SCIENTIFIC AND STATISTICAL COMMITTEE
to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
October 5th – 7th, 2015

The SSC met from October 5th through 7th at the Hilton Hotel, Anchorage, AK.

Members present were:

Farron Wallace, Chair
NOAA Fisheries—AFSC

Robert Clark, Vice Chair
Alaska Department of Fish and Game

Chris Anderson
University of Washington

Jennifer Burns
University of Alaska Anchorage

Lew Coggins
U.S. Fish and Wildlife Service

Sherri Dressel
Alaska Department of Fish and Game

Kari Fenske
Washington Dept. of Fish and Wildlife

Brad Harris
Alaska Pacific University

Anne Hollowed
NOAA Fisheries—AFSC

George Hunt
University of Washington

Gordon Kruse
University of Alaska Fairbanks

Steve Martell
Intl. Pacific Halibut Commission

Franz Mueter
University of Alaska Fairbanks

Lew Queirolo
NOAA Fisheries—Alaska Region

Kate Reedy
Idaho State University Pocatello

Matt Reimer
University of Alaska Anchorage

Alison Whitman
Oregon Dept. of Fish and Wildlife

Members absent were:

Seth Macinko
University of Rhode Island

Terry Quinn
University of Alaska Fairbanks

General Comments

The SSC notes that the stock assessment review process has become extremely time constrained for both the Crab and Groundfish Plan Teams. The SSC recommends that this process be reviewed in an effort to allow more time for Plan Team preparation of their reports and have all documents intended for SSC review available two weeks prior to our meeting.

C-1 BSAI Crab SAFE and Harvest Specifications

Bob Foy (NMFS-AFSC), Jack Turnock (NMFS-AFSC), and Diana Stram (NPFMC) presented the Crab Plan Team (CPT) report and sections of the Crab SAFE. Public testimony was provided by Scott Goodman (Bering Sea Fisheries Research Foundation) and John Hilsinger (Aleutian King Crab Research Foundation).

The SSC reviewed the SAFE chapters and information provided by the CPT with respect to the stock status information from 2014/2015, relative to total catch in that time period (Table 1). The SSC notes that no stock was subject to overfishing in 2014/2015, and that Pribilof Islands blue king crab remains in an overfished status. In addition, Table 2 contains the SSC recommendations for 2015/2016 catch specifications.

Table 1. Stock status of BSAI crab stocks in relation to status determination criteria for 2014/15. 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 $B_{MSYproxy}$	2014/15 MMB[1]	2014/15 MMB / MMB_{MSY}	2014/15 OFL	2014/15 Total catch	Rebuilding Status
1	EBS snow crab	3	78.9	157.8	168.0	1.06	73.5	44.7	
2	BB red king crab	3	13.03	26.06	27.25	1.05	6.82	5.44	
3	EBS Tanner crab	3	13.40	26.80	71.57	2.67	31.48	9.16	
4	Pribilof Islands red king crab	4	2.87	5.74	8.89	1.55	1.36	0.001	
5	Pribilof Islands blue king crab	4	2.06	4.12	0.3	0.14	0.0016	0.00007	Overfished
6	St. Matthew Island blue king crab	4	1.86	3.72	2.48	0.67	0.43	0.15	
7	Norton Sound red king crab	4	0.93	1.86	2.27	1.22	0.26	0.16	
8	AI golden king crab	5					5.69	3.19	
9	Pribilof Islands golden king crab	5					0.09	Conf.	
10	Adak red king crab	5					0.054	0.001	

[1] MMB as estimated during this assessment for 2014/15 as of 2/15/2015.

Table 2. SSC recommendations for 2015/16 (stocks 1-6). Values for stocks 7, 8, 9, and 10 were set by the SSC in April and June 2015. Diagonal fill indicates parameters not applicable for that tier. Values are in thousand metric tons (kt).

Chapter	Stock	Tier	Status (a,b,c)	F_{OFL}	B_{MSY} or $B_{MSYproxy}$	Years[1] (biomass or catch)	2015/16[2] MMB	2015 MMB / MMB_{MSY}	γ	Mortality (M)	2015/16 OFL	2015/16 ABC	ABC Buffer
1	EBS snow crab	3	b	1.32	157.8	1979-current [recruitment]	147.2	0.93		0.23(females) 0.386 (imm) 0.2613 (mat males)	83.1	62.3	25%
2	BB red king crab	3	b	0.27	26.1	1984-current [recruitment]	24.69	0.95		0.18 default Estimated[3]	6.73	6.06	10%
3	EBS Tanner crab	3	a	0.58	26.8	1982-current [recruitment]	53.7	2.00		0.34 (females), 0.25 (mat males), 0.247 (imm males and females)	27.19	21.75	20%
4	Pribilof Islands red king crab	4	a	0.18	5.65	1991-current	13.7	2.42	1.0	0.18	2.12	1.59	25%
5	Pribilof Islands blue king crab	4	c	0.18	4.1	1980-1984 1990-1997	0.455	0.11	1.0	0.18	0.00116	0.00087	25%
6	St. Matthew Island blue king crab	4	b	0.18	3.72	1978-current	2.45	0.65	1.0	0.18	0.28	0.22	20%
7	Norton Sound red king crab	4	b	0.157	1.9	1980-current [model estimate]	1.68	0.88	1.0	0.18 0.68 (>123 mm)	0.21	0.19	10%
8	AI golden king crab	5				See intro chapter					5.69	4.26	25%
9	Pribilof Island golden king crab	5				See intro chapter					0.09	0.07	25%
10	Adak red king crab	5				1995/96–2007/08					0.05	0.03	40%

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

[2] MMB as projected for 2/15/2016 at time of mating.

[3] Additional mortality males, two periods: 1980-1985; 1968-1979 and 1986-2013. Females, three periods: 1980-1984; 1976-1979; 1985-1993 and 1968-1975; 1994-2013. See assessment mortality rates associated with these time periods.

Snow Crab
Last year, the SSC accepted the use of a new growth model with a differentiable transition for the current assessment but recommended that a non-parametric function for growth might be more suitable than the five-parameter growth model for each sex, suggested by the CIE reviewer. This year's snow crab assessment included six alternative models.

Model 0 is last year's model but with the standard deviation parameter of the growth function set to 0.5. Growth is modeled with two linear segments connected at a differentiable ("smooth") transition point. The fact that this year's Model 0 differed from last year's accepted model was problematic to the CPT and SSC. Although the change sounds simple, it is not clear that the resultant effect is minor. The SSC is concerned that the use of this model parameter could create bias, but no information was presented to allow such an evaluation. **The SSC requests that, as a matter of standard practice and as consistent with the Terms of Reference, last year's accepted model, updated with new data, as well as associated ABC/OFL specifications, should be routinely brought forward each year. Doing so allows evaluation of the consequences of updating the model with new data without the complication of any model structure changes. It also allows evaluation of the consequences of new alternative models being proposed.**

Model 1 makes the following three additional changes from Model 0: (1) the survey logistic curves were changed from estimating a size at 95% selected, to an offset from the size at 50% selected; (2) survey q for the first time period (1978–1981) was changed to a probit scale; and (3) the 2010 industry survey availability was changed to a probit scale. Model 2 is the same as Model 1 but with the constant maturation probability removed and an increased weight on smoothing point for the female probability of maturing. Model 3 is the same as Model 2, but the length at 50% selected for female discards was changed from 4.2 to 4.4 (log scale), and the likelihood weight for growth data was increased from 2.0 to 3.0. Model 4 was the same as Model 3 but further removed a penalty on directed fishing mortality estimates for male crab after 1991. Model 5 was the same as Model 4 but with the penalty on female fishing mortality estimates after 1991 removed and pot-lift data used to estimate pre-1992 fishing mortality for female discards.

Despite being a data-rich situation, the snow crab stock assessment is a difficult one owing to apparent data conflicts, limited time between completion of the survey and the CPT and Council meetings, and limited analytical personnel. Recent divergent observations of survey biomass, size composition, and other data create difficulties in modeling the dynamics of this crab stock. The 2014 survey results (higher crab biomass) contrast with survey results in 2013 and 2015 (lower crab biomass). Also, size composition data in 2010/2011 and increasing levels of discards relative to retained crab appear to suggest increasing recruitment. However, these observations on biomass and size composition can be affected by other factors, such as survey selectivity, changes in cold pool on q, and encounters with high crab density stations. Major changes in bottom temperature in recent years may confound these issues. **The SSC requests adding a table of commercial fishery CPUE to the annual stock assessment; considerations of fishery CPUE could be investigated to help reconcile data conflicts.**

Unfortunately, conflicting data challenges facing this stock assessment were compounded by the manner in which alternative models were presented and reported. While the SSC greatly appreciates the assessment authors' efforts to address all of the previous requests for alternative models, a big difficulty with this year's assessment is that alternative models are not adequately reported to allow evaluation by the CPT or SSC. In the future, when time is limited, it is more imperative to limit the number of alternative models to those that can be carefully documented, instead of attempting to address all requests with limited documentation. **The SSC recommends that the number of alternative snow crab models be brought forward with full documentation, and should be assessed annually, during the May CPT meeting.**

In this assessment, alternative models included multiple model changes, thus making it impossible to decipher the effects of any one change on model results. Model 1 makes three changes from Model 0, Model 2 includes three additional changes, Model 3 includes two more, whereas Models 4 and 5 include 1 change each. Difficulty understanding the model changes and their implications extended to members of the public, who also expressed serious concerns about transparency, and the level of documentation for proposed new models in this year's stock assessment. To be useful, each sequential change should be a stand-alone model, to allow the effects of individual changes to be evaluated individually. **Consistent with the Terms of Reference, the SSC strongly supports the CPT's recommendation for careful documentation of incremental effects of model changes on results. Information should be presented in such a way as to allow understandable comparisons among alternative models and outcomes, including factors that are important in determining model results.**

The CPT raised concerns about the six alternative models. For instance, they were concerned about large differences in results from Models 0 and 1, even though the model changes involved relatively minor re-parameterizations. The author later confirmed the Model 0 configuration was correct, but the Model 1 configuration incorrectly increased weighting of the trawl discard catch. A subsequent reconfigured Model 1 produced results similar to Model 0. In addition, the CPT expressed concerns that the results suggest that Model 0 converges to a local (not global) minimum, because the objective function was higher than that for the almost identical Model 1. Finally, the CPT also observed that the likelihood associated with the female growth smoothing parameter changed substantially among Models 1, 2, and 3. The Team discussed the poor model fit to female mature biomass (Fig. 62), but a solution is uncertain. **As a matter of standard practice, the SSC requests that a suite of alternative starting parameter values be employed to help assure that models converge to a global, not a local, minimum.**

The SSC struggled to relate the alternative models chosen to a chronology of specific requests for model changes by the CPT and SSC since last year's assessment. The snow crab SAFE chapter contained only an abbreviated version of the CPT's requests from their May 2015 meeting with an even briefer response. Extensive SSC comments on this assessment, reported in their October 2014 report, were not even mentioned. **Every stock assessment should include a chronological list of relevant requests by the CPT and SSC along with authors' response to each request, even if time did not yet allow them to be addressed.** The authors are referred to the Tanner crab assessment, which provides an excellent example of careful documentation of relevant CPT and SSC comments received since last year's assessment, along with specific responses to each comment.

Additional graphical results (e.g., residuals, retrospective plots) would have allowed a better evaluation of the relative contributions of various data and observations on model outcomes, as well as assisted in model selection using more objective quantitative methods. The SSC appreciates graphs showing differences among models with respect to likelihood values (Tables 13 and 14), growth (Fig. 54d,e), female biomass (Fig. 63), male biomass (Fig. 65), male biomass at mating (Fig. 86), full selection fishing mortality (Fig. 107), and male discard estimates (Fig. 108). However, available information made it difficult to decipher the effects of individual model changes on goodness-of-fit to data. For instance, plots of residual patterns for model and survey biomass would be helpful for mature females (Fig. 62) and mature males (Fig. 64), just as was done for population total mature biomass (Fig. 3 and 4). **The SSC requests the reporting of additional model diagnostics, such as plots of retrospective patterns, plots of residuals from alternative model fits to survey biomass, and the like, as typically reported in other assessments.**

Lacking model diagnostics, residuals, and retrospective plots, model selection becomes somewhat arbitrary. The assessment authors' preference for model 5 was based largely on a desire to remove the penalty on fishing mortality estimates, as implied from findings of a separate modeling study. The implied assumption is that the mortality penalty causes biases in the other models. However, no residual plots are presented, and statistical criteria did not form the basis for model choice.

It appeared to the SSC that trends in survey data seem to provide little influence on model biomass. Fundamentally, the survey results *should* be the primary dataset driving model results. This leads to the question about appropriate data weighting in the model. Size composition can be affected by chance encounters with aggregations of crab of certain sizes, differences in survey selectivity that vary with bottom type, temperature that regulates crab distribution, and other factors. **Therefore, the SSC requests a sensitivity analysis to determine the effect of down-weighting size composition data.** An upcoming data-weighting workshop may provide some guidance about data weighting for this stock assessment.

This assessment includes the notion that survey q must be less than one. Survey q need not be taken to be the proportion of crab caught in the path of the trawl. Such an interpretation implies that we actually know the size of that area. Rather, it can be taken to mean the area swept compared to the whole area over which crab are distributed. **In any case, the SSC requests that a model be brought forward in which q is free and not bound by an upper limit of one.** If the model cannot fit the survey results owing to an assumption about q, then it is necessary to revisit these assumptions or develop an informative prior.

The SSC appreciates the list of data gaps and research needs. **The SSC recommends that new studies on female growth should be a high research priority to better define the relationship between growth increment and pre-molt carapace width (e.g., Fig. 54d). The lack of data near the transition point in the growth curve and the clumped nature of the available data limit clear specification of the transition point with unknown consequences on the stock assessment.** This relationship appears to be better defined for males (e.g., Fig. 54e). There was much discussion about the shape of the female growth curves and potential effects on model results.

Given numerous unresolved concerns with available model runs, the CPT recommended adoption of Model 0, which is closest to the 2014 model configuration. The SSC struggled to select a model among the choices provided, for reasons already stated. It was not possible to evaluate potential model improvements represented in Models 1-5, and the SSC struggled with Model 0 because it is not last year's accepted model, the impacts of changes to the growth function were not evaluated, and concern that the model did not converge to a global minimum. However, the SSC determined that there were no better options as alternative models yielded similar biomass trends, and, regardless of model choice, the stock is not overfished and overfishing did not occur in 2014/15. **For these reasons, the SSC agreed with the CPT to accept Model 0.**

Moreover, for this assessment, the SSC supports the CPT's recommended 25% buffer for fishery management. Previously, the buffer was 10%. Reasons to increase the buffer to 25% this year include considerable uncertainty in the current assessment owing to data conflicts (e.g., 2014 vs. 2015 and 2013 and earlier biomass, size compositions), considerable model uncertainty, large uncertainty in the choice of best model, concerns about model convergence, and lack of clarity about what factors determine model results. The 25% buffer value was developed by the CPT based on consideration of buffers used for other species with similar levels of uncertainty. For these reasons, the SSC agrees that the current assessment is very uncertain. **Acceptance of Model 0 with a 25% buffer lead to ABC and OFL specification reported in Table 2.**

Finally, the SSC strongly endorses the CPT request to review a thorough documentation of alternative snow crab models at the crab workshop and CPT meeting in January 2016. The hope is that additional model documentation will lead to improved confidence, such that uncertainty can be reduced again to levels commensurate with Tier 3 crab stocks.

Bristol Bay Red King Crab

In 2015, the author updated the assessment with the new NMFS bottom trawl survey time series, including the 2015 data, and updated the catch time series. In response to a request from the SSC and the CPT in 2014 to explore temperature effects on survey q, the author brought forward two new models. The author did not have time to address many of the CPT and SSC requests and the author indicated that these will be addressed in the future.

The SSC appreciates the author's work on temperature effects on survey q. The analysis shows a weak positive relationship between survey q and temperature. The SSC agrees with the CPT that incorporation of the relationship does not have a significant effect on model performance and recommends using Model 1 as the basis for estimation of the 2015/16 biological reference points. **Based on the results of Model 1 with a 10% buffer, the SSC recommends the following: the stock is managed in Tier 3a and the ABC and OFL specifications are reported in Table 2.** The stock is not overfished and overfishing did not occur in 2014/15.

The SSC reiterates its previous concern that improvement in model fit by increasing M is not a sufficient condition for accepting Model 1. The SSC restates its previous recommendation that the author should test the hypothesis that natural mortality varies annually due to environmental change by running a model with a random walk on M and then statistically evaluating relationships between time trends in estimated M relative to plausible mechanisms influencing M. We agree that this model should not be used for setting biological reference points; however, it may provide useful information on the appropriate time stanzas for time varying M. Mechanistic explanations for the resulting time stanzas could then be explored.

The SSC agrees with the CPT that the author should explore a model that incorporates the 2013 through 2015 side-by-side BSFRF data.

Tanner Crab

The directed fishery for Tanner crab was reopened in 2013/14 for the first time since 2009/10, after a new stock assessment model (TCSAM) was accepted in 2012 for harvest specifications. Based on the new model, the stock was placed in Tier 3 and was declared rebuilt. The structure of the models approved by the CPT and SSC has largely remained the same for several years and the assessment has focused on exploring the effects of changes to the input data. Historical data have been re-analyzed and updated in recent years, but effects of these updates on model results have been relatively minor. At the same time, an alternative version of the model that implements a new parameterization of fishing mortality has been developed for comparison with the new Generic Model for Alaska Crab Stocks (Gmacs) model, which is scheduled to be presented as an alternative to the current model during the next assessment cycle.

The SSC commends the author for his clear exposition of model explorations and detailed responses to previous CPT and SSC comments. Not all of these have been addressed, as many are awaiting development of the new Gmacs model, and the SSC appreciates that these earlier comments are being carried forward in the assessment.

For this year's assessment, revised historical time series were incorporated into the model and new 2014/15 data were added to the time series. The CPT-recommended model uses the newly standardized dataset for crab, from the NMFS EBS trawl survey (1975 through 2015), along with a standardized weight-at-size regression applied to all previous survey years. The 2013/14 fishery data used in the 2014 assessment were modified to correct an error, and the model was updated with retained catch, bycatch, and size composition data from the 2014/15 crab fisheries, as well as data on Tanner crab PSC in the groundfish fisheries in 2014/15.

The author systematically explored incremental changes to the input data and model structure. First, impacts of iterative changes to input data on results from last year's model were explored. The results suggest that, in spite of substantial changes to the input data, biomass and recruitment estimates are relatively consistent over different combinations of survey time series and size-to-weight conversions. The newly standardized time series and weight-size regression (Dataset 6) represent use of the best available data and were used in all further models.

Second, eight different model configurations were explored, essentially representing a factorial design that focuses on the following three sets of comparisons:

1) What is the effect of different ways of implementing fishing mortalities? Models implementing the 2013 TCSAM fishing mortality were compared to models using a new parameterization of fishing mortality as implemented in Gmacs.

(2) What is the effect of assuming normal versus log-normal likelihoods for fishery catches? and

(3) Are large crab in the model fully selected? This was explored by setting the logistic selectivity to 1 for the largest size bin.

Model selections were based on comparing the negative log-likelihood among models. None of the four models that assumed full selection of large crab converged, and were eliminated from further consideration. However, the SSC notes that models E and F (fixing selectivity at 1 in the largest size bin) achieved a fit almost as good as the corresponding models A and B, respectively, based on the negative log-likelihood. This fit was presumably achieved with fewer parameters, as asymptotic selectivity was fixed in the model. Nevertheless, the convergence issues suggest that the model has trouble accommodating this selectivity pattern, possibly due to differences in selectivity between males and females. Furthermore, it resulted in model fits with somewhat unrealistic shapes (e.g., Fig. 31).

Among the remaining models, those with log-normal likelihoods for the fishery catches (B, D) were eliminated from consideration because they poorly fit the discard mortality time series. Finally, the fit of model A (last year's model) had a considerably lower negative log-likelihood than that of model C (Gmacs fishing mortality). Although the SSC had some concerns about the model comparisons, as detailed below, **we agree with the author and CPT to use Model A with dataset D for harvest specifications.** The SSC also agrees with several other decision points, including (1) the time period to use for recruitment in projections (1982 to present, as before); (2) using logistic selectivity that increases steeply at 5 inches, which is the assumed 'retained catch selectivity', to address recent changes in legal size limits; and (3) **the use of a 20% buffer for the reasons outlined by the CPT**, namely that the same buffer was used in 2014, the model is essentially the same, and the same uncertainties remain.

The OFL for this stock is based on the Tier 3 control rule and the stock is currently in Tier 3*a* because the estimated biomass is well above the B_{MSY} proxy. The stock was not overfished and overfishing did not occur in the past year (Table 1). Applying a 20% buffer and updating projections to reflect changes to the final snow crab model, as adopted by the SSC at this meeting, results in the OFL and ABC for 2015/16 as summarized in Table 2.

Other recommendations and ongoing issues include the following:

- The SSC endorses all of the CPT recommendations with respect to poor fits to some of the retained catch time series, poor fits to the size composition data for retained catch and survey data, and issues with the total directed fishery selectivity curve for males (in particular the 1996 'outlier').
- The SSC also concurs with the CPT recommendation to move forward with model C, implementing the new Gmacs fishing mortalities. The SSC was unable to fully compare models, as the summary tables in the assessment did not include the number of model parameters for evaluating differences in likelihoods. The negative log-likelihood is expected to decrease for more complex models. The description provided suggests that model C includes additional parameters compared to model A, yet had a higher negative log-likelihood, contrary to expectations.
- The SSC would have liked to have seen residual diagnostic plots for models assuming a log-normal likelihood (B and D) to assess more fully the rationale for not further considering these models.
- There are continuing concerns about the most appropriate weights to use for different data components (CVs, effective N, etc.), and the SSC looks forward to recommendations from the data-weighting workshop.

- Strong residual patterns in numbers at size remain a concern and suggest model mis-specification with respect to growth. In response to earlier comments, the author suggests that time-varying growth can be explored in the future with the new Gmacs model. In addition, we note that the growth model assumes a linear increase in growth increments with pre-molt size. However, the available data for GOA Tanner crab suggest a possible inflection point in growth (Fig. 25). If there is, indeed, an inflection point, the current model would tend to overestimate growth of larger crab, particularly if growth is extrapolated beyond the range of available data, which could, in part, account for the residual patterns. Growth data for Tanner crab specific to the EBS were collected in 2015, and the SSC looks forward to results from an analysis of these new data.
- The model, for some time, has included a much higher natural mortality rate over a period of five years in the early 1980s, to account for unexplained declines in biomass. The period with elevated M differs between male (1981-85) and female crab (1980-84). If increased mortality is due to predation on certain size classes, faster-growing males should be affected before females, but in the model, the increase in M occurs one year <u>later</u> for males. A mechanistic rationale for increased M during this period, and for differences in the timing between males and females, is still lacking and we encourage the author to evaluate the evidence for changes in M more objectively by allowing for time-varying M in the model.
- The model overestimates female bycatch mortality in the snow crab fishery (Fig. 64). The SSC recommends exploring the basis for this, such as mis-specification in M or, perhaps, the penalty weighting factor for female M in the model.

We note the following minor points:

- The text and table on p. 22 should clarify whether the 20% CV is implemented identically for normal and log-normal likelihoods or if the CVs (on the un-transformed scale) differ between these models.
- The table on page 13 includes an obviously incorrect coefficient for the weight-length regression for immature females.
- Several of the in-text tables (p. 21, 22) had formatting issues.
- In Figure 31, the title on the middle panel is incorrect (it should read 1987, instead of 1977).

Pribilof Islands Red King Crab

The fishery for Pribilof Islands red king crab (PIRKC) has been closed since 1999, due to uncertainty in estimated red king crab abundance and concerns for bycatch mortality of blue king crab. Fishing mortality is limited to incidental catches in the directed crab fisheries and PSC in groundfish fisheries. Recent catches range from 0.00106 thousand t to 0.0131 thousand t (0.002 to 0.029 million pounds; 2010/2011 through 2014/2015) and are well below the annual OFL/ABCs. The stock was above the MSST in 2015/2016 and is not overfished. Overfishing did not occur in the 2014/2015 year.

Two alternative assessment modeling methods were presented this year. The status quo method calculated MMB as a three-year running average, weighted by the inverse of the variance. The alternative method was a further investigation of the length-based integrated assessment model first presented in 2014. The SSC appreciates the responsiveness of the author to SSC suggestions. Model scenarios of the length-based integrated assessment included fitting male and female abundance and computing OFLs using the Tier 3 and 4 control rules, and fitting males only and computing OFLs using the Tier 3 and 4 control rules. Additional exploratory model configurations included a scenario with variable survey catchability for the males only, and a scenario with reduced survey abundance CVs in the 1990s, to force the model to fit the higher abundances. For this year, fishery selectivity was borrowed from Bristol Bay red king crab, rather than using knife-edge selectivity and incorporated a discard mortality of 20%. The author conducted simulations and determined that 5-mm length bins were appropriate for use in the integrated assessment. Growth was estimated using length frequency data outside the model. Female growth appeared very similar to the Bristol Bay red king crab stock, while males were somewhat different than in Bristol Bay.

Both the integrated assessment model with male and female data and the male-only model fit the length frequency data, but the fit of both models to the survey abundance estimates continues to be poor. A scenario of the integrated assessment model was presented that decreased the CVs during the 1990s, when the survey catches were high. While this resulted in improved fits to survey abundances in the 1990s, the fit remained poor in subsequent years. A scenario of the integrated assessment model was investigated with a variable catchability q. While this model produced good fits to the survey data, the author found little to no relationship between q and bottom temperatures or sea surface temperatures. A model scenario that excluded low abundance data from the 1970s and 1980s did not improve the fits to the data starting in the 1990s.

The SSC supports the CPT's recommendations to use the three-year inverse-variance running average assessment method for estimating MMB and continuing with Tier 4 harvest control rules. This results in an OFL and ABC as specified in Table 2. The B/B_{MSY} ratio is >1, placing PIRKC in Tier 4a.

The SSC further recommends reduction in the maximum permissible ABC by adopting a buffer of 25% to address the large uncertainties associated with the survey biomass point estimates.

The SSC supports the CPT recommendations to continue work on the integrated assessment, continue calculation of the three-year inverse-variance running average assessment, and to investigate the random effects model for PIRKC. Regarding the integrated assessment, the SSC supports the CPT recommendation to investigate a scenario down-weighting the length frequency data, and a scenario that applies uniform weighting across all years (i.e., either a constant CV or a constant standard error).

The CPT noted that highly varying survey estimates could result from a low density population combined with aggregation behavior of red king crab. Alternatively, it may be that a variable portion of the stock is unavailable to the survey. To elucidate this, the SSC reiterates its previous recommendation that the author evaluate ADF&G pot survey data and retained catch size-frequency data.

Pribilof Islands Blue King Crab

The Pribilof Islands blue king crab (PIBKC) fishery began in 1973 and has been closed, with no retained catches, since 1998/99. The PIBKC stock was declared overfished in 2002, and a rebuilding plan was implemented in 2003. The rebuilding plan closed directed PIBKC fishing until the stock was rebuilt. In 2009, NMFS determined the stock would not meet its 10-yr rebuilding horizon. Subsequently, Amendment 43 to the King and Tanner Crab FMP, and Amendment 103 to the BSAI Groundfish FMP, were approved by the Secretary of Commerce in January 2015. This action, a revised rebuilding plan, closed the Pribilof Island Habitat Conservation Zone to Pacific cod pot fishing, which accounts for the highest recent rates of PSC of this stock. This area was already closed to groundfish trawl fishing. PSC and discards have been steady or decreasing in recent years, with total catch mortality in 2014/15 of 0.07t.

Two methods for calculating MMB were presented in this year's assessment. As in the 2014 assessment, MMB was estimated using the NMFS trawl survey data with a three-year running average, centered on the current year and weighted by the inverse of its variance (IV method). An alternative approach was presented in which a random effects model was used to smooth the survey time series, project MMB, and calculate B_{MSY} (random effects method). The random effects method resulted in a B_{MSY} 25% higher than the IV method. The random effects method predicts higher estimates of MMB during the 1980s, because the smoothed time series incorporates process error, rather than being as strongly influenced by low estimates with smaller variances as in the IV method. However, the two methods yield very similar MMB and OFL values in this assessment owing to nearly identical results based on recent survey years. **The SSC supports the CPT's recommendation to use the random effects method to smooth the MMB time series, because it is more robust to inter-annual variation than the IV method.** The projected MMB increased from 0.34 kt in 2014/15 to 0.46 kt in 2015/16 and remains well below the minimum stock size threshold. The SSC noted that, while the projected 2015/16 MMB increased, there are a very limited number of crab observations to support population extrapolations.

The SSC supports the CPT's and authors' recommendations for management of Pribilof Islands blue king crab under Tier 4c. The SSC recommends basing the OFL on a modified Tier 5 calculation of average bycatch mortalities between 1999/2000 and 2005/2006 to reflect the conservation concerns with this stock and to acknowledge the existing non-directed bycatch/PSC mortality (Table 2). Similarly, the SSC supports using a 25% buffer for the ABC calculation. The Pribilof Islands blue king crab stock is overfished; however, overfishing did not occur during the 2014/15 season.

The MSY stock size (B_{MSY}) is based on mature male biomass at the time of mating (MMB_{mating}), which serves as an approximation for egg production. For 2015/16, $B_{MSYproxy}$ = 4.109 kt of MMB_{mating} derived as the mean MMB_{mating} from 1980/81 – 1984/85 and 1990/91 – 1997/98. Compared to other BSAI crab stocks, the uncertainty associated with the biomass estimates for Pribilof Islands blue king crab is very high due to insufficient data and the restricted distribution of the stock relative to the survey sampling density. As a result, the stock demonstrated highly variable levels of MMB during both of these time periods, likely leading to uncertain approximation of B_{MSY}.

Saint Matthew Island Blue King Crab

Authorship of the Saint Matthew's Island Blue King Crab (SMBKC) assessment changed in 2014. A three-stage catch-survey analysis is used to assess the male crab greater than or equal to 90 mm carapace length. The author incorporated the new bottom trawl time series updated to include the 2015 biomass estimates. In this assessment cycle, the author responded to CPT requests by bringing forward 20 models for review. These models addressed a broad suite of technical issues including estimation of effective sample sizes, estimation of molting probabilities, estimation of selectivity, and treatment of trawl hotspots at station R24. In addition, the author considered alternative time blocks for estimation of selected parameters. The SSC commends the author on his ambitious review of a variety of model configurations.

The SSC reviewed the suite of candidate models. As noted by the CPT, models 2-7 and 9 down weighted the pot survey relative to the NMFS trawl survey. The SSC agrees with the CPT that the pot survey continues to be an important source of information for this stock, particularly given the uncertainty in trawl survey estimates. Therefore, the SSC focused their attention on Models T, 0, 00, 1, 10 (with sub-options), and 11. The CPT recommended going forward with Model 1.

Relative to last year's accepted model, Model 1 incorporated the following changes introduced in Model 0, 00:

1. Model 0 revised the methods for estimation of effective sample size, used the robust normal approximation for estimation of the length composition likelihood, converted weights to CVs for catch and discard biomass, and revised the mean weight used for legal males.
2. Model 00 added a reduction in the weight for the penalty on groundfish bycatch from 1 to 0.01.
3. Model 1 added a change to the CVs for pot fishery discard biomass before and after 2005 and changed the effective sample sizes for pot length frequencies before and after 2005.

The SSC notes that the transition from Model T to Model 0 and the transition from Model 00 to Model 1 incorporated more than one model change. In the future, the SSC requests that model changes be brought forward incrementally; a process that would be consistent with the CPT and SSC model change guidance to authors. These proposed incremental changes can be evaluated best during the spring assessment cycle.

In general, the SSC agrees with the CPT's rationale for delaying implementation of models 2 – 11 at this time. The SSC expects that further guidance regarding data-weighting may emerge from the upcoming Center for the Advancement of Population Assessment Methodology (CAPAM) data-weighting workshop.

The SSC encourages continued work on issues of estimating strata means for strata that include land masses. We recognize that this is a larger issue that would impact more stocks than just SMBKC. A general approach to the treatment of stations where land masses occupy a large fraction of the survey block is needed. The SSC recommends that general methods to address this issue be brought forward in 2016. In addition, the SSC encourages the author to examine the role of flow through Sarychev Strait as a possible contributor to the persistent high density of blue crab in the vicinity of station R24.

While additional work is needed on the treatment of survey hot-spots and data-weighting (especially with respect to the pot survey), the SSC agrees that results from Model 1 can be used in this year's assessment cycle. We note that, relative to the previously approved model configuration (Model T), Model 1 produced higher estimates of OFL, ABC, and F_{OFL}.

The SSC agrees that the data available for this stock place the stock in Tier 4b and recommends that the 2015/16 ABC be set with a 20% buffer on the OFL. Based on information derived from Model 1 for the reference period 1978 through 2015, the OFL and ABC are as specified in Table 2.

Norton Sound Red King Crab
The SSC reviewed a progress report on the Norton Sound Red King Crab assessment and associated research. The annual process start date has been changed to February 1, where the CPT would establish proposed ABC/OFL estimates in their January meeting, and the SSC and Council would review the documents in their February meeting. There were no new model requests from the CPT in May 2015 and none from the SSC in June 2015.

The SSC reiterates its concern that the mortality parameter used for the last length class is viewed as biologically implausible. The SSC appreciates the State's efforts to explore the mechanisms underlying the observed rapid decline in the largest size class. In particular, the report on tagging studies should be useful in interpreting whether these large losses of older crab were due to movement out of the district or some unknown source of mortality. The SSC also appreciates receiving an update on observed molting probabilities. The SSC encourages efforts in the future to incorporate this new information into the assessment.

The CPT requested that the assessment author present additional information to better understand the iterative re-weighting process for setting the effective sample size for length-frequency data. The SSC supports the CPT's recommendations of exploring iterative re-weighting procedures after the CAPAM data-weighting workshop in late October 2015. **The SSC also recommends that the author follows the terms of reference and provide retrospective estimates of spawning stock biomass and the appropriate statistics (e.g., Mohns' rho).**

Pribilof Island Golden King Crab
In June 2015, the SSC concurred with the CPT recommendation that this stock continue to be managed under Tier 5 in 2016; and the CPT's and the author's recommended status quo OFL and ABC as specified in Table 2.

The author applied the random effects model to the available slope survey area-swept biomass estimates of golden king crab in the Pribilof Islands area. The CPT reviewed plots of estimated and projected total biomass, mature male biomass, and legal male biomass for the entire district and for specific combinations of survey subareas. The CPT noted that more survey data are required, and that ancillary information on mature and legal biomass from the surveys (size/sex measurements) is only available for the last 3 surveys. The random effects model was unable to estimate a process error term when only 3 years of data were used. The CPT recommended that the random effects model be re-evaluated after results from the 2016 slope survey are available. **The SSC concurs with the CPT's recommendation.**

Other Items
January CPT meeting and modeling workshop
The SSC endorses the agenda items for the Crab Modeling workshop, scheduled for January 14-15, 2016 in Anchorage. This workshop will focus on applying the Generic Model for Alaska Crab Stocks (Gmacs) to Bristol Bay red king crab and St. Matthews blue king crab. Pending resolution to the resources available for AIGKC assessments**, the SSC recommends that the AIGKC be brought forward to the January CPT meeting for evaluation. The SSC looks forward to reviewing this assessment at the February 2016 Council meeting.**

Economic SAFE

The SSC appreciates the brief preview of the economic SAFE, to be given in more detail in February. The SSC highlights the following trends for additional consideration then:

- Given global sanctions against Russia, and generally improving economic conditions through 2014, to what is the decline in prices (10-15% for king crab, 5% for snow crab) attributable?
- Crew positions went up by about 10%, on about 10% fewer vessels. Are there changes in crew sourcing and composition underlying labor demand?
- Active plants decreased from 12 to 9 (25%). Are there geographic or community patterns that reflect changes in how the fishery is supporting Alaska communities?
- Payments to plant workers are 45% lower than in 2012 (on a 29% drop in landings). Is this trend observed within the still-active plants, and are there changes in labor sourcing that would have important community effects?

C-2 Groundfish Plan Team Report and Harvest Specifications

The SSC received a series of presentations from Grant Thompson (NMFS-AFSC), Jim Armstrong (NPFMC), and Jon Heifetz (NMFS-AFSC) that included all items from the September 2015 Joint, BSAI, and GOA Groundfish Plan Team (GPT) meetings. Public testimony was received from Chad See and Gerry Merrigan (Freezer Longline Coalition); Heather McCarty, Jeff Kaufman, and Mateo Paz-Soldan (Bering Sea Fisherman's Association and City of Saint Paul); and Julie Bonney (Alaska Groundfish Data Bank).

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

Halibut DMR

The SSC agrees with GPT's recommendations that long-term (ten year) averages be used in 2013 while methods are identified for future DMR estimation.

EBS pollock stock structure

The SSC reviewed a document evaluating the stock structure of EBS walleye pollock relative to current assessment and management boundaries. The SSC appreciates the thorough review of any genetic or other biological information relevant to the spatial population structure of walleye pollock at a scale that may differ from current stock definitions. The document provides some evidence for substantial connectivity among populations at a broader spatial scale than current management areas, such as synchronicity in recruitment. In contrast, there is little to no evidence for finer-scale spatial structure. **The SSC agrees with the Plan Team and the author that there is "little or no concern" regarding EBS walleye pollock stock structure.**

Pacific Cod

Eastern Bering Sea

Based on recommendations by the Joint Team Subcommittee on Pacific cod models, the author explored a number of alternative models that fall into the following three groups: (1) last year's model with relatively minor variants (Models 0,7, and 8); (2) last year's model 2 and two minor variants (2,3,4); and (3) a new model 5, which is a variant of model 2 that explores a number of features deemed important by the author, as well as a minor variant (6) that addresses an issue with model 5 regarding unacceptable large gradients.

The models resulted in a wide range of spawning biomass and depletion estimates, primarily resulting from differences in the treatment of survey catchability (q fixed vs. estimated). Models that estimate catchability generally produce substantially lower biomass estimates (higher q). Based on retrospective behavior, fits to the survey data, and gradient vectors, models 2-4 and 6-7 had the best performance.
The author raised five issues for consideration by the GPT and the SSC.

(1) Weighting of composition data. A variety of weighting schemes have been examined by the author. The SSC had no specific recommendation but notes that tuning mean input sample sizes to the harmonic mean of output sample sizes has the advantage of being an accepted practice for the Pacific Council.

(2) Survey catchability and selectivity. The SSC has been on record encouraging the development of an alternative model that estimates q, due to the very weak or non-existent evidence for net avoidance, which has been corroborated by recent work. This makes the fixed value for q, which was always based on weak evidence, even less tenable than before. Therefore, the SSC agrees with the GPT that the author should bring forward one of the model alternatives that estimate q (models 2-6) in December. A related issue is the treatment of survey and fishery selectivity, which displays a pronounced peak and, in one case, two peaks (at intermediate and at the largest size). This pattern implies that the survey detects far fewer large cod than are present in the population. The SSC suggests that at the time of the survey, some of these "missing cod" may be in the northern Bering Sea (NBS) outside the standard survey area. Pacific cod likely undertake seasonal feeding migrations into the NBS each summer. A simple analysis of the 2010 NBS survey would allow an assessment of the proportion of Pacific cod in the NBS and their size composition relative to Pacific cod sampled in the survey area.

(3) Temporal variability in survey selectivity. The SSC concurs with the GPT to allow selectivity in the model to vary "as little as needed". We have no additional recommendations on the issue at this point.

(4) Large gradients in estimated parameter solutions. The SSC had no comment but agrees with the GPT to eliminate model 5 from consideration in this assessment cycle.

(5) Review procedure. As for the annual review of Pacific cod models by the subcommittee, the SSC defers to the GPT, but we recommend leaving the review in place for the coming assessment cycle in the interest of vetting models to balance exploratory analyses and the development of viable assessment models. In regard to the CIE review, the GPT discussed whether to limit models for this assessment cycle to model 0 and its variants pending a more thorough review by the CIE. The SSC agrees with the GPT to not limit our options for December to models that fix catchability.

Based on consideration of the above issues, in particular concerns about catchability and selectivity, the SSC concurs with the GPT request to bring forward model 0 (last year's model) and model 2 for harvest specification in December.

Aleutian Islands

The preliminary assessment for Aleutian Islands Pacific cod focused on the base model, which is the random effects model used last year, and several alternative age-structured models. The age-structured models are adaptations of those used in the EBS, and similar issues arose in fitting the models. All of these models estimate a biomass that is much higher than survey biomass. The GPT did not consider any of the age-structured model versions credible but encouraged further development of an age-structured model for the GPT. **The SSC concurs with this recommendation and with the GPT request to bring forward the random effects model (model 0), a variant of model 0 that includes IPHC longline survey CPUE as a second index, and one of the age-structured models (model 3) with additional constraints on survey selectivity.**

<u>Gulf of Alaska</u>
Preliminary models for Pacific cod in the Gulf of Alaska included four alternative model structures, including last year's model (model 0) and the final model from 2011 (model 2). Two variants on last year's model were developed to address the treatment of age-1 fish in the model and the use of 1984 and 1987 survey data (models 3, 4). **The SSC concurs with the Team'sGPT's recommendation to bring forward models 0 and 4 in December.** In addition, the SSC encourages a step-by-step exploration of the impact of the 1984 and 1987 data on model performance. If there is not enough time to complete these analyses by December, and considering the upcoming change in assessment authors, this issue could be addressed in the next assessment cycle. Uncertainties or potential biases in the 1987 age data could also be explored by working with the aging group or through a review of previous work on this issue.

Sablefish
The SSC reviewed the GPT report for BSAI and GOA sablefish. The report summarized GPT discussions regarding results of the 2015 longline survey in the BSAI, whale depredation, and ongoing work on spatially explicit reference points. The SSC notes that the area apportionment has been fixed since 2013. While the SSC agrees that apportionment can remain fixed for one more year, we request that the author place a high priority on updating the apportionment in 2016. We recognize that sablefish will undergo a CIE review in 2016, and the spatially explicit area apportionment model will be reviewed as part of that process.

BSAI and GOA Rockfish
<u>BSAI Blackspotted and rougheye rockfish stock structure</u>
The BSAI blackspotted/rougheye rockfish complex is assessed by an age-structured model for the Aleutian Islands and Tier 5 methods applied to survey biomass estimates for the eastern Bering Sea. Data on catch and discards are collected by observers. This complex is taken in fisheries, such as rockfish (POP) trawl, Atka mackerel trawl, and Pacific cod (longline).

Since 2013, the BSAI GPT has expressed a "strong concern" about the conservation of this rockfish complex in the WAI area, and provided seven reasons for this concern. In December 2013, the SSC agreed with the GPT's concern about the WAI component of the stock and asked for an update in the next stock assessment. An updated analysis of these concerns was presented in the 2014 SAFE. Analyses of exploitation rates were further updated recently by Spencer (2015) in a report titled *"Updated spatial analysis of BSAI blackspotted/rougheye rockfish exploitation rates."* The GPT again reiterated their strong concerns about this rockfish complex at their September 2015 meeting.

The basis for these concerns can be summarized as follows. In most recent years, the WAI has generally accounted for 30% to 50% of the total BSAI catches, which is the largest harvest of this complex among all BSAI subareas. In each year during 2009 through 2015, except 2011, the exploitation rates in the WAI area exceeded annual harvest levels that would have been applied had area-specific harvests been set at ABC targets based on the $F_{40\%}$ control rule. Subsequent to high catches, biomass declined in the WAI area. In addition to biomass declines, there has been an increase in the proportion of survey tows that failed to catch blackspotted/rougheye. Thus, the WAI portion of this complex is currently estimated to have low abundance and high exploitation rates. Indicators of local area depletion include declines in both the mean age and mean length of rockfish in this complex in the WAI. Although declines in mean size have not yet been seen in other BSAI subareas, recent catches and exploitation rates in the EBS have been increasing and are now comparable to exploitation rates in WAI. In such cases of spatially disproportionate harvest with conservation concerns, spatial management of fishery harvest is highly advisable to prevent subarea depletions and to maintain stock sizes capable of producing maximum sustainable yields.

Current management does not recognize blackspotted/rougheye rockfish in the WAI as a spatial management unit. In lieu of this, a 'maximum subarea species catch' (MSSC) has been used for subarea harvest recommendations that are not included in the final OFL/ABC specifications provided by the NOAA-Fisheries Alaska Regional Office. MSSCs are intended to communicate harvest levels in a transparent manner that would allow progress in meeting management goals to be easily monitored. This MSSC approach has been used for a few years now, but it has not been effective. For instance, the MSSC for blackspotted/rougheye rockfish in the WAI for 2015 was 46 t, but through August 29th, the 2015 catch in this area was 62 t, an 'overage' of 16 t. Of this, Amendment 80 cooperatives caught only 44 t, their lowest since 2008, but other fisheries caught more than usual. Public testimony indicated that outreach efforts may not have adequately informed non-Amendment 80 vessels participating in these fisheries because likely participants were unknown in advance of the fishery, given recent changes in management in the region.

Management approaches to rectify this situation require careful exploration and consideration. For instance, simply setting an area-specific ABC would result in placing this complex on discard status after the area-specific ABC is attained. While this may be a viable option, discarded blackspotted/rougheye rockfish are likely to suffer high mortality rates. Thus, fishing mortality would continue to increase even after the ABC has been met, thereby limiting the conservation benefits of this approach.

Application of the Council's stock structure policy to the BSAI blackspotted/rougheye rockfish complex leads to clear guidance on next steps. Specifically, the ranking of this complex as a "strong concern" triggers steps 2 and 3 of that policy. Step 2 is:
With input from the agency, the public, and its advisory bodies, the Council (and NMFS) should identify the economic and management implications and potential options for management response to these findings, and identify the suite of tools that could be used to achieve conservation and management goals. In the case of crab and scallop management, ADF&G needs to be part of this process.

The SSC recommends the following three actions. First, the SSC recommends that step 2 of the Council's stock structure policy should be initiated, which involves forming a working group to

consider appropriate measures to address this situation. Second, the SSC requests that the Council work with the NMFS Regional Office to establish a mechanism for inseason reporting to the industry when the MSSC goal is being approached. Third, improved outreach should be undertaken to advise all recent and prospective new fishery participants about the concerns regarding the blackspotted/rougheye rockfish complex. As the workgroup and Council make progress to evaluate management alternatives, results from next year's improved inseason notification process and outreach can be brought forward for consideration. However, the SSC strongly advises that the formation of the work group should not be delayed owing to the ongoing pressing conservation concerns for this resource.

GOA Other Rockfish and DSR

The GOA GPT brought forward a number of items concerning rockfish assessment and management. Items included the (1) stock structure template, (2) utility of rockfish data from the IPHC survey, (3) GOA-wide demersal shelf rockfish (DSR) assessment, (4) random effects approach for other rockfish, and (5) use of ages in rockfish stock assessment models. A document by Tribuzio et al. (2015) titled, "Other Rockfish and Demersal Shelf Rockfish Stock Assessment Tasks in the Gulf of Alaska" formed the basis for the GOA GPT presentation by Jon Heifetz (NMFS-AFSC). The SSC expresses its gratitude to Dr. Cindy Tribuzio (NMFS-AFSC) and her colleagues for a very clear and informative report.

Stock Structure Template

Concerning application of a stock structure template, information was tabulated for the large number of species in this group in Appendix A of Tribuzio et al. (2015). The team noted that there were no genetic data for other rockfish. There are few age structures for ageing and sparse life history information. The lack of information and the number of species to be considered is daunting. **The SSC encourages the GPT to develop a prioritized list of species based on their commercial importance.**

Utility of IPHC Survey Data

Among the rockfish encountered, only canary, quillback, redbanded, silvergray, and yelloweye rockfish occur fairly regularly in the IPHC survey. Relative population numbers for these species are greatest in the East Yakutat/Southeast Outside (EY/SEO) management area. **The SSC agrees with the GPT that incorporating IPHC survey data from this area may be useful for these species and encourages the assessment authors to investigate this possibility more fully.**

Demersal Shelf Rockfish Assessment and DSR/Other Rockfish Species Management

There were several issues concerning demersal shelf rockfish (DSR) and other rockfish (OR). Appendix B of the report discussed an age-structured model for yelloweye rockfish in Southeast Alaska Outside Waters. The GPT expressed concern about an unusually high level of precision in model results, especially considering available input data. This assessment is based on a submarine and remote operated vehicle surveys, and the SSC was concerned to learn that funding for future surveys is uncertain. The SSC agrees with the GPT's advice for further model development and looks forward to a presentation on this age-structured model, once it has been fully vetted by the GPT.

Previously, the SSC expressed concerns about the appropriateness of the current management grouping for the seven DSR species. These seven species (canary, china, copper, quillback, rosethorn, tiger, and yelloweye rockfish) are managed in the DSR complex in the EY/SEO region (area 650), and in the OR complex in all other regions. A primary question concerns whether a GOA-wide assessment would be more appropriate for these species.

A very preliminary set of alternative management options were developed. These include Alternative 1: status quo, Alternative 2: Bring DSR into the OR complex, and Alternative 3: Make a GOA-wide DSR assessment. Alternative 2 included three suboptions. Public testimony highlighted the complexity of management issues involved with some of the alternatives. For instance, under Alternative 3, an ABC of 29 t for West Yakutat would likely result in placement of DSR on discard status. The ability to manage in-season for such an ABC is a concern, given that the halibut fishery takes a large proportion of DSR and that the directed halibut fishery does not fall under the Council's jurisdiction.

The Plan Team recommended further evaluation of author-preferred Alternative 3. Issues with bycatch of DSR in the halibut fishery emphasize the need for more thorough consideration of this alternative. Moreover, the prospects for developing a GOA-wide DSR assessment should consider that the survey information is best developed for Southeast Alaska, and that future funding for those surveys is uncertain. The SSC advises that additional consideration should be given to Alternative 2 as well. For example, if all these species are combined, would this result in grouping species of divergent life history characteristics? How species group management would be affected due to climate change and resulting distributional shifts in species (e.g. silvergray rockfish in Southeast Alaska)?

The SSC suggests that this analysis should not be rushed. The prospects for developing a GOA-wide DSR assessment should consider that the survey information is best developed for Southeast Alaska, and that future funding for those surveys is uncertain. Also, for the various alternatives, assemblage membership should be carefully re-examined to make sure that species in the assemblage share some common characteristics. Alternative combinations of species should be considered. The SSC also encourages involvement of industry members to incorporate of fishery and management complexity in analyses.

Random Effects Model for Survey Averaging

The utility of a random effects approach for survey averaging was investigated for the OR complex. Multiple approaches were investigated. The analysts working on this project are still developing the methods and do not recommend switching to a random effects modeling approach for survey averaging at this time. The SSC looks forward to further progress on this research.

Use of Ages in Rockfish Stock Assessment Models

Pete Hulson (NMFS-AFSC) has been examining rockfish age-structured stock assessment models to address a number of questions. One common question is the concern about how many age groups should be included in each assessment. Concern was expressed that too few age groups were being used in some assessments, leading to a large number of individuals in the final "plus" group. As a rule of thumb, it is desirable to have no more than 15% of individuals in the plus group. For November, the plan is to bring forward four GOA rockfish assessments, with two alternative models, including one that evaluates where to set the plus age group. The intention is that results will lead to guidance that can apply to all rockfish assessments. **The SSC suggests that Dr. Hulson should also explore the utility of delay-difference**

models as an alternative way to model the plus age group. Dr. Quinn and others have published on this approach. The SSC looks forward to reviewing this analysis in December.

BSAI and GOA Flatfish

GOA Northern and Southern Rock Sole

The only substantive change to the assessment models for rock sole over last year's assessment is that now an asymptotic selectivity is assumed. The 2015 GOA bottom trawl survey data has not yet been added to the assessment. In its present state, the model for Northern Rock Sole (NRS) is extremely sensitive to a specified model parameter that largely affects the recruitment estimates. The Plan Team recommends that, if this pattern persists after the data are updated, options to stabilize recruitment should be used. **In addition, the SSC also recommends identifying the source of information that is responsible for the large recruitment anomalies in the NRS model.**

GOA Rex Sole

The last full assessment for rex sole was in 2011, and the new assessment will be implemented in the SS3 platform. There have been slight differences between the old assessment platform and the SS3 model, due to differences in parameterization of selectivity curves and the inability to replicate the age-length transition matrix in SS3. **The SSC supports the Plan Team's recommendations, including the recommendation to move forward with the SS3 assessment platform.**

BSAI and GOA Arrowtooth

A new generalized assessment model is being developed for arrowtooth flounder to address inconsistences between the current models that are used to assess BSAI and GOA stock status. The new platform will allow for multiple survey indices to be fitted simultaneously. It is anticipated that the new modeling platform will be able to replicate the old platforms identically. The SSC looks forward to seeing the results of the new platform where data and assumptions are treated consistently between the GOA and BSAI stocks.

BSAI and GOA Squid

Squid are currently managed as Tier 6 species in both the GOA and BSAI, with OFLs established by using a representative time period. The BSAI squid OFL is calculated as the average of 1978 through 1995 catch, and the GOA squid OFL is based on the 1997 through 2007 maximum catch. The CIE review of the squid assessments in 2013 suggested aligning the assessment methods for squid across GOA and BSAI, but in December 2014, the SSC felt that selecting a time period appropriate for each area was a more important consideration, and chose to keep the status quo assessment method.

There have been long-standing concerns regarding the lack of assessment data for squid. The abundance of squid in the BSAI and GOA is highly uncertain. Survey biomass estimates have acceptable CVs, but undoubtedly underestimate squid populations, and temporal variability in survey estimates is unlikely to represent actual changes in abundance. It is unlikely that sufficient data could be gathered to improve the assessment without considerable expense due to the distribution of squid (generally distributed beyond the shelf break and in deeper waters), and because the species that likely makes up the majority of the squid biomass and incidental catch in the BSAI (*Berryteuthis magister*) appears to have multiple spawning cohorts within each year. As a result, even a dedicated annual squid survey conducted during only a limited part of the year is unlikely to provide an accurate annual population estimate.

Squid catch in the BSAI during 2014 exceeded the TAC and approached the ABC. As of September 5, 2015, the total BSAI squid catch (2,174 t) greatly exceeded the TAC of 340 t, exceeded the ABC of 1,970 t, and has the potential to exceed the OFL of 2,620 t. Exceeding these harvest limits, coupled with the recognition that current levels of incidental catch appear to be well below those that would pose a conservation concern, and the acknowledgement that fisheries limit their ability to avoid PSC species (e.g., salmon and herring) when moving away from high concentrations of squid, prompted another look at the method for setting the ABC and OFL for squid in the GOA and BSAI.

While management as a Tier 6 species allows for limiting catch, it is likely that current levels of incidental catch in the BSAI and GOA are well below those that would pose a conservation concern, and likely much less than MSY. This is supported by observations that squid have inherently high stock productivity due to their rapid growth, maturation, and short lives, and evidence from other areas (e.g., NEFMC 2010) suggest it is unlikely a highly productive stock could be overfished in the absence of an intensive directed fishery.

Untargeted, squid are unlikely to pose a conservation concern. It might be possible to depart from the precedent of estimating an OFL and focus on ensuring that specifications do not unnecessarily constrain current fisheries, while prohibiting the development of a directed squid fishery, without sufficient information to properly manage stocks. Possible options include the following:

- Move squid to Ecosystem Component. This would not constrain current fisheries and would prohibit the development of a directed squid fishery since squid retention would be limited. However, this would result in squid discards, since they are generally unsuitable for making fish meal, and Ecosystem Component status potentially would disallow processing squid for bait, which could put more pressure on other bait species. If squid are moved to an Ecosystem Component, it will be important to continue tracking squid catch, retaining tools to limit squid catch if necessary (e.g., maximum retention allowance), and to explore possibilities of allowing processing of squid bycatch for bait.
- Set ABC with no OFL (OFL "unknown", e.g., Atlantic deep-sea red crab fishery). Input from Council staff and NOAA General Council noted that it was unclear whether this option is feasible, and the SSC expressed discomfort with this option, as well. However, this option would not unnecessarily constrain current fisheries and could reduce discards by allowing retention of incidental squid for use as bait. This option might not prohibit the development of a directed squid fishery, unless an OFL was later implemented.

For the December meeting, **the SSC requests further evaluation of what it would take to move squid to an Ecosystem Component, and requests clarification on whether it is possible to set an ABC with no OFL.** In addition to suggestions the SSC made for the squid assessment in the December 2014 minutes, **the SSC supports the Groundfish Plan Team's suggestion that the squid assessment options brought forward in December include, at a minimum, the current Tier 6 approach, the Tier 6 approach using maximum catch, and an approach similar to the Tier 5 approach, using F=M=1**

as the estimate of OFL, fishing mortality, and using survey biomass as a "minimal" biomass estimate.

BSAI Forage Fish

The BSAI forage fish report is brought forward on a biennial basis. The objectives are to investigate trends and describe interactions between fisheries and forage base. The SSC commends the authors on the dramatic improvement in the report content and format. Overall, the authors were very responsive to SSC comments on this report from the last BSAI forage report and from applicable comments from the GOA forage fish report. Major updates include a restructuring of the report and a great deal of additional information, including a 'data gaps and research priorities' section and analysis and evaluation of temporal trends for three main forage species in the BSAI (capelin, eulachon, and herring).

The SSC had several suggestions for additions and clarifications to be addressed, to the extent possible, prior to the December meeting. Of particular interest was the information presented related to the different temperature regimes developed for this report. The SSC asks for exploration of alternatives to the temperature regimes that were developed and that additional information on how the timing of ice retreat could impact forage fish distribution and abundance be explored. The SSC suggested looking at the distribution of prohibited species catch in commercial catches over space and time, in addition to those of the surveys. For species such as herring that have specifically timed migrations, distributions from the surveys are determined by the intersection of the timing of spawning and timing of the surveys. The distribution of prohibited species catch might help to better delineate migrations and distributions over both time and space. The SSC asked for additional clarification on the Togiak herring biomass estimates used in Figure 29, specifically whether these estimates were from aerial surveys or from age-structured model estimates, and what component of the population they represented (e.g., mature biomass, spawning biomass, mature and immature biomass combined). If the biomass estimates were from the aerial survey, it would be valuable to investigate the conditions during the surveys for each year, as this could affect whether the estimates are more or less likely to represent spawning or mature biomass. If the estimates were from the Togiak herring age-structured model, a four-year running average is not recommended.

There were also two suggestions for additional research priorities for Pacific herring. The first involved expanding the research priority on genetics to include a comparison of genetic composition of herring on the overwintering grounds and on the spawning grounds. The second was to use recent observer estimates of herring PSC in the groundfish trawl fishery to continue the analysis of Tojo et al. (2007) and explore the seasonal migration of herring in relation to variability in climate and oceanographic conditions. This may provide information to re-evaluate the appropriateness of the current Herring Savings Areas and may also provide insights regarding implications of climate change.

Model Naming

The SSC thanks the joint Groundfish Plan Teams for their thoughts regarding different methods for tracking and archiving versions of assessment models. The information contained in the Team Procedures document was quite useful in framing this issue.

The SSC recognizes that commercial software companies have adopted a variety of naming conventions for version control. These conventions help the developer, user, reviewer, and public make sure they are accessing the same code. The SSC recognizes that software version control sites such as Github, already have repositories to track and archive software changes and upgrades. Likewise, analysts that use stock synthesis to implement their assessment regularly report on the current release used for the assessment.

The Team Procedures document clarifies that the proposed development and testing of a naming convention should focus on tracking the modeling configurations used for a particular stock assessment. The rationale for this request is two-fold. First, it will help us understand how long it has been since a benchmark change in model configuration has occurred; second, it will help the reviewers and public to track model changes. **Of the options presented in the Joint Plan Teams minutes, the SSC agrees that Option 4 has several advantages and recommends that this Option be advanced next year.** Under Option 4, analysts would number their models as follows:

"Alpha-numeric model identifiers incorporating two-digit year labels of the form "*yy.jx*," where the digit after the decimal ("*j*") represents a major accepted model change and the alphabetic character ("*x*") represents a proposed model change (e.g., "12.1c" and "13.4a" might describe two models introduced in 2012 and 2013, respectively)".

Differences between major and minor changes would be calculated based on "average difference in spawning biomass" (ADSB: see equation in Team Procedures) or as noted in sub-option c below, some other improvement to the model.

The SSC also reviewed the 4 sub-options advanced by the Plan Team.

a. The numbering convention as described above.

b. The numbering convention as described, except that the final model for 2014 is considered to be the original version of the base model in all cases.

c. The numbering convention described, except that the distinction between "major" and "minor" model changes is determined subjectively by the author on the basis of qualitative differences in model structure, rather than the performance-based criterion.

d. Sub-options 4b and 4c combined.

Regarding sub-option b, the SSC recognizes that starting the naming convention using 2014 as the default start year (e.g., 14.jx) would help the user and developer by eliminating the need to trace the origins of the current model back to its year of first use. We will accept this option for circumstances where tracking the origin of the current model back in time poses a significant time commitment for the analyst. However, if the analyst knows (or can easily identify) the year when a particular major model improvement occurred, we would appreciate the author's effort to identify the year of origin.

The SSC recognizes that some subjectivity is inherent in the model naming convention and that some important structural changes may not result in significant changes to average spawning biomass (e.g., the proposed change may be focused on estimates of variance, rather than the mean). Therefore, sub-option c is also acceptable where needed.

The SSC also requests that the groundfish, crab, and scallop plan teams strive to adopt a common naming convention.

C-3 Pribilof Canyon Corals

The SSC received a presentation from Steve MacLean (NPFMC) on the Bering Sea Canyons action timeline, then Chris Rooper (AFSC) and Mike Sigler (AFSC) presented their report entitled "*Validation of models of the distribution of structure-forming invertebrates in the eastern Bering Sea using an underwater stereo camera*". Public testimony was provided by: Merrick Burden (Marine Conservation Alliance), Donna Parker (Arctic Storm), Heather Brandon (World Wildlife Fund), Jackie Dragon (Greenpeace), and Jon Warrenchuk (Oceana).

Background

In 2012, the NPFMC received testimony from environmental organizations suggesting management measures were needed to provide Essential Fish Habitat (EFH) protection to coral, sponge, and other benthic habitat for fish and crab species in two of the five major eastern Bering Sea canyons (Pribilof and Zhemchug). In response, the Council requested that the AFSC determine whether Bering Sea canyons were unique habitats, and whether there were invertebrate assemblages within the canyons vulnerable to the effects of commercial fishing, such as coral and sponge communities. This work was reported to the Council in 2013, and published by Sigler et al. (2013) and Sigler et al. (2015). They concluded that about 1/3 of the predicted coral habitat for the eastern Bering Sea slope occurs in Pribilof Canyon, an area that comprises only about 10% of the total slope area, and that there were no unique faunal features that distinguished Pribilof or Zhemchug Canyons from the surrounding slope areas. Subsequently, the Council requested that the AFSC conduct field research to validate the predictions of the presence/absence model. Camera surveys were conducted in August and September 2014, and a white paper entitled "*Validation of models of the distribution of structure-forming invertebrates in the eastern Bering Sea using an underwater stereo camera*" was prepared. The SSC has been asked to review this report and to provide an opinion regarding the conclusions about distribution and abundance of corals in the eastern Bering Sea relative to the Council's purpose and needs statement.

Model Validation Summary

During summer 2014, AFSC scientists conducted an optical survey of the eastern Bering Sea slope and outer shelf to verify model predictions of coral, sponge, and sea whip presence/absence, estimated using bottom trawl survey data. Additionally, the survey generated data on invertebrate density, height, and fish associations and the presence of fishing gear and the location of damaged invertebrates. Corals were generally rare and occurred at 32 of 250 camera transects, most of which were located in Pribilof Canyon and the slope area to the northwest. The model based on bottom trawl survey data performed well, correctly predicting 72% of coral observations, 65% percent of sea whip observations, and 59% of sponge observations.

Models were also constructed using camera survey data and with both trawl and camera data combined (unified model). The unified model performed best overall for corals (82% correct) and sponges (71% correct), and the camera-based model performed best for sea whips (76%). Coral densities were generally much lower, and the individual coral height were much shorter than in GOA and AI. Highest coral densities were found in Pribilof Canyon and the tallest coral occurred in the slope area to the northwest of

Pribilof Canyon. Sponge densities and heights were highest surrounding Pribilof Canyon, north of Bering Canyon, and in some locations in Zhemchug Canyon. Sea whip densities and heights were greatest on the outer shelf between Pribilof and Zhemchug Canyon and to the south of Pribilof Canyon. The authors reported significant positive relationships between fish density and the presence of coral and sponge for some rockfish species and king crabs, but found significant negative relationships for grenadiers and *Chionoecetes* crabs. Fishing gear evidence was detected in 12.8% of transects. Trawl gear detections were found in 111 m to 394 m depths. Longline or crab gear detections were in 241 m to 748 m depths. Damaged organisms were detected in 27% of transects and included demosponges (0.3%), *Isididae* corals (2.9%), and sea whips (9.0%). It is notable that the two observed damaged corals were found on transects at 455 m and 759 m depth. This is deeper than trawling generally occurs. The authors noted that the source of the damage (fishing or natural) was not discernable. Vulnerability to fishing was inferred using the upper two quantiles of the density and height models. Areas with highest relative vulnerability for corals occurred in narrow areas of the two arms of Pribilof Canyon and in deeper areas to the northwest along the slope. The areas with the highest sponge and sea whips relative vulnerability were centered on the shelf break and extended from Pribilof Canyon to the north for sponge and from Bering Canyon to the north for sea whips.

General Comments

The SSC appreciates the substantial work invested in the white paper and recognizes the major efforts of many parties (AFSC, industry, NGOs, and Council staff) relative to corals since 2012. The SSC commends the report authors on successful implementation of the field study, a thorough analysis and notes that independent surveys to validate species distribution models are very rare. Although there are challenges (e.g., sampling design and spatial scaling) associated with comparing independent camera surveys to trawl data-based model results, the camera survey and associated validation work provide the Council with a level of confidence about the models' predictions that is much higher than is typically available.

The SSC supports the authors' model choice and suite of validation measures (ROCs, threshold probability, Cohen's Kappa, and diagnostic plots). Their choice of sampling design was pragmatic, given the aim of model validation and highly patchy nature of corals. However, as the project was aimed at the model-validation, the sample units had an unequal probability of being sampled. The probability of sampling in the camera drop survey was not constant across the survey region and was low or zero in some areas based on the probability of coral occurrence in the trawl-based models and as a result of time and logistical constraints. To avoid potential biases in any calculations across observations (design-based inferences), the SSC emphasizes that sample units need to be adjusted for the probability of being sampled in both stages of the survey design prior to making calculations. Estimates not adjusted for the probability of being sampled may be biased so we recommend that the authors re-visit the report to ensure that any unadjusted results are appropriately caveated. The SSC agrees with the authors that their presence/absence, height, or density GAM model results are not biased as calculated in the document.

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The SSC concurs with the authors' general conclusion that the camera survey successfully validated the models developed using the trawl survey data. Both the validation diagnostics and observed coral presence indicate that the trawl survey model is realistic in its prediction of coral distribution.

The SSC supports the authors' recommendation to use the unified model for coral and sponge analyses, and the camera-only model for sea whip analyses.

The SSC provides the following specific comments:

- The relatively weaker performance of the sponge and sea whip models is likely due to the emphasis on coral presence/absence validation in the station selection process.

- The General Additive Models employed in this analysis are smoothers that represent complex interactions when applied to predict species distributions and are prone to overfitting data. We support the authors' approach to address this by limiting the number of inflection points (knots) and by exploring the spatial overlaps of observed versus modeled presence/absence values. In future iterations of this work, we recommend the authors provide overall model prediction error maps.

- Caution is required when inferring associations between fish species and corals, due to endogeneity issues (e.g., fish and corals are both associated with hard benthic structures). The authors report that work to compare fish associations with hard structures with and without corals is ongoing.

- The authors' work on identifying areas of coral, sponge, and sea whip vulnerability is informative. However, the expected impacts of fishing on corals, sponges, and sea whips vary based on species-specific susceptibility (e.g., height) to fishing gear and recovery rates. The models in this report are not species-specific and, therefore, do not reflect these important details. In particular, caution is required when interpreting the vertical height and density model results, as the maps do not differentiate species that have different body forms and heights and different aggregations.

- The camera survey observed coral densities that were on average 20 to 240 times lower than in other studies in the Aleutian Islands and Gulf of Alaska. The authors attribute these differences to the much smaller amount of appropriate substrate available for coral colonization in the study area, relative to the AI and GOA.

- It is notable that this study estimated the average density of corals to be 140 times lower than that reported by Miller et al. (2015). The authors attribute these differences to using randomized sampling (within an unequal probability design) and a broader distribution of sample locations within the canyons versus the systematic and localized placement of transects in the Miller et al. study.

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- Corals, sponges, and sea whips are spatially patchy and, therefore, area-wide, transect-level density estimates are not particularly informative when considering potential fishing impacts. In future iterations of this work, the authors should consider characterizing the likelihood of gear-coral interactions. One possibility is to consider each camera transect as a virtual fishing event (with view-area = swept area), and use the frequency of “gear” - coral interaction as the basis for modeling interactions.

- The authors appropriately used error balancing methods to identify the correct probability thresholds for estimating the proportion of suitable habitat in the Pribilof Canyon relative to the study area. Their application of these methods to the Miller et al. (2015) suitable habitat data resulted in a substantial decrease in apparent habitat proportions reported by Miller et al. (from 70% to 46%) in the Pribilof canyon, and demonstrates that care needs to be taken when setting these thresholds.

Where are we relative to the Council's April 2014 Purpose and Needs Statement?
In its Bering Sea Canyon motion (13 April 2014) the Council initiated action to determine whether or how they should recommend amendment of the BSAI Groundfish and Crab FMPs to protect known, significant concentrations of deep-sea corals in the Pribilof Canyon and the adjacent slope, from fishing impacts under the appropriate authorities of the MSA. They envisioned a multistep process to inform this decision (underlined). The number bulleted points are SSC identified work, to date, related to these steps.

1. <u>Identify a discrete area or areas of significant abundance of deep sea corals in, and directly adjacent to, the Pribilof Canyon.</u>
    - The camera survey and associated validation work demonstrates that the trawl survey data can be used to effectively model coral distribution.
    - Camera survey-based coral densities are very low relative to GOA and AI, likely due to availability of suitable hard substrate.
    - Sigler et al. (2015) concluded that the 5 canyons are not faunally distinct features of the eastern Bering Sea slope, but that the major characteristics structuring fish and invertebrate communities were depth, latitude, and sediment, rather than submarine canyons. One notable feature of these canyons is that about one quarter of the coral habitat predicted for the eastern Bering Sea slope occurs in Pribilof Canyon, an area that comprises only ~10% of the total slope area.
    - Habitat suitability models, adjusted using appropriate error balancing, modification suggest about 20% to 50% of coral habitat is in the Pribilof Canyon.

2. <u>Assess the potential for fishing impacts on the identified area or areas of significant coral abundance.</u>
    - The ongoing EFH Review includes corals, sponges, and sea whips as biological structures and formally assesses their potential and realized vulnerability to the effects of fishing in the Bering Sea, including the shelf, slope, and canyons.
    - The vulnerability results presented in this report do not directly address fishing impacts, but can be used to evaluate the expectations of the EFH Fishing Effects (EFH FE) model.

3. <u>Evaluate the historical and current patterns of fishing effort and fish removals in and adjacent to the Pribilof Canyon.</u>

- The ongoing EFH Review examines historical and current levels of fishing in the Bering Sea, including the shelf, slope, and canyons at substantially higher spatial resolution (25km^2) than previous work (Miller et al. 2015 = 400 km^2).
- The EFH FE Model estimated bottom contact will be included in the Ecosystem Considerations chapter.

4. Consider the types of management measures that would be appropriate to conserve discrete areas of significant coral abundance, while minimizing impacts on established fishing activity.
    - The Council needs to determine if the coral distributions generated by Sigler et al. (2015) and the validation analysis constitute "discrete areas" of "significant" coral abundance.
    - While lower in density than in the AI and GOA, the coral densities in Pribilof Canyon and the region to the NW are higher than elsewhere on the Bering Shelf.

Moving Forward
Information on the dependence of managed eastern Bering Sea species on coral, sponge, and whip habitats is lacking. While recognizing the difficulty of quantifying the importance of these habitats to fish and invertebrate populations, the SSC notes that there are no empirical data to support a quantitative assessment of the costs and benefits of coral, sponge, and sea whip protection measures on fish stock production.

The SSC continues to encourage the Council to be explicit in its choice of objectives for coral, sponge, or sea whip management measures, as the specific objectives selected will likely alter the scope, spatial scale, and the toolkit appropriate for evaluating and achieving those objectives (see the June 2014 SSC report for a range of potential scenarios).

Finally, as noted in the 2014 June SSC report, the Council may want to consider aligning the Canyon process with the ongoing EFH 5-year review. This will leverage additional tools (e.g., fishing effects model) and information to support the determination of whether or not management actions for coral, sponge, and sea whips are warranted in the eastern Bering Sea and, if so, the evaluation of management alternatives.

C-5 EM Workgroup
Diana Evans (NPFMC) presented the draft Electronic Monitoring (EM) Pre-Implementation Plan, as developed by the EM workgroup (EMWG), and Farron Wallace (NMFS-AFSC) presented the EM Implementation Cost Analysis. The SSC was tasked with reviewing the two documents and providing comments. There was no public testimony.

The overarching goal of the project plan is to evaluate the efficacy of EM, in combination with other tools, for an accounting of retained and discarded catch. If successful, EM accounting methods could ultimately be fully integrated into the catch accounting system. The plan describes a proposed pre-implementation project to deploy EM systems on a fleet of up to 60 longline vessels in the 40' to 57.5' range to evaluate the logistics and practical aspects of EM deployment, use, data capture, and data analysis. These vessels are those where it would be difficult to deploy human observers on board, due to lack of bunk space or life raft capacity. EM will be deployed at a sample rate of 30% of the fleet, over four time periods, in 2016. EM data capture will focus on discard estimation and seabird interactions, although these data will not be used in actual discard estimation in 2016. The cost analysis was a simulation of expected costs of implementing EM per the pre-implementation plan.

The SSC greatly appreciates the work of the EMWG in developing this project plan and enlisting 56 vessels, so far, that are willing to have an EM system deployed during the fishing season. EM shows promise as a tool for data collection, especially on vessels where deployment of human observers is problematic, and we laud the work of the EMWG to begin the process of evaluation of this method of data capture.

The SSC had the following observations and comments on the plan and cost analysis:

- There is a general lack of performance metrics in the pre-implementation plan. It will be important to develop metrics to evaluate success or failure of vessel and trip selection procedures, deployment of EM gear, operation and reliability of EM gear, video data quantity and quality, and veracity of counts derived from analysis of video data.
- The current sampling design holds selection probabilities constant for all participants. This results in a single vessel in certain seasonal cells. The SSC advises that this design be revisited once the final number of vessels in the program is known and performance metrics are identified, to ensure that the experiences of a single vessel, or analysis of a single vessel's data, at the beginning or end of the season does not drive, or prevent reaching, conclusions about the program.
- As pre-implementation proceeds, it will be important to consider and analyze how EM-derived video data can be integrated into the catch accounting system. Figure 3 in the plan document provides an excellent roadmap for these considerations. The SSC encourages the EMWG to use simulation approaches, like that used in the development of the Annual Deployment Plan (ADP), to provide answers to the decision points on the roadmap in Figure 3. Data collected during the 2016 EM pre-implementation program will likely be useful to inform simulation work to evaluate the estimation decision points articulated in the plan. For example, stratification and sampling rates for EM deployment could be considered with the simulation approach used in the development of the ADP. Similarly, development and assessment of performance metrics for EM could be accomplished via this same simulation approach.
- The SSC also notes the importance of the EMWG continuing to consider how the loss of necessary biological information, accrued from human observers, will be replaced from sources such as EM collected data (e.g., stereo cameras to collect fish length) or information collected in other portions of the overall observer program.
- The cost report estimates cost for deployment of EM in 2016, and shows how EM implementation costs are projected to vary. Data on actual costs, including vessel costs like foregone fishing due to inoperable EM systems, should be part of the data collected from this project. The SSC suggests the EMWG look to other EM programs to get a sense of how these costs change with experience.

- Ultimately, the EM program will need to be evaluated with respect to the tradeoffs of sampling design and sampling allocation, cost of implementation and analysis, and the utility of data derived, compared to those of the current observer program.

C-6 Observer Program 2016 Annual Deployment Plan

Craig Faunce (NMFS-AFSC) presented the draft 2016 Annual Deployment Plan (ADP) for Observers in the North Pacific Groundfish and Halibut Fisheries off Alaska. There was no public testimony.

The 2016 ADP details proposed efforts to obtain at-sea and dockside observations suitable for estimating groundfish and halibut fishery catches and discards in the Gulf of Alaska (GOA) and Bering Sea/Aleutian Islands (BSAI) within current budget constraints. The draft 2016 ADP also provides a review of and technical basis for proposed plan modifications based on the successes and challenges of previous seasons for the partial coverage category. As the SSC previously noted, this will be an ongoing process to improve the program.

Three major changes were made to the 2015 ADP in developing the 2016 draft plan. These changes address issues that arose from analysis of catch and discard data from 2013 and 2014, and from those previously identified by the SSC and Council.

1. Change stratification to three gears (trawl, pot, hook and line) instead of two vessel lengths. Trip selection will be the sole basis for random assignment of observers to vessels in 2016. Vessels that volunteer will be moved to the no selection (zero coverage) category.
2. Revised deployment rates for the three new “optimized” strata.
3. Discontinue conditional releases due to life raft capacity. These vessels would be eligible for the 2016 EM program.

This draft ADP is a culmination of efforts that began several years ago with incremental improvements fostered through a collaboration of stakeholders, the Council and advisory bodies, and agency staff. The SSC greatly appreciates the thought put into and rigor of analyses that led to the recommended new stratification scheme and allocation of sampling among strata as described in Appendix B of the ADP. The SSC believes that the draft ADP presents an appropriate approach to providing statistically based estimates of catch and discards that meet the Council’s recent motion and objectives for the revised observer program. We support the analysts’ approach to assessing accuracy, precision, and coverage (via gap analysis) through simulation using observer data from 2013 and 2014. **The SSC also supports the analysts’ choice of three gear-based strata, and the methods used to optimally allocate sampling to each.**

The SSC also had the following observations and comments on the draft ADP:

- The SSC notes the changes to observe declare and deploy system (ODDS) to facilitate linking observer records with the eLandings system. This change, although voluntary, should improve catch estimation and analysis of performance of the observer program.
- We also note that the sampling design for taking genetic tissues from salmon PSC in the GOA has been retained from the 2015 ADP. This design allows for efficient collection of genetic tissues to inform stock identification efforts on Chinook salmon PSC in the GOA.

- As more observer data are collected, we anticipate that additional changes and enhancements to the stratification scheme and allocation of observed trips among strata will be made. The simulation approach will be extremely useful to evaluate any proposed changes.
- As EM matures as a viable alternative, tradeoffs between EM and human observing systems will have to be considered in light of their respective logistical, statistical, and cost constraints.

C-7 Observer Coverage on BSAI Trawl CVs

The SSC received a presentation from Sam Cunningham (NPFMC) of the initial draft RIR/IRFA for a proposed regulatory action that would, depending on the alternative selected, mandate or permit voluntary access to full observer coverage in the BSAI groundfish CV trawl sector. No public testimony was offered.

The document presents a cogent assessment of a regulatory action that could, depending upon the action alternative adopted, affect the way in which some BSAI trawl-endorsed CVs access and pay for observer coverage. At present, non-pollock groundfish trawl CVs delivering shoreside that are assigned "partial-coverage" under the North Pacific Groundfish and Halibut Observer Program are permitted by NMFS to voluntarily operate under full observer coverage. This voluntary action does not remove these vessels from ex-vessel landings fee obligation, incurred by having been assigned to the "partial observer" sampling population under the ADP.

Those operators that have, thus far, requested permission from NMFS to participate in this program have been limited to AFA CVs. They voluntarily pay the full-coverage observer cost, while also incurring obligations under the "partial-coverage fee structure", based upon a percentage of the vessel's gross ex-vessel landed value. The motivation for assuming these additional costs is attributed to a need to steward limited halibut PSC allowances, within their respective AFA cooperative management structures.

The draft lays out behavioral changes that might be expected from the various impacted parties, in response to each alternative, option, and suboption under consideration. In general, the analysis does a commendable job of identifying the critical decision points and the rationale behind each. It appropriately uses available empirical data and informed assumptions to characterize reasonable outcomes that may emerge from selection of each of the alternatives.

The analysts reported numerical errors in several of the tables (6-9) contained in the draft. These should be corrected at their earliest opportunity. Several editorial issues identified in the SSC review will be forwarded to the analysts. Another concern that requires clarification is the seemingly conflicting description of Alternative 3 without Option 1, and Alternative 3 with Option 1. If it is the Council's intent to say that Option 1 would apply Alternative 3 only to AFA trawl CVs, as opposed to all trawl CVs, then they should make that clear. This issue should be resolved before release. **At the present state of the proposal's development, the SSC believes the draft is appropriate for public release, subject to the editorial correction that can be readily completed.**

There are opportunities to strengthen future versions of the document. The SSC recommends that the Council add an action alternative that would permit retention of the functional status quo. As the suite of alternatives is presently constituted, the selection of Alternative 1 (status quo) is not an available choice because current regulations do not authorize voluntary selection of full coverage. That raises both procedural and substantive concern.

In the latter regard, having the possibility of retaining the existing partial-coverage payment structure would permit exploration of net welfare effects on NMFS' revenue-limited observer coverage that are not treated elsewhere in the draft. It is the case that freeing CVs from their partial-coverage payments will reduce the funding directed towards partial-coverage observers. Any reduction in funding incurred by a 'budget-constrained' observer program necessarily adversely impacts the analytical value of resulting scientific and management data. In turn, all those dependent upon these data, whether directly (e.g., fishing sectors, scientists, managers) or indirectly (e.g., consumers) potentially experience a welfare reduction. An accounting of such effects is required within the RIR, along with a "net benefit to the Nation" conclusion. The current draft is deficient in this regard and any subsequent analysis must resolve this shortcoming.

The analysis raises, but does not directly address, several interesting economic questions. The observer-program design is fundamentally dependent upon widely distributing the observer-coverage cost burden, with those benefiting most from the management structure carrying a proportionally greater share. It is reasonable to conclude that CV's that volunteer to incur both full-observer coverage and partial-coverage fees must derive benefits that exceed the sum of the observer fees or one would not observe anyone voluntarily incurring these costs, which might suggest they are not excessively burdened (i.e., they derive offsetting benefits) from this opportunity. At the very least, this hypothesis deserves further examination. However, without an action alternative that provides for this regulatory outcome, this inquiry will be omitted.

This tension between funds and coverage dictates the relative efficacy of the observer program in fulfilling its scientific and monitoring mandates. A broader treatment of structural tradeoffs and distribution of benefits from more extensive observer coverage could clarify impacts accruing to all "interested" groups (e.g., resource owners, harvesters of the target groundfish species, users of PSC and bycatch species, managers, CDQ groups, co-op members – observers, observer providers). This additional exploration and elaboration would, perhaps, be most appropriate after the Council has identified its preliminary preferred alternative.

D-1 Ecosystem Committee Report

Steve McLean of the NPFMC Staff informed the SSC that the Ecosystem Committee Discussion Paper on a Bering Sea Fishery Ecosystem Plan was not yet ready for review by the SSC and that it would be ready by the December Council meeting.