring with it consistency in handling practices between regions, the 2017-19 permit application includes: 1) a directive to develop vessel-specific, NMFS-approved decksorting safety guidelines, in coordination with the captain and crew; 2) a maximum decksorting time of 35 minutes and a commitment to facilitate communication between the observers and crew, such that the most viable halibut are readily identified, processed, and returned to the water; 3) a requirement that all halibut follow a single pathway from the net to the observer, to promote orderly and efficient sampling; 4) a requirement for metal length strips, or engraved rulers, in all sampling chutes; and 5) a proposal to continue testing use of digital data collection devices to obtain length and weight measurements more quickly and efficiently.

In the 2015-17 EFPs, all halibut that entered the factory were collected after passing the in-factory observer and a complete census was conducted. Observer counts and census data could then be combined to determine haul-specific bycatch shortly after the completion of processing. In 2018-19 the permittee is no longer interested in collecting these data, but requests that interested captains still be allowed to do so as they have found this to be a valuable method for evaluating, and sometimes augmenting, fishing behavior

to avoid halibut in subsequent hauls. Other than several regulatory exemptions that are required to implement decksorting activities, the permittee plans to fish in accordance will all seasonal and geographic restrictions of the fisheries being sampled and no additional groundfish or halibut quota is requested as part of the permit. Halibut excluders may be used in addition to decksorting, but are not required.

The SSC recommends approval of this permit as submitted and recognizes that the operational research conducted here represents the next logical step toward eventual systematization of decksorting in various fishing sectors in the BSAI and GOA for which demonstrable savings of halibut can be realized.

Halibut Genetic Sampling EFP

This exempted fishing permit application from IPHC details an opportunistic sampling effort to augment the sample pool from a 2016 genetic study (Drinan, DP, HM Galindo, T Loher and L Hauser. 2016. Subtle genetic population structure in Pacific halibut *Hippoglossus stenolepis*. Journal of Fish Biology 89, 2571-2594) that found potential stock structure of Pacific halibut within the Aleutian Islands. This study found that samples from the western Aleutian Islands were genetically distinct from samples other regions in the North Pacific; however, the study lacked winter samples from the western Aleutians to support these results.

This application would allow a single vessel to collect biological samples from incidentally caught halibut during the winter A Season for Pacific cod in the western Aleutians. Biological sampling would be conducted by the crew, with the exception of a viability assessment conducted by a federal observer. IPHC will be coordinating with the NMFS Observer program to facilitate the sampling. An EFP was needed in order to allow for the crew to take the biological samples by exempting the vessel from the requirements to return all prohibited species to sea immediately.

AFSC found the application sufficient and valid for further consideration. **The SSC concurs and recommends the Council consider this EFP application from the IPHC.**