Excerpt from the minutes of the BSAI Plan Team (Nov. 2010; no recommendations)

The joint Teams accepted the author's preferred Model B (see Joint Team Minutes). Therefore the remaining issue for the BSAI Team was the OFL and ABC recommendations and ABC area apportionments.

Mike Sigler accepted the model, but suggested that the values of natural mortality and trawl survey catchability were uncertain; he noted that the stock size estimates included a lot of small fish from incoming year classes. Bill Clark observed that the uncertainty of M and q were not very different from other assessments and had been fully discussed in September. Grant Thompson said that small fish were only a small part of the author's recommended ABC for 2011. The Team approved the author's recommended OFL and ABC, set according to the standard control rule for a Tier 3b stock. Still, because of the influence of the incoming 2006 and 2008 year classes on projected biomass, the Team notes that the 2012 estimate may be lower next year than projected this year.

Kerim Aydin observed that in the absence of an area apportionment between the Bering Sea and Aleutian Islands, the exploitation rate of cod in the Aleutian Islands continued to be about twice that in the Bering Sea (based on simple ratios of catch and survey abundance), and biomass continued to decline in the Aleutian Islands. A member of the public commented that for various reasons (including Steller sea lion mitigation measures) cod catches in the Aleutians were unlikely to increase and were very likely to decline in 2011. The Team is nonetheless still concerned about the disproportionate exploitation of cod in the Aleutian Islands and recommends the earliest possible implementation of separate area ABCs.

Applying the Kalman filter approach to the updated (through 2010) time series indicates that the best estimate of the current biomass distribution is 91% EBS and 9% AI, replacing the previous proportions of 84% and 16% respectively.

The author informed the Team of his plans to develop a separate AI Pacific cod assessment in the near future.

Excerpt from the minutes of the GOA Plan Team (Nov. 2010; recommendation <mark>highlighted</mark>)

The Plan Team accepts model B, and the associated ABC and OFL levels with the caveats and concerns about the discrepancy between the pattern of last years numbers at age and those estimated in this assessment. The Team appreciated the authors' effort in reducing the number of models for presentation.

The Team questioned why the pattern in numbers at age is so different this year compared to last year's assessment given that very little data has been added. In particular, the 2009 survey showed lots of one-year olds but they do not appear to be reflected in the model estimates. This appears to result in a declining trend in the projection model compared to a rapidly increasing trend from last year's version. It was noted that the numbers at age used in last years projection model will be different than the numbers at age for this year's model. The difference may be in the demographic parameters as specified (there were some difficulties converting stock synthesis output to age-specific schedules required for the projection model) but should be explained.

For all models, the recruitment deviation in 2008 appears to go to zero (as reflected in Figure 2.2b) and that appears contrary to the 2009 survey data. The senior author noted that the selected model had survey catchability deviations set to zero in 2009 (along with the recruitment deviation). Also, size at age 1 is really different last couple of years.

<mark>The Team noted that it would be useful to have a presentation of the estimates relative to the data, particularly for the most recent survey (and sub-27 cm abundance index).</mark> The ABCs in historical

perspective indicate that even with a 2012 ABC of 78,200 it would be third highest catch in history (noting that the TAC drops below the ABC due to the state fishery).

Excerpt from the minutes of the Joint Plan Teams (Nov. 2010; non-recommendation <mark>highlighted</mark>)

Grant Thompson presented the BSAI and GOA assessments, both of which used essentially the same three models. The models were chosen in the course of two rounds of trials and reviews by the Teams and the SSC (in May/June and September/October). Model A was the 2009 preferred model, whose main features were:

(i) Natural mortality M = 0.34 fixed externally.

(ii) Length-specific commercial selectivities, estimated in blocks of years, some forced to be asymptotic. Commercial age compositions fitted where available, length compositions where not. Commercial CPUE not fitted.

(iii) Age-specific trawl survey selectivity with annually varying left limb. Trawl survey age composition and CPUE fitted. The product of catchability and selectivity of 60-80 cm fish required to be 0.47 based on a small set of data from archival tag recoveries.

(iv) IPHC longline survey length compositions (not CPUE) fitted.

(v) Cohort-specific growth parameters, with the standard deviation of length at age estimated externally.

(vi) Aging bias of of +0.4 years at all ages estimated by profiling and accounted for.

(vii) Input standard deviations of a number of parameters estimated iteratively so as to match output standard deviations.

Model B was the same as Model A with some incremental modifications, viz:

(i) Smaller length bins (1 cm instead of 3 and 5) to make full use of the length data.

(ii) Five fishery seasons were modeled instead of 3.

(iii) A single growth schedule was fitted.

(iv) The few fishery length-at-age data were left out.

(v) IPHC survey length data were left out.

(vi) Parameter values estimated iteratively in the 2009 assessment were carried over to Model B.

Model C was the same as Model B but all age composition and length-at-age data were left out because of concern about aging bias.

Recent survey results affected all model fits. GOA survey abundance increased by 200% in 2009 and EBS survey abundance by 100% in 2010.

Convergence was an issue for almost all models. In fitting the models, first a best estimate was located by perturbing ("jittering") the parameter vector at successive local minima. Reproducibility of the best estimate was then tested by jittering the best estimate and refitting many times. The best estimate was seldom relocated. The CV of the present biomass estimate in these trials was about 3% for Model A in the EBS and 10-20% for Models B and C in the EBS and all models in the GOA.

All model fits to EBS survey abundance were good, and to GOA survey abundance similar. All models fitted the catch length compositions well. Models A and B fitted the age compositions well.

Model A approximated the modes in EBS survey length frequencies reasonably well, but Model B less well. Model C matched the modes very closely but at ages that were high by a year because the fitted growth schedule was permitted to be negative at age one. Grant explained that this could happen because there were no age or size-at-age data whatsoever in the model, so the model could fit the data with length-at-age (and survey selectivity at age) shifted relative to Models A and B. This anomaly could easily be fixed.

All models estimated produced similar estimates of EBS trawl survey selectivity. In the GOA the survey selectivity estimates from Models A and B were extremely variable, to the point of being hardly believable. The estimates for Model C were also quite variable but much less so.

Historical abundance estimates for all models were similar in the EBS. In the GOA Models A and B were similar but Model C estimated very high levels of abundance in the 1970s, which Grant thought were impossible.

Grant adopted a number of criteria for choosing a best model, according to which Model B was better than Model A (better bin and season structure, more parsimonious), and Model C was disqualified because of the anomalous length-at-age in the EBS and the impossible abundance estimates in the GOA. Both Teams agreed with Grant's choice of Model B and his rationale.

Grant previewed upcoming developments in the cod assessment: the option in Stock Synthesis of fitting a Richards growth schedule (with positive lengths at age one) instead of the von Bertalanffy, the possibility of estimating aging error internally, a CIE review in March/April, and possibly an Aleutian Islands assessment. In view of the impending CIE review, the Teams did not attempt at this meeting to formulate any requests for modeling work. But we do want the Teams and the SSC to review the CIE recommendations (and any public submissions) in the May/June period before Grant settles on a program of work for the September/October meetings. We would ask REFM to schedule the CIE review accordingly.

Excerpt from the minutes of the SSC (Dec., 2010; recommendations highlighted)

BSAI and GOA Pacific cod

The SSC commends the authors for their thorough and conscientious responses to public, Plan Team, and SSC recommendations. Kenny Down (Freezer Longliner Coalition) provided public testimony on BSAI Pacific cod. He supports the authors preferred model and model estimates and commented that the process was good and many improvements were made such as constant growth. Julie Bonney (Alaska Groundfish Databank) expressed concerns about an increased ABC this year and then declining thereafter.

The Pacific cod assessments and data that went into the assessment have received a great deal of scrutiny over the last few years. There continues to be concern on the accuracy of age readings. Other issues include the natural mortality rate, the trawl survey catchability coefficient, the modeling of commercial selectivity (variable or not, asymptotic or not, fishery by fishery), modeling of survey selectivity, and the modeling of growth (constant, cohort-specific, year-specific).

Since last year, many changes have been considered or made, based on recommendations from the public, the Plan Teams and the SSC. To streamline the model evaluation process, a set of six models were presented in this year's preliminary assessment, as requested by the Plan Teams in May, and reviewed by the SSC in June of this year. Following Plan Team review in September and SSC review in October a final set of three models were requested to be included for final evaluation. The three candidate models (A, B, and C) were considered in developing the 2011 and 2012 OFL/ABC specifications. Model A is

identical to the model accepted for use by the BSAI Plan Team and SSC in 2009 and the only model from the preliminary assessment to be carried forward.

Current Models

Model A was the 2009 preferred model. Main features of model A included: 1) natural mortality M = 0.34 fixed externally, 2) length-specific commercial selectivities, estimated in blocks of years, some forced to be asymptotic, 3) age-specific trawl survey selectivity with annually varying left limb, 4) the average product of catchability and selectivity of 60-80 cm fish required to be 0.47, 5) cohort-specific growth parameters, with the standard deviation of length at age estimated externally, 6) Aging bias of +0.4 years at ages 2+ estimated by profiling, 7) Input standard deviations of a number of parameters estimated iteratively so as to match output standard deviations.

Model B was the same as Model A with some incremental modifications including: 1) smaller length bins (1 cm instead of 3 and 5) to make full use of the length data, 2) five fishery seasons were modeled instead of 3, 3) a single growth schedule was fitted, 4) the few fishery length-at-age data and age composition data were left out, 5) IPHC survey length data were left out, 6) values estimated iteratively in the 2009 assessment were carried over to Model B.

Model C was the same as Model B but all age composition and length-at-age data were left out, because of concern about aging bias.

Model Evaluation

The authors used four criteria to evaluate and select the final model. The criteria include: 1) does the model make full use of the information in the size composition data, 2) has the seasonal structure of the model been justified statistically, 3) is the model sufficiently parsimonious, and 4) does the model estimate plausible lengths at age?

SSC Comments and Recommendations

There will be a CIE review of Pacific cod models in early 2011 and information from this review will be used to produce another suite of models that will be considered for PT and SSC review in the spring.

The SSC has a number of model suggestions that may be considered through the next assessment cycle by the author as time permits:

Evaluate reduced catch season and size bin structures that are more parsimonious, but do not diminish the information content.

Trawl survey catchability used in the assessment and model sensitivity to model estimates or plausible alternatives should be evaluated.

Simplifying trawl survey selectivity should be investigated and model fit to data components evaluated.

Re-tune aging bias to try to better match the observed age modes.

Evaluate estimating aging bias within the model.

Evaluate Richards growth curve alternative.

Continued research that would provide information on age-determination errors and potential biases.

Given the divergence in population abundance between the AI and BS the SSC recommends that an AI assessment be brought forward for evaluation (only) during the next assessment cycle. Biomass

The SSC offers the following modeling issues that could be considered during the CIE review:

BSAI Pacific cod

There were a number of data changes and updates in this year's assessment that included; 1) catch data for 2004-2009 were updated, and preliminary catch data for 2010 were incorporated, 2) commercial fishery size composition data for 2009 and 2010 were updated, 3) age and mean length at age data from the 2009, size composition and numeric abundance information from the 2010 EBS shelf bottom trawl survey were incorporated, 4) seasonal catch per unit effort (CPUE) data for the trawl, longline, and pot fisheries from 2009 were updated, as was the 2010 preliminary catch.

The numeric abundance estimate from the 2010 EBS bottom trawl survey was up 24% from 2009. The IPHC survey 2009 estimate was down 35% from 2008 and was the second lowest point in the time series. The 2010 AI biomass estimate, used to compute the current ratio of BSAI biomass to EBS biomass, was down 26% from the 2006 estimate and was the low point of the time series. Applying a simple Kalman filter approach, adopted by the SSC in 2004, the current biomass distribution is 91% EBS and 9% AI compared to previous proportions of 84% and 16%, respectively.

All model fits to EBS survey abundance were good and produced similar estimates of EBS trawl survey selectivity at age, although the estimates from Model C appeared to be shifted by one year relative to Models A and B. Model A produced the most plausible lengths. Model C matched the modes very closely, but at ages that were higher by a year because the fitted growth schedule was unconstrained.

Model B is thought to have a better defined bin and season structure and was more parsimonious than model A. Model C was disqualified partly due to anomalous length-at-age in the EBS. The SSC agrees with author's and Plan Team's rationale, choice of Model B and Tier 3b designation for calculating the ABC and OFL recommendations, shown below in metric tons. The 2006 and 2008 year classes appear to be strong, and stock abundance is expected to increase substantially in the near term.

Stock/ Assemblage	Area	2011		2012	
		OFL	ABC	OFL	ABC
Pacific cod	BSAI	272,000	235,000	329,000	281,000

GOA Pacific cod

There were a number of data changes and updates that included; 1) catch data for 2004-2009 were updated, and preliminary catch data for 2010 were incorporated, 2) commercial fishery size composition data for 2009 were updated, and preliminary size composition data from the 2010 commercial fisheries

were incorporated, 3) age composition and mean-length-at-age data from the 2009 bottom trawl survey were incorporated into models A and B, 4) age composition and mean length at age data from the 2008 January-May longline fishery were removed from models B and C, 5) seasonal catch per unit effort (CPUE) data for the trawl, longline, and pot fisheries from 2009 were updated, and preliminary catch rates for the trawl, longline, and pot fisheries from 2010 were incorporated, and 6) size composition data from the State-managed Pacific cod fishery for 1997-2009 were updated and 2010 incorporated.

In terms of population numbers and biomass, a record high of 752,651 t was observed by the 2009 bottom trawl survey, when the population was estimated to include over 573 million fish. This followed the lowest observed survey biomass in 2007 of 233,310 t and a 2005 model estimate that was the low point at 140 million fish. The 2009 biomass estimate represented a 223% increase over the 2007 estimate.

All three models fit the GOA survey abundance time series relatively well throughout the time series, with the exception of 2009. In 2009 all model estimates were well below the highest survey abundance in the time series. Models A and B produced similar historical abundance time series; whereas Model C produced a very high historical abundance, implying that spawning biomass was five times B35% for the better part of the first decade. The latter was deemed implausible by the authors. There is little difference in fishery selectivity as estimated by all three models. In general, selectivities that are not forced to be asymptotic tend to show decreasing selectivity at large size.

Model A produces the best fit between observed and expected values for size at age, although the root-mean-squared-errors are about the same for all three models. Model B estimates for age 1 size appears to be about 2 cm high on average (which may be the result of the assumed aging bias) and Model C estimates an age 1 size that is very close to the observed average. Model B is thought to have a better defined bin and season structure and was more parsimonious than model A. Model C was disqualified partly due to impossibly high abundance estimates generated in the GOA model.

Based on Model B results, there is a slight decline in the estimated 2011 spawning biomass of 124,100 t, or 48% of unfished spawning biomass compared to the last assessment. Model B results also indicate a slight decline in subsequent years. This is in contrast to last year's assessment which projected an increase in biomass. Recent year classes (2006 – 2008) are also estimated to be substantially lower than in last year's assessment.

The SSC accepts the Plan Team's and the author's preferred model (Model B), Tier 3a designation, and the 2011/12 ABC and OFLs shown in metric tons below. The probability of the stock being below B20% was estimated to be less than 1% in 2011 and subsequent years.

Stock/ Assemblage	Area	2011		2012	
		OFL	ABC	OFL	ABC
Pacific Cod	W		30,380		27,370
	C		53,816		48,484
	E		2,604		2,346
	Total	102,600	86,800	92,300	78,200

Excerpt from the minutes of the SSC (Feb., 2011; recommendation <mark>highlighted</mark>)

Discussion paper on BSAI Pacific cod split

The SSC received a staff presentation from Jon McCracken (NPFMC). Public testimony was provided by Dave Fraser (Adak Community Development Foundation), Frank Kelty (City of Unalaska), Jon Warrenchuk (Oceana), Kenny Down (Freezer Longliner Coalition), and Brent Paine (United Catcher Boats).

The paper discusses various approaches to sector allocation revisions, should cod BSAI ABC and TAC be separated into BS and AI. A substantial amount of uncertainty remains with respect to these action alternatives, especially in light of the 2010 SSL BiOp and RPAs. We have no empirical experience to understand fishing sector behavioral responses to the RPAs. As the author demonstrated, until these uncertainties can be clarified, it is difficult to arrive at a clear understanding of the "reasonably likely" outcomes that may emerge from each apportionment alternative identified in the paper. The SSC has previously expressed concern when reviewing the Draft RIR/IRFA supporting the 2010 SSL RPA action that conflicting expectations and assertions concerning cod fishing patterns and redeployment in response to recently proposed management actions (e.g., Amend. 90 RIR, 2010 SSL RIR) further confound analysis of impacts of AI and BS sector apportionment splits. The prospect of triggering another ESA consultation on AI Steller sea lions also adds to the difficulty in moving forward with this action.

It is noteworthy that recent cod biomass estimates indicate that the proportion of the combined BSAI biomass that AI represents is smaller than previously estimated (i.e., historical estimate >16%; new estimate ~9%). As AI cod allotments are reduced on the basis of the revised biomass, some sectors' shares may become inaccessible (e.g., NOAA may not be able to open a fishery due to limited TAC). This may have very significant implications for apportioning future AI cod fishing opportunities necessary to sustain patterns of historical dependency (e.g., catch distributions by area, operating mode, and gear type). The split of cod allocation between the BS and AI is likely to reduce the potential for localized depletion of AI cod by the BSAI cod fleet. However, the SSC notes that the potential still remains for localized depletion, given that a large portion of the fishable area may be closed under SSL closures.

<mark>The SSC recommends that the stock assessment author and Plan Team develop a plan of action for how the BSAI cod assessment should evolve. The possibilities include maintaining the status quo of a modeling approach in the BS and survey biomass in the AI, having separate models for the BS and AI, or having a single BSAI model (with or without geographic stratification and movement).</mark>

The discussion paper cites several aspects of a future AI cod sector apportionment action that may require the Council to revisit its original Problem Statement and 'purpose and need' rationale. Formal clarification of the Council's desire in regards to examining limits on EBS TACs, specifying area-specific allocations, and the disposition of latent permits are identified by the analyst. The interplay between the Federal AI cod fisheries and the State's parallel-waters AI fishery will also require Council examination and guidance, particularly in light of the most recent actions by the Alaska Board of Fisheries and ADF&G regarding SSL mitigation and several pending lawsuits challenging the 2010 BiOp and RPAs.

Depending on the Council's expectations for further analysis of this topic, revisions to this discussion paper could advance the development of the initial documents (e.g., RIR, IRFA) necessary to support formal Council action. If the discussion paper were revised, the SSC recommends expressly incorporating the recently announced State of Alaska AI cod management changes into the analytical baseline.