JOINT MEETING OF THE BSAI AND GOA GROUNDFISH PLAN TEAMS
May 1, 2012

Members of the Plan Teams present for the meeting, which convened via WebEx, included those shown in bold below.

BSAI Team

Grant Thompson	**AFSC REFM (BSAI co-chair)**
Mike Sigler	**AFSC (BSAI co-chair)**
Kerim Aydin	AFSC REFM
Lowell Fritz	AFSC NMML
David Carlile	**ADF&G**
Alan Haynie	**AFSC REFM**
Jane DiCosimo	**NPFMC (Coordinator)**
Henry Cheng	**WDFW**
Brenda Norcross	UAF
Mary Furuness	NMFS AKRO Juneau
Bill Clark	**IPHC**
Dave Barnard	**ADF&G**
Leslie Slater	USFWS
Dana Hanselman	**AFSC ABL**

GOA Team

Jim Ianelli	**AFSC REFM (GOA co-chair)**
Diana Stram	**NPFMC (GOA co-chair)**
Sandra Lowe	**AFSC REFM**
Chris Lunsford	**AFSC ABL**
Jon Heifetz	**AFSC ABL**
Mike Dalton	AFSC REFM
Kristen Green	ADF&G
Henry Cheng	**WDFW**
Nick Sagalkin	ADF&G
Paul Spencer	**AFSC**
Leslie Slater	USFWS
Nancy Friday	AFSC NMML
Tom Pearson	NMFS AKRO Kodiak
Ken Goldman	ADF&G
Steven Hare	IPHC
Craig Faunce	**AFSC FMA**

Others in attendance: Pat Livingston, Anne Hollowed, Farron Wallace, Teresa A'Mar, Kenny Down, Mark Maunder, Pete Hulsen, Buck Stockhausen, Dave Fraser, Charlie Trowbridge, Ernie Weiss.

February 2012 Pacific cod workshop

The Teams agreed to forward, without review, a summary report of recommendations from a Pacific cod workshop that was held at the NMFS AFSC on February 6, 2012. The Teams will review the report as part of its compilation of recommendations for changes to research priorities for 2014 – 2018; the Teams did not want to delay SSC consideration of any specific recommendation that it might wish to consider for 2013 – 2017, since the Teams are out of synchrony with SSC and Council adoption of research priorities each year.

Last year the Teams identified a critical need for research on the catchability of Pacific cod by the EBS survey trawl. The value of the trawl survey catchability parameter currently used in the assessment model is based on the assumption that roughly half of the Pacific cod in the 60-81 cm range are unavailable to the survey trawl because they can inhabit the water column above the headrope. If Pacific cod are being herded vertically by the survey trawl (i.e., if Pacific cod exhibit a "dive response" to an oncoming vessel or net), or if the catchability value used in the model is otherwise inaccurate (e.g., due to the very small sample size of the archival tagging study by Nichol et al. (2007)), the model would give biased estimates of biomass and other quantities. If the assumptions about vertical availability of Pacific cod used in the BSAI and GOA Pacific cod models are correct, it is expected that higher catch rates would be observed with the poly Nor'Eastern, because its higher vertical opening results in greater catchability, selectivity, or both. Jane DiCosimo reported that Bob Lauth informed her that funds were received from the NOAA Cooperative Research Program to investigate vertical herding behavior of Pacific cod in response to the eastern Bering Sea shelf survey bottom trawl during the first leg of the survey. As noted in the Pacific cod workshop report, the investigation will involve use of the of a Dual frequency IDentification SONar (DIDSON) on the trawl for observing and quantifying movements of Pacific cod in front of the trawl. A second component will be a side-by-side trawl study to compare catch rates of Pacific cod between the standard EBS shelf survey bottom trawl (83-112 Eastern) and the standard GOA survey bottom trawl.

Proposals for the 2012 preliminary Pacific cod assessments

Five background documents were provided to the Teams prior to the meeting, and are included in these minutes as the following set of attachments:

1) Pacific cod model structures included in the final 2011 SAFE reports
2) Pacific cod minutes from the November 2011 Plan Team and December 2011 SSC meetings
3) Bering Sea Pacific Cod Stock Assessment Model Scenarios Requested by Freezer Longline Coalition (FLC) and Quantitative Resource Assessment (QRA), including the same appendix responding to the 2011 CIE review that was provided last year at this time
4) Summary of 2012 Pacific cod model recommendations from the BSAI senior author
5) Summary of 2012 Pacific cod model recommendations from the Plan Teams, SSC, and public (this attachment excerpts *just the recommendations* from Attachments 1, 2, and 3)

The meeting began with an introduction by BSAI senior author Grant Thompson, who summarized very briefly the above attachments and the annual cycle for development of models to be analyzed in the preliminary and final assessments for Pacific cod.

At last year's August/September meeting, the Teams recommended that the authors' preferred model not be included in the final assessment. Grant asked whether this was a standing policy of the Teams and, if so, whether it applied to both the preliminary and final assessments or just the final assessment. **The Teams clarified that the authors are welcome to present their own models during the preliminary assessment, but the Teams reserve the right to request that those models be excluded from the final assessment.** Given this clarification, and in the interest of time, the Teams agreed to forgo a discussion of the authors' own proposals for this year's preliminary assessment (Attachment 4).

Not counting the authors' own proposals, a total of 12 proposals were received prior to the meeting: three from the Teams, six from the SSC, and three from the FLC/QRA (Attachment 5). One of the GOA Team proposals was essentially identical to one of the SSC proposals, which brings the total down to 11 unique proposals. During the course of the meeting, two other proposals were added, bringing the total of unique proposals to 13. The final set of proposals is shown in Table 1.

The Teams made two passes through the final set of proposals: The first pass separated those proposals that were amenable to allocation among a set of requested models ("model proposals") from those that were not ("non-model proposals"), and assigned priority rankings to all proposals (except for two that were deemed too generic to rank); the second pass allocated all medium-priority and high-priority model proposals among a set of requested models (Table 1).

In the first pass, the Teams determined that six of the proposals were not amenable to allocation among a set of requested models, either because they lack specificity, they involve parameters estimated outside of the assessment model, or they can be explored sufficiently without developing and presenting a full set of results for an additional model. Of these six non-model proposals, two were not assigned a priority ranking, three were ranked as medium priority, and one was ranked as high priority. For the non-model proposals, the Teams clarified the meanings of "medium" and "high" priority rankings as follows: "Medium" means that the Teams expect to see an attempt made to address the proposal, while "high" means that the Teams expect this attempt to be successful.

Seven proposals were determined to qualify as true model proposals. One of these (FLC1: include last year's final model with time-varying growth) was ranked as low priority, another (SSC6: develop an age-structured model for the Aleutian Islands) was ranked as medium priority, and the other five were all ranked as high priority for at least one region. The six medium-priority and high-priority model proposals were then allocated among a set of requested models.

Recommendations

- For the EBS, the Teams recommend that the preliminary assessment include the following four models, which are in addition to any models that the authors wish to propose: Model 1 is last year's final model, Model 2 is last year's final model with re-tuned catchability, Model 3 is last year's final model with a new fishery selectivity period beginning in 2008 or 2010, and Model 4 is last year's final model without age data. For Model 3, the Teams acknowledge that estimating a full set of selectivity parameters with only 2-4 years of data may be challenging.
- For the AI, the Teams recommend that a preliminary assessment be developed with a simple, age-structured model configured in Stock Synthesis *if there is enough time to do so*. This initial attempt at age-structured modeling of the AI stock may serve largely to determine whether the lack of age data prohibits meaningful parameter estimation at the present time.
- The Teams recommend that the AFSC begin production ageing of AI Pacific cod.
- For the GOA, the Teams recommend that the preliminary assessment include the following two models, which are in addition to any models that the authors wish to propose: Model 1 is last year's final model, and Model 2 is last year's final model with re-tuned catchability.
- The Teams recommend that Stock Synthesis be modified so that a prior distribution can be placed on the average, across the 60-81 cm size range, of the product of catchability and selectivity at age, where the average is weighted by long-term average numbers at length.
- For both the EBS and GOA, the Teams recommend that the authors attempt to explore the divergent ageing bias trends in the two regions and the impacts thereof.
- For both the EBS and GOA, the Teams recommend that the authors attempt to evaluate the biological basis for estimated patterns of seasonal weight at length.
- For both the EBS and GOA, the Teams recommend that the authors attempt to estimate catchability internally. This can be addressed as an option under Model 1 without developing and presenting a full set of results for an additional model (full results for the base case of Model 1 are requested, however).
- For the GOA only, the Teams recommend that the authors reduce the number of parameters. This can be addressed as an option under Model 1 without developing and presenting a full set of results for an additional model (full results for the base case of Model 1 are requested, however).

Notes

- Teresa A'mar will be the senior author of the GOA assessment this year.
- The BSAI Team may need to consider separate specifications for the AI this year, depending on how much progress is made in developing an age-structured model for the AI stock.
- A member of the public suggested that the process of submitting model proposals would be easier if the authors would commit in advance to a preferred model.

Table 1. List of proposals and Joint Plan Team recommended models for preliminary assessments.

Model proposals

Topic	Number	Proposal	Proposed area	Priority	Model 1	Model 2	Model 3	Model 4
Ageing	FLC2	Include last year's Model 4 or this year's preferred model without age data	EBS	high				EBS
Aleutians	SSC6	Develop age-structured model	AI	medium	AI			
Base model	new	Include last year's final model without modification	EBS, GOA	high	EBS, GOA			
Growth	FLC1	Include last year's Model 3b with time-varying growth	EBS	low				
Q/selectivity	BPT1	Consider new fishery selectivity period starting in 2008 or 2010	EBS	high			EBS	
Q/selectivity	FLC3	Include last year's Model 3b with re-tuned catchability	EBS, GOA	high (EBS)		EBS		
Q/selectivity	new	Include last year's Model 3 with re-tuned catchability	GOA	high		GOA		

Non-model proposals

Topic	Number	Proposal	Proposed area	Priority
Ageing	GPT1/SSC3	Explore divergent ageing bias trends in EBS and GOA and impacts thereof	EBS, GOA	medium
General	SSC1	Keep no. models small, retain current model for several years	EBS, GOA	n/a
General	SSC5	Apply additional scrutiny to GOA stock	GOA	n/a
Growth	SSC2	Evaluate biological basis for seasonal weight at length	EBS, GOA	medium
Parsimony	SSC4	Reduce number of parameters	GOA	high
Q/selectivity	JPT1	Estimate catchability internally	EBS, GOA	medium

1 Pacific cod model structures included in the final 2011 SAFE reports

*1.1 Model structures considered in the 2011 EBS assessment (**Model 3b** was adopted)*

The Pacific cod stock assessment models were reviewed in March of 2011 by three scientists contracted by the CIE. A total of 128 unique recommendations were received from the CIE reviewers. Following the review in March, a set of seven models was requested for inclusion in the preliminary assessment by the Plan Teams in May, with subsequent concurrence by the SSC in June. Following review in August and September, four of these models (Models 1, 2b, 3, and 4) were requested by the Plan Teams or SSC to be included in the final assessment. In addition, the SSC requested one new model, which is labeled here as Model 3b.

Model 1 is identical to the model accepted for use by the BSAI Plan Team and SSC in 2010, except for inclusion of new data and corrections to old data.

In the preliminary assessment, the only difference between Model 1 and Model 2b was that the pre-1982 portion of the AFSC bottom trawl time series was omitted from the latter. In the present assessment, the following additional changes were made relative to Model 1:

- The 1977-1979 and 1980-1984 time blocks for the January-April trawl fishery selectivity parameters were combined. This change was made because the selectivity curve for the 1977-1979 time block tended to have a very difficult-to-rationalize shape (almost constant across length, even at very small sizes), which led to very high and also difficult-to-rationalize initial fishing mortality rates.
- The age corresponding to the *L1* parameter in the length-at-age equation was increased from 0 to 1.4167, to correspond to the age of a 1-year-old fish at the time of the survey, which is when the age data are collected. This change was adopted to prevent mean size at age from going negative (as sometimes happened for age 0 fish in previous assessments, and as happened even for age 1 fish in one of the models from the 2010 assessment), and to facilitate comparison of estimated and observed length at age and variability in length at age.
- The parameters governing variability in length at age were re-tuned. This was necessitated by the change in the age corresponding to the *L1* parameter (above).
- A column for age 0 fish was added to the age composition and mean-size-at-age portions of the data file. Even though there are virtually no age 0 fish represented in these two portions of the data file, unless a column for age 0 is included, SS will interpret age 1 fish as being ages 0 and 1 combined, which can bias the estimates of year class strength.

Model 3 is identical to Model 2b, except that ageing bias was estimated internally and the parameters governing variability in length were re-tuned (again).

Model 3b is identical to Model 3, except that the parameters governing variability in length were estimated internally, all size composition records were included in the log-likelihood function, and the fit to the mean-size-at-age data was not included in the log-likelihood function.

Model 4 is identical to Model 3b, except that ageing bias was not estimated internally and the fit to the age composition data was not included in the log-likelihood function.

*1.2 Model structures considered in the 2011 GOA assessment (**Model 3** was adopted)*

The Pacific cod stock assessment models were reviewed in March of 2011 by three scientists contracted by the CIE. A total of 128 unique recommendations were received from the CIE reviewers. Following the review in March, a set of seven models was requested for inclusion in the preliminary assessments (of which only the EBS version was actually completed) by the Plan Teams in May, with subsequent concurrence by the SSC in June. Following review in August and September, GOA versions of three of these models (Models 1, 3, and 4) were requested by the Plan Teams or SSC to be included in the final GOA assessment. In addition, the SSC requested one new model, which is labeled here as Model 3b.

Model 1 is identical to the model accepted for use by the GOA Plan Team and SSC in 2010, except for inclusion of new data and corrections to old data.

Model 3 in the present assessment differs from Model 1 in the following respects:

- The age corresponding to the *L1* parameter in the length-at-age equation was increased from 0 to 1.3333, to correspond to the age of a 1-year-old fish at the time of the survey, which is when the age data are collected. This change was adopted to prevent mean size at age from going negative (as sometimes happened in previous EBS Pacific cod models), and to facilitate comparison of estimated and observed length at age and variability in length at age.
- The parameters governing variability in length at age were re-tuned. This was necessitated by the change in the age corresponding to the *L1* parameter (above).
- A column for age 0 fish was added to the age composition and mean-size-at-age portions of the data file. Even though there are virtually no age 0 fish represented in these two portions of the data file, unless a column for age 0 is included, SS will interpret age 1 fish as being ages 0 and 1 combined, which can bias the estimates of year class strength.
- Ageing bias was estimated internally. To preserve a large value for the strength of the 1977 year class and to keep the mean recruitment from the pre-1977 environmental regime lower than the mean recruitment from the post-1976 environmental regime, ageing bias was constrained to be positive (this constraint was not included in the EBS version of Model 3; here, it ultimately proved to be binding only at the maximum age).

Model 3b is identical to Model 3, except that the parameters governing variability in length were estimated internally, all size composition records were included in the log likelihood function, the fit to the mean-size-at-age data was not included in the log likelihood function, selectivity and catchability in the 27-plus trawl survey were both forced to be constant over time, and catchability deviations in the sub-27 survey were given normal priors with mean = 0 and standard deviation = 0.46. The sigma value of 0.46 for the annual deviations in catchability for the sub-27 survey was chosen on the basis of the variability in age 1 survey selectivity from Model 3b in this year's EBS Pacific cod model. This variability had a CV of 0.49, which corresponds to a sigma of 0.46, assuming a lognormal distribution. As with Model 3, ageing bias was constrained to be positive (this constraint was not included in the EBS version of Model 3b; here, it ultimately proved to be binding only at age 1).

Model 4 is identical to Model 3b, except that variability in survey catchability and selectivity was configured as in Models 1 and 3, ageing bias was not estimated internally, the fit to the age composition data was not included in the log-likelihood function, and mean recruitment in the pre-1977 environmental regime was constrained to be less than mean recruitment in the post-1976 environmental regime (this constraint was not included in the EBS version of Model 4; here, it ultimately proved to be binding).

2 Pacific cod minutes from the November 2011 Plan Team and December 2011 SSC meetings

2.1 Joint Plan Team

Grant Thompson described the candidate models for this year's specifications, which had evolved through a series of meetings and trials including a CIE review in March, a team conference in May and SSC meeting in June that produced an intermediate suite of candidates, and finally the September team meeting and October SSC meeting where the candidates for this meeting were chosen. Last year's model was Model 1 and had these features:

- *M* fixed at 0.34.
- Length-specific commercial selectivities for all fisheries, some forced to be asymptotic, estimated for blocks of years.
- Age-specific survey selectivity with an annually varying left limb.
- Survey catchability fixed at the value obtained in the 2009 assessment (0.77), where it resulted in the product of catchability and selectivity at 60-81 cm equal (on average) to the desired value of 0.47 in the EBS and 0.92 in the GOA. The desired values were based on a small number of archival tags.
- Assumed ageing error bias of +0.4 y at all ages.
- A single growth schedule for all years (cohort-specific in the 2009 assessment).
- Length composition data not used where age data were available (to avoid double fitting).

This year's assessment provided additional candidate models as follows:

- Model 2b in the EBS was the same as Model 1 except that pre-1982 trawl survey data were left out of the fit and Grant made a few minor but helpful housekeeping changes to the model configuration. Model 2b was fitted only in the EBS.
- Model 3 was the same as Model 2b except that ageing error was estimated internally.
- Model 3b for the EBS was the same as Model 3 except that the standard deviation of length at age was estimated internally, the mean length-at-age data were left out of the likelihood, and all length frequency data were used. In Model 3b for the GOA, there were also some constraints on survey catchability, survey selectivity, and ageing error parameters to keep the estimates reasonable and to approximate more closely the amount of survey variability estimated in the EBS.
- Model 4 for the EBS was the same as Model 3b except that all age composition data were left out of the fit (to avoid the whole issue of ageing error). Model 4 for the GOA also had a constraint on pre-1977 recruitment.

In the EBS, all of the models produced similar estimates of historical recruitment and present abundance, and similar fits to the survey biomass estimates. All of them also predicted mean length at age among younger fish in good agreement with the modes in the survey length frequencies. In the GOA, Models 1 and 3 produced similar estimates but Models 3b and 4 produced much higher estimates of abundance and estimates of historical recruitment that differed from each other and from the first two models. The higher abundance estimate by Model 3b resulted mainly from its much lower estimate of survey selectivity at 60-80 cm. In the GOA, Model 3 fitted the age data better than Model 3b, and showed more between-year variation in estimated survey selectivity.

Grant showed some graphs of variation among years in mean length at age 1. This variation adds to the variance of length at age 1 when the model is fitted, so external estimates of the standard deviation of length at age tend to be too low. For that reason Grant felt that the models that estimated the standard deviation internally (3b and 4) were superior in that respect.

Grant also reported jitter tests for all models. Convergence is still weak for some, especially in the GOA. It was questioned whether the jitter tests were meaningful, given that the jitters were scaled to the very wide bounds on the parameters. He suggested that the tests be run with the "Fballpark" penalty, which leads the parameter vector to a realistic neighborhood during the first phase of minimization, avoiding excursions to extreme regions of parameter space.

In the assessment document Grant had set out some criteria for model selection based on CIE, SSC, and other recommendations. These criteria included: (i) the model should continue to be fitted to the age composition data, (ii) the ageing error should be estimated internally, (iii) the model fit should estimate the desired value of the product of survey catchability and selectivity at 60-81 cm (0.47 in the EBS and 0.92 in the GOA), and (iv) the model should estimate the full variance of length at age. By these standards Model 3b was the clear choice in the EBS. In the GOA none of the models had all the desired features and Grant settled on Model 3 on the grounds that it had all of the most important features.

After some discussion the Teams endorsed the author's decision to estimate ageing error internally and continue fitting to the age data. It was noted, however, that the ageing error estimates were troubling. In the EBS, both of the models that estimated ageing error (Models 3 and 3b) produced very similar estimates of the ageing error parameters, but in the GOA, Models 3 and 3b produced parameter estimates that were quite different from each other and from the EBS values. It appears that in the GOA these parameters are not well determined by the data.

The Teams also supported the practice of relying on the target values of survey catchability times selectivity at 60-81 cm to scale the abundance estimates. The empirical support for these values is not strong, but both values are plausible, they are the best external estimates available, and at this point we still need an external estimate to scale the fits. Bob Lauth reported on planned field work using a Didson sonar to investigate the vertical distribution of cod in front of the EBS survey trawl, and paired tows with the EBS and GOA survey trawls to see whether the higher-opening GOA trawl (7 m vs 2.5) catches substantially more cod in the EBS. **The Teams strongly support this research**. We feel that more information on survey catchability is needed to inform the assessment.

At the same time, **the Teams encouraged the author to try estimating survey catchability internally again.** It is possible that with the other improvements made in this assessment, catchability will be estimable, at least in the EBS assessment.

2.2 BSAI Plan Team

2.2.1 Eastern Bering Sea

Grant Thompson presented the Pacific cod assessment. The various candidate models for this year's harvest specifications were discussed by the joint teams (see JPT minutes). In the EBS, Model 3b was the clear choice by the standards adopted by the author and the teams. The BSAI team agrees with the specifications based on Model 3b recommended by the author.

In addition to the joint teams' recommendations, **the BSAI team recommends that the author check for any poor fits to commercial length frequencies that might indicate a change in selectivity**

resulting from the implementation of Amendment 80 in 2008 and the creation of longline cooperatives in 2010.

2.2.2 Aleutian Islands

The team discussed two alternatives for accounting for the Aleutians in the ABC: a Tier 5 calculation based on Kalman filtering of the Aleutian survey biomass estimate, or a simple expansion of the ABC from the EBS assessment by the ratio of AI and EBS survey estimates (presently 9%). The team preferred the second method, which has been the standard. The combined BS/AI specifications were calculated this way.

2.3 GOA Plan Team

Grant Thompson provided an overview of the Pacific cod model considered in this year's assessment in the Joint Plan Team meeting. The various candidate models for this year's harvest specifications were discussed by the joint Teams (see JPT minutes). In the GOA, Model 3 and 3b were chosen for further consideration by the Plan Team based on the criteria adopted by the author. The authors' preferred model was Model 3. Although model Model 3b had better diagnostics for some of the model fits, estimates of the product of survey catchability and selectivity was lower than that observed by Nichol et al.(2007) which resulted in Model 3b having stock size estimates that were much higher than Model 3. The Team noted that retrospective analyses indicated that when data were added the revised abundance estimates in the most recent years tended to be lower. The Team agreed with the author and selected model 3 and also noted that since the retrospective patterns seemed to indicate an upward bias, a more conservative and consistent approach is warranted.

The Team discussed ideas for field work that could help with some of the uncertainties in the stock assessment. The model estimates that age-2 cod have a lower selectivity than age-1 cod. Field work to identify locations of age-2 Pacific cod may help support this model result. Also discussed were studies to directly estimate ageing bias using methods such as samples from known-aged tagged fish similar to what has been done for sablefish.

The Team pointed out that the ageing error bias is estimated to be different between the GOA and Bering Sea. They **encouraged exploration of this phenomenon and in particular, how estimates of ageing bias affect model results.**

The Team discussed the Kalman filter approach for areal apportionment of ABC. Similar to sablefish, the Team reasoned that variations between apportionment schemes are unlikely to have biological consequences in terms of stock conservation. The Kalman filter approach and past methods using unweighted proportions give similar results and both were acceptable to the Team.

2.4 SSC

Since last year's assessment, the Pacific cod models underwent a CIE review and, as in 2010, model proposals from stakeholder were considered. These were reviewed by the Joint Plan Team in May/September and by the SSC in June/October to reduce the numerous recommendations from the CIE review, Plan Teams, SSC, and the public to a more manageable set of five models that were brought forward in this year's assessment.

The SSC appreciates the tremendous work that went into improvements to the Pacific cod model in recent years and thanks the author for clearly laying out the recent history of the assessment models. For next year's assessment cycle in both areas, the SSC supports the current protocol of vetting models through a public process and selecting a limited set of models to bring forward. We agree with a recommendation from the CIE review that the number of explorations and new model configurations for upcoming assessments should be reduced to allow for a thorough evaluation of the performance of the current model over several assessment cycles.

The author proposed seven model evaluation criteria; 1) fitting the age composition data (unanimous CIE recommendation), 2) internal estimation of aging error bias (much more efficient), 3) correspondence between the model-estimated mean size-at-age and the empirical survey mean size-at-age of the first three modes of the average survey size composition, 4) correspondence of the product of survey catchability and survey selectivity (for the 61 to 80 cm size range) from the model and the value of 0.92 estimated by Nichol et al. (2007), 5) accounting for full variability in the observed length-at-age among individuals and years, 6) low temporal variability in survey selectivity and catchability, and 7) reasonable retrospective behavior. The Plan Team endorsed, and **the SSC concurs, with these selection criteria, which are a distillation of past preferences and recommendations from the Plan Teams, CIE reviewers, the public, and the SSC.**

One of the largest sources of uncertainty in both assessments remains the catchability of Pacific cod in the survey. **The SSC strongly supports proposed research on the vertical distribution of Pacific cod relative to the EBS bottom trawl and comparisons between the EBS and GOA trawl gear.**

Other comments that pertain to both areas:

- The SSC notes that weight-at-age in both regions was lowest in May-Aug. or Sept.-Oct. and highest in Jan.-Feb. These patterns seem somewhat counter-intuitive and we encourage the authors to evaluate biological basis for these patterns.
- The recommended models for both regions estimate ageing bias as a linear function of age, but the estimated patterns in bias by age differs by region increasing from approximately 0.34 at the youngest age to 0.85 at the oldest age in the BSAI assessment (model 3b), but decreases from 0.36 to 0 at the oldest age in the GOA assessment (model 3).

2.4.1 <u>BSAI Pacific cod</u>

Public testimony was provided by Kenny Down (Freezer Longline Coalition), who urged the SSC to continue the current protocol of vetting models in a public process. The FLC supports continued work on determining catchability and supports selection of model 3b and the associated ABC for 2012.

For this year's assessment, the 2010 preferred model, as accepted by the SSC in December 2010, was updated with new data and was used as the base model for 2011 as requested by the SSC. Other models were used to explore a number of incremental changes to the base model and their consequences. The author and the Plan Team recommend model 3b, which includes the following features: 1) Natural mortality is fixed at M = 0.34, 2) pre-1982 trawl survey data were are excluded, 3) ageing bias is estimated internally as a linear function of age (previously, bias was fixed at 0.4 across ages), 4) commercial length composition data are fitted with length-specific selectivities by fishery, estimated in blocks of years, 5) Trawl survey age composition data are fitted with age-specific selectivities, 6) catchability is fixed at 0.77 based on limited tagging experiments, 7) standard deviations of length-at-age are estimated internally as a linear function of length-at-age, and 8) mean length-at-age data are not included in the likelihood. In addition, a number of other, sensible changes were made as previously reviewed and recommended by the Plan Team and the SSC.

Survey biomass increased substantially between 2009 and 2010 and showed a moderate increase in 2011. All model-based estimates of total biomass have been increasing for the last three years and are expected to increase further due to above-average recruitment in 2006, 2008, and possibly in 2010, although the 2010 estimate is highly uncertain and has only been observed once in the survey.

Based on the proposed selection criteria, model 3b was the clear choice. Model diagnostics and a comparison of likelihoods suggest that model 3b provides a reasonable fit overall and the best fit to the age composition data. **The SSC agrees with the author and Plan Team to use model 3b for stock status determinations in 2012, and sees no compelling reason to reduce the ABC from the maximum permissible value under Tier 3a as summarized below in metric tons:**

Stock/		**2012**		**2013**	
Assemblage	**Area**	**OFL**	**ABC**	**OFL**	**ABC**
Pacific cod	BSAI	369,000	314,000	374,000	319,000

The SSC requested in its December 2010 minutes that a separate assessment for the AI be brought forward because of concerns over diverging trends in the biomass estimates for the AI and EBS. In response, the author provided a Tier-5 assessment for AI cod as an appendix to the current assessment. The author plans to develop an age-structured model for the Aleutians in 2012. We look forward to reviewing a preliminary model in October 2012.

2.4.2 GOA Pacific cod

No public testimony was provided specific to the GOA assessment, but see the above BSAI cod section above for general testimony on the cod assessments. The current GOA assessment was updated with new survey and commercial data series for CPUE, catch at age, and catch at length. The 2011 bottom trawl survey estimated a 33 % decrease in abundance over the 2009 survey estimate, but this was still a 199% increase from the 2007 estimate.

Models considered for the GOA cod assessment were similar to those for the BSAI assessment. The 2010 preferred model, as accepted by the SSC in December 2010, was updated with new data and was used as the base model for 2011 (model 1). Other models (models 3, 3b, and 4) were similar to the corresponding models for the BSAI and included the following features: 1) model 3 included internal estimation of the aging bias as a linear function of age, a modification of the L1 parameter in the length-at-age equation to correspond to the age of age 1 fish at the time of the survey, and external estimation of the variability in length-at-age, 2) model 3b was similar to model 3 but estimated variability in length at age internally, was not fit to the mean size at age data, fixed the selectivity and catchability for the 27cm-plus size classes in the trawl survey to be constant over time, and used a normal prior distribution for the catchability deviations in the sub-27 cm size class, and 3) model 4 was similar to model 3b but excluded all age composition data and constrained the pre-1977 mean recruitment to be less than the post-1976 mean recruitment. In addition, a number of other sensible changes were made as previously reviewed and recommended by the Plan Teams and the SSC.

Because no model met all of the selection criteria, the criteria were prioritized with the highest priority placed on criteria 1-4. The author recommended model 3 because of the good fit to the age composition data, estimating ageing bias internally, a good match between estimated and observed size modes at ages 1 and 3, and a good fit to the Nichol et al. (2007) estimate of the product of survey catchability and selectivity. The Plan Team agreed with the author's choice and also noted that the retrospective patterns indicate that inclusion of additional data tends to decrease estimates of abundance, which supports models with a higher level of survey catchability, such as models 1 and 3.

Based on these considerations, model diagnostics, and an examination of the likelihood components, **the SSC accepts the Plan Team's and the authors' preferred model (model 3), Tier 3a designation, and the 2012/13 ABC and OFLs shown below in metric tons.** With respect to area apportionments, the SSC requested in December 2010 that the simple Kalman filter approach, which has been used to estimate the proportions of Pacific cod biomass in the EBS and AI since 2004, be applied to the GOA as well. We heard that a special working group intends to review and standardize approaches to area apportionments across stock assessments to improve consistency. Until the group makes its recommendations, the SSC endorses the status quo method for area apportionments based on the three most recent surveys, resulting in area apportionments of 32% Western, 65% Central, and 3% Eastern:

Stock/ Assemblage	**Area**	**2012 OFL**	**2012 ABC**	**2013 OFL**	**2013 ABC**
Pacific Cod	W		28,032		29,120
	C		56,940		59,150
	E		2,628		2,730
	Total	104,000	87,600	108,000	91,000

The SSC raised two concerns about the current model. First, authors' use of jitter runs is intended to ensure that the model converges to a global minimum of the objective function. We note that of the 50 runs included in the final jitter runs (Fig.2.12), no two model runs resulted in same estimates for any of the models except model 3b and that the objective value function (on the log-likelihood scale) differs substantially among runs. This suggests that there is still considerable uncertainty about whether the model has converged to the "best" solution. The SSC suggests that a further reduction in the number of parameters may be warranted to improve convergence. Secondly, based on the preferred model (model 3), the estimated fishing mortalities have exceeded F_{ABC} in the past 5 years (F_{OFL} in 2 years), suggesting that additional scrutiny for this stock may be warranted. However, current stock status indicates an increasing biomass trend supported by several years of above-average recruitment. Therefore the SSC concurs that a reduction from the maximum permissible ABC is not warranted at this time.

$p(\boldsymbol{\theta} \mid \mathbf{y}) = \begin{Bmatrix} \mathbf{Q} \\ \mathbf{R} \\ \mathbf{A} \end{Bmatrix} \begin{matrix} \textit{uantitative} \\ \textit{esource} \\ \textit{ssessment} \end{matrix}$

LLC

Quantitative Resource Assessment LLC

San Diego, CA
USA.

3 Bering Sea Pacific Cod Stock Assessment Model Scenarios Requested by FLC/QRA

3.1 Introduction

Requesting model scenarios for the Pacific cod stock assessments without knowledge of the assessment authors preferred model and alternatives greatly complicates the process. Therefore, we request that the assessment author use his best judgment when interpreting our requests and contacts us with any questions about the scenarios. We include our previous commentary of the CIE reviewers' reports that the assessment author, Plan Team, and SSC, can use as a guide in creating their own scenarios or interpreting the scenarios that we request (see Appendix).

3.2 BS Scenarios Requested

1) Model 3b, last year's base case model. We assume that this will automatically be one of the models.
2) Model 3b with survey catchability adjusted so that the product of catchability and selectivity is similar to that estimated by Nichol et al. (2007).
3) Model 3b with temporal variation in growth. We will leave it to the assessment author to decide which growth parameters should vary or if cohort specific growth should be used.
4) Model 4, last year's model and or this year's preferred model that excludes the age data.

3.3 GOA Scenarios Requested

1) Model 3b (which was not the base case) with survey catchability adjusted so that the product of catchability and selectivity is similar to that estimated by Nichol et al. (2007).

3.4 Appendix: Report on the Pacific cod CIE review

3.4.1 Summary

The three reviewers generally agree that the Pacific cod assessment is based on the best available science, but there a few areas that need improving through additional research and data collection. The reviewers did not provide any novel suggestions that would greatly improve the assessment or deal with the remaining issues.

The review process followed a set of questions outlined in the terms of reference. I present my summary below based on these questions. I have also added topics addressed by the reviewers that were not included in the terms of reference. My recommendations are provided at the bottom of each section in italics. I also summarize my recommendations that are relevant to choosing the 2011 model assumptions.

3.4.2 Assumptions for 2011 model

Further investigation is needed to determine the appropriate method to model and estimate the aging error and selectivity parameters.

Include the age composition data and the length composition data (or age conditioned on length and length composition) for all years if an appropriate aging error matrix can be generated, otherwise exclude the age data.

Include the conditional age at length data and the length composition data, rather than the mean-size-at-age data, and estimate the variation in length at age inside the stock assessment model.

Keep the current data partitioning.

Use dynamic binning for composition data

Eliminate the pre 1982 survey data.

Time blocks should be determined by initially modeling selectivity as a random walk.

Fix the catchability at the value estimated by Nichol et al. (2007).

Fix natural mortality at the value from Jensen's (1996) equation.

Use the bootstrap method to estimate the samples sizes, scale them so that the average is 300, then use iterative reweighting to update the samples sizes by fitting the Michaelis–Menton equation to the observed and effective samples sizes.

Model time invariant survey selectivity, but model temporal changes in growth.

Fix the standard deviation of recruitment the annual residuals at 0.6 and test the sensitivity of management parameters to 0.4 and 0.8.

3.4.3 Terms of reference topics

3.4.3.1 Use of age composition data

The reviewers acknowledge that there is aging error/bias. They recommend including the age composition data in the assessment model in conjunction with an aging error matrix. They noted that excluding the aging data caused some undesirable model behavior. The reviewers also recommended continuing the research into the sources of the aging bias.

There was some concern that the age composition data used the same information as the length composition data so that the data was used twice. This needs to be clarified. However, double weighting of data is not too concerning since the weights are arbitrary in the current model. If the weights are "estimated" inside the model, then the issue of double weighting needs to be addressed.

Include the age composition data and the length composition data (or age conditioned on length and length composition) for all years if an appropriate aging error matrix can be generated (see below), otherwise exclude the age data.

3.4.3.2 Use of mean-size-at-age data

The reviewers recommend excluding the mean-size-at-age data, particularly if temporal variation in growth is not modeled. The mean-size-at-age data is the same data as used in the age composition and length composition data so the data sets are not independent.

Include the conditional age at length data and the length composition data rather than the mean-size-at-age data. This data provides information on variation of length at age, mean length at age, and temporal variation in mean length at age. The appropriate data to include also needs to consider the information required to estimate an aging error matrix.

3.4.3.3 Use of ageing bias as an estimated parameter

The reviewers did not agree on whether estimating the aging bias in the assessment model was the best approach. The models run during the review were not adequate to determine if the aging bias could be estimated appropriately. More research is needed on the form of the aging error and bias and whether it can be estimated within the stock assessment model.

The aging error comes from at least two sources: 1) variability in reading the ages as indicated by double reading and 2) bias due to "false" rings being formed or the edge effect. An appropriate functional form for the aging error needs to be developed that can accommodate these two sources of error. We need to obtain the model files and investigate the appropriate method to model and estimate the aging error.

3.4.3.4 External estimation of between-individual variability in size at age

All three reviewers suggest estimating the variation of length at age outside the stock assessment model. This is partly due to undesirable model behavior when it was estimated inside the model.

The model does not include age conditioned on length data and therefore ignores some of the information available to estimate variation in length at age. Estimating variation in length at age outside the model does not take account of the aging error or selectivity. Variation in length at age should be estimated inside the model while including the age conditioned on length data. The development of a more appropriate growth model should also improve the models estimates of variation in length at age.

3.4.3.5 Catch data partitioned by year, season, and gear

The reviewers consider that the current catch data partitioning is appropriate. One reviewer noted that there is uncertainty in the catch estimates and this should be investigated.

Keep the current catch partitioning. Consider investigating a model that combines all catch into a single fishery for each season (it might be appropriate to reduce or eliminate the number of seasons) and use time varying selectivity for the fishery (the approach used by Ianelli for assessing pollock). The length composition data would need to be raised to the total catch within each fishery and summed across fisheries.

3.4.3.6 Size composition data partitioned by year, season, gear, and 1-cm size intervals

The reviewers consider that the current size composition data partitioning is appropriate. They recommended using dynamic binning to reduce the number of zeros in the likelihood function.

Keep the current size composition partitioning and use dynamic binning.

3.4.3.7 Age composition data partitioned by year, season, and gear

The reviewers consider that the current age composition data partitioning is appropriate. The reviewers were ambivalent about the use of the pre 1982 survey data because it probably does not influence the results.

Keep the current age composition partitioning and eliminate the pre 1982 survey data.

3.4.3.8 Functional form of the length-at-age relationship and estimating the parameters thereof

The reviewers noted the poor performance of the Richards growth curve due to the need to constrain one of the parameters to be positive.

A new growth curve needs to be developed for the Pacific cod assessment and implemented in Stock Synthesis.

3.4.3.9 Number and functional form of selectivity curves estimated, including assumptions regarding which selectivity curves should be forced to exhibit asymptotic behavior

The reviewers suggested that at least one selectivity curve should be asymptotic. They also suggested that a random walk should be used to model time varying selectivity to identify changes is selectivity and use this to determine where the time blocks should be applied.

The reviewers did not understand the types of selectivity curves available in Stock Synthesis. A selectivity curve can be created as a random walk over age (or length). This would allow a bimodal selectivity curve. The parameter for each age (the age offset) can also be modeled as a random walk over time, as can the parameters for functional forms.

A more robust approach is needed to model selectivity and determine which selectivity curves are asymptotic. Time blocks should be determined by initially modeling selectivity as a random walk.

3.4.4 Fixing the trawl survey catchability coefficient for the recent portion of the time series such that the average product of catchability and selectivity across the 60-81 cm size range equals the point estimate obtained by Nichol et al. (2007)

The reviewers recommended fixing the catchability at the value estimated by Nichol et al. (2007). They noted that when estimated, the estimate was similar to the Nichol et al. (2007) value. They also recommended collecting more tagging data to improve the estimate.

Fix the catchability at the value estimated by Nichol et al. (2007) and encourage further data collection.

3.4.4.1 Fixing the natural mortality rate at the value corresponding to Jensen's (1996) Equation 7

The reviewers recommended that the value of natural mortality continue to be fixed at the value from Jensen's (1996) equation. They also noted that it should be updated once the aging bias has been addressed and that age-specific natural mortality should be investigated.

Fix natural mortality at the value from Jensen's (1996) equation until the issues in the stock assessment model have been addressed, then estimate natural mortality within the stock assessment model and consider age specific natural mortality.

3.4.4.2 Input sample sizes for size composition and age composition data, and input log-scale standard deviations for survey abundance data

The reviewers recommended that the standard errors used for the survey index of abundance likelihood function should be reevaluated based on the survey design. The reviewers generally agreed with the bootstrap method used to estimate sample sizes, but noted that rescaling the averages to 300 caused the samples sizes to be lower than that suggested by the model fit to the composition data (effective sample sizes).

Use the bootstrap method to estimate the samples sizes, scale them so that the average is 300, then use iterative reweighting to update the samples sizes by fitting the Michaelis–Menton equation to the observed and effective samples sizes.

3.4.4.3 Allowing for annual variability in trawl survey selectivity

The reviewers questioned the need for annual variability in survey selectivity. However, they did recognize that catchability might change over time due to environmental factors such as bottom water temperature.

One reason for allowing the trawl survey selectivity to change over time is to accommodate changes in mean size at age for the young individuals. Temporal changes in catchability could also be due to abundance of different types of prey.

Model time invariant survey selectivity, but model temporal changes in growth.

3.4.4.4 Setting the input standard deviation of log-scale recruitment (σR) equal to the standard deviation of the estimated log-scale recruitment deviations

The reviewers were not conclusive about how to deal with the standard deviation of recruitment residuals. A value of 0.6 is supported by meta-analysis.

Fix the standard deviation of recruitment residuals at 0.6 and test the sensitivity of management parameters to 0.4 and 0.8.

3.4.4.5 Use of survey data and non-use of fishery CPUE data in model fitting

The reviewers recommended continuing to exclude the fishery CPUE data from the estimation of model parameters. One reviewer recommended excluding them completely because they might cause confusion. They recommended that the fishery CPUE data should be standardized.

Standardize the fishery CPUE indices and continue to include them in the assessment model, but not contributing to the estimation of parameters.

3.4.5 Other topics

3.4.5.1 Standardizing the survey

One reviewer suggested that the survey index of abundance be standardized for factors such as vessel, temperature, bottom type, location, and depth using a GLM or GAM. This reviewer also suggested mapping the habitat to improve the survey design.

Standardizing the survey for factors such as vessel, temperature, bottom type, location, and depth is a reasonable approach, but it might be better to post stratify by temperature, bottom type and depth each year rather than simply using a GLM. The habitat mapping could be used in this approach.

3.4.5.2 Jittering

Jittering the initial starting values of the estimated model parameters came up several times in the reviews. Jittering is a method to make sure that parameter estimates are the best values given the data and model assumptions. This is done because several years ago the model put forward had not converged properly and a better set of parameter values was found prior to the SSC meeting. The sensitivity of results to initial parameter values is probably caused by the selectivity curves. The need to jitter the starting values greatly increases the amount of time needed to do the assessment.

The model needs to be made more stable so it does not need jittering. This might be achieved by developing more robust selectivity curves.

3.4.5.3 Year to year changes in the model structure

The reviewers questioned the changes in model assumptions from year to year and suggested that the model structure should be fixed for a few years and the assessment only include updated data. In the years between “benchmark assessments” research could be carried out to improve the model.

Fixing the model structure for a few years is a reasonable approach to deal with several practical issues, but it would require the existence of a reasonable model. Unfortunately, and despite the substantial progress made on the Pacific cod assessment, there are still a few major issues that need to be resolved.

3.4.5.4 Tagging studies

The value of tagging studies came up several times in the reviewers’ reports. The obvious need is to determine catchability for the survey using archival tags. However, well designed conventional tagging studies could be used to provide information on selectivity and natural mortality, validate aging, estimate abundance and exploitation rates, and evaluate stock structure.

A well designed and comprehensive tagging study is highly recommended.

3.4.5.5 Alternative modeling environments

The reviewers noted that alternative modeling environments might be useful to either customize model assumptions or double check model results. Developing a completely new customized assessment model for Pacific cod with all the functionality needed for sensitivity test would be a substantial task. It would be much better to request that the Stock Synthesis code be modified into a form that makes customization easy. Stock Synthesis can be configured to replicate either exactly or approximately many other stock assessment models and it would be better to apply simplifications of Stock Synthesis rather than using other models. The main reason to use another model is to identify programming errors in Stock Synthesis.

Request that Stock Synthesis becomes more user customizable.

3.4.5.6 Over parameterization

The reviewers mentioned several times that the models are over parameterized or nearly so. I doubt if this is correct. The issue is more likely related to poor model structure and parameterization (i.e. the selectivity curves).

The models are not over parameterized, but work needs to be carried out to make the model more stable.

3.4.5.7 Management strategy evaluation

The reviewers recommend continuing the management strategy evaluation work.

Management strategy evaluation (MSE) is very useful, but time consuming. Solving some of the issues in the assessment model are higher priority than the MSE work.

3.4.5.8 Diagnostics

The reviewers suggested several diagnostics that should be applied to the stock assessment including retrospective analysis, residual analysis, and evaluation of the correlation matrix to identify parameters that are highly correlated.

These are useful diagnostics and could be used to help select which model assumptions are appropriate. Retrospective analysis should not be used to determine the size or direction of the bias, only that some form of model misspecification exists.

3.4.5.9 Dynamic reference points

One reviewer noted that auto correlated recruitment may cause the abundance to drop below management reference levels even if the fishing mortality is relatively low.

Consider instituting dynamic reference points that take account of variation in recruitment

4 Summary of 2012 Pacific cod model recommendations from the BSAI senior author

4.1 2011 preliminary Model A revisited

At this point, I would like to consider a model similar to Model A from the 2011 preliminary BSAI assessment (Joint Plan Team comments pertaining to Model A are listed at the end of this attachment). A few features of Model A were incorporated into Model 3b in the final assessment (Model 3b was ultimately adopted by the Plan Team and SSC). The features of Model A that I would like to explore further in this year's preliminary assessment (with a couple of highlighted modifications) are listed below.

Relative to Model 3b in the 2011 BSAI SAFE, the following items would be changed in the data file:

- GGT1. Define fisheries with respect to each of the five seasons, but not with respect to gear (in Model 3b, fisheries were defined with respect to both season and gear).
- GGT2. Eliminate fishery CPUE data (in Model 3b, fishery CPUE data were included for purposes of comparison, but were not used in estimation).
- GGT3. Add a new population length bin for fish in the 0-0.5 cm range, which would be used for extrapolating the length-at age curve below the first reference age (in Model 3b, the lower bound of the first population length bin was 0.5 cm).

Relative to Model 3b in the 2011 BSAI SAFE, the following items would be changed in the control file:

- GGT4. Use the Richards growth equation (in Model 3b, the von Bertalanffy equation—a special case of the Richards equation—was used).
- GGT5. Define fishery selectivity curves for each of the five seasons, but not stratified by gear type (in Model 3b, seasons 1-2 and 4-5 were lumped into a pair of "super" seasons, and fisheries were also *gear*-specific).
- GGT6. Choose a single fishery that will be forced to exhibit asymptotic selectivity by determining which fishery comes closest to exhibiting asymptotic selectivity when unconstrained (in Model 3b, the January-April trawl fishery was forced to exhibit asymptotic selectivity).
- GGT7. Model survey selectivity as a function of length (in Model 3b, survey selectivity was modeled as a function of age).
- GGT8. Estimate numbers at age for ages 1-10 in the initial numbers-at-age vector (in Model 3b, only ages 1-3 in the initial numbers-at-age vector were estimated).
- GGT9. Use annual—but not random walk—*dev*s for survey catchability (in Model 3b, survey catchability was constant).
- GGT10. *Initially* (see iterative tuning procedure described below), use annual random walk *dev*s for all estimated selectivity parameters (in Model 3b, certain fishery selectivity parameters were estimated independently in pre-specified blocks of years; the only time-varying selectivity parameter for the survey was *ascending_width*, which had annual—but not random walk—*dev*s)

In addition to the above changes, the following parameters would be tuned iteratively:

- GGT11. Tune the age composition "variance adjustment" (a multiplier applied to the input sample sizes) iteratively such that the mean effective sample size equals the mean input sample size (in Model 3b, this multiplier was fixed at 1.0).
- GGT12. Tune the base value for survey catchability iteratively such that the average of the product of catchability and survey selectivity across the 60-81 cm range equals 0.47, corresponding to the Nichol et al. (2007) estimate (in Model 3b, the base value was left at the value used in the 2009 assessment).

GGT13. Tune σ_{dev} for survey catchability iteratively such that the root-mean-squared-standardized-residual of the survey abundance estimates equals 1.0 (in Model 3b, σ_{dev} for survey catchability did not exist).

GGT14. Tune σ_{dev} for each estimated selectivity parameter iteratively to match the standard deviation of the estimated *dev*s, except remove the *dev*s for any selectivity parameter with an iteratively tuned σ_{dev} less than 0.005. New proposed change relative to last year's Model A: After following the preceding procedure, adjust σ_{dev} for any remaining *dev* vector to account for the model's inability to integrate out random effects, using the method I described at the February SSC recruitment workshop and the April Plan Team recruitment workshop (in Model 3b, σ_{dev} did not exist for any fishery selectivity parameters; the only survey selectivity parameter with a *dev* vector had σ_{dev} set at the value used in the 2009 assessment).

GGT15. Estimate σ_R internally. New proposed change relative to last year's Model A: After following the preceding procedure, adjust σ_R to account for the model's inability to integrate out random effects, using the method I described at the February SSC recruitment workshop and the April Plan Team recruitment workshop (in Model 3b, σ_R was set at the value used in the 2009 assessment).

4.2 Joint Plan Team (September, 2011)

"In Model A …, the catchability and selectivity deviations are treated as random effects but they are not properly integrated out. The MLEs are therefore suspect, and the iterative tuning may produce pathological results."

"Allowing survey catchability to vary from year to year, perhaps substantially, achieves a better fit to the data but at the expense of discounting the relative abundance data. Some members felt strongly that this was a mistake. The survey catchability estimates produced by Model A seemed to be missing in the presentation."

"The great variability of survey selectivity estimates from Model A is a clear indication that the model is overfitting the data."

"In view of the many new features in Model A and several concerns about it, the Teams do not favor including it … as one of the candidates in November."

5 Summary of 2012 Pacific cod model recommendations from the Plan Teams, SSC, and public

5.1 Joint Plan Team (November, 2011)

JPT1: “The Teams encouraged the author to try estimating survey catchability internally again. It is possible that with the other improvements made in this assessment, catchability will be estimable, at least in the EBS assessment.”

5.2 BSAI Plan Team (November, 2011)

BPT1: “The BSAI team recommends that the author check for any poor fits to commercial length frequencies that might indicate a change in selectivity resulting from the implementation of Amendment 80 in 2008 and the creation of longline cooperatives in 2010.”

5.3 GOA Plan Team (November, 2011)

GPT1: “The Team pointed out that the ageing error bias is estimated to be different between the GOA and Bering Sea. They encouraged exploration of this phenomenon and in particular, how estimates of ageing bias affect model results.” (See also SSC3.)

5.4 SSC (December, 2011)

5.4.1 EBS and GOA

SSC1: “We agree with a recommendation from the CIE review that the number of explorations and new model configurations for upcoming assessments should be reduced to allow for a thorough evaluation of the performance of the current model over several assessment cycles.”

SSC2: “The SSC notes that weight-at-age in both regions was lowest in May-Aug. or Sept.-Oct. and highest in Jan.-Feb. These patterns seem somewhat counter-intuitive and we encourage the authors to evaluate biological basis for these patterns.”

SSC3: “The recommended models for both regions estimate ageing bias as a linear function of age, but the estimated patterns in bias by age differs by region increasing from approximately 0.34 at the youngest age to 0.85 at the oldest age in the BSAI assessment (model 3b), but decreases from 0.36 to 0 at the oldest age in the GOA assessment (model 3).” (See also GPT1.)

5.4.2 GOA only

The SSC raised two concerns about the current model.

SSC4: “First, authors’ use of jitter runs is intended to ensure that the model converges to a global minimum of the objective function. We note that of the 50 runs included in the final jitter runs (Fig. 2.12), no two model runs resulted in same estimates for any of the models except model 3b and that the objective value function (on the log-likelihood scale) differs substantially among runs. This suggests that there is still considerable uncertainty about whether the model has converged to the ‘best’ solution. The SSC suggests that a further reduction in the number of parameters may be warranted to improve convergence.”

SSC5: “Secondly, based on the preferred model (model 3), the estimated fishing mortalities have exceeded F_{ABC} in the past 5 years (F_{OFL} in 2 years), suggesting that additional scrutiny for this stock may be warranted.”

5.4.3 AI

SSC6: “The SSC requested in its December 2010 minutes that a separate assessment for the AI be brought forward because of concerns over diverging trends in the biomass estimates for the AI and EBS. In response, the author provided a Tier-5 assessment for AI cod as an appendix to the current assessment. The author plans to develop an age-structured model for the Aleutians in 2012. We look forward to reviewing a preliminary model in October 2012.”

5.5 Freezer Longline Coalition (April, 2012)

5.5.1 EBS only

FLC1: “Model 3b with temporal variation in growth. We will leave it to the assessment author to decide which growth parameters should vary or if cohort specific growth should be used.”

FLC2: “Model 4, last year’s model and or this year’s preferred model that excludes the age data.”

5.5.2 EBS and GOA

FLC3: “Model 3b … with survey catchability adjusted so that the product of catchability and selectivity is similar to that estimated by Nichol et al. (2007).”