Pacific cod model proposals and other comments submitted by the Plan Teams and SSC in 2013

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Last year, the BSAI and GOA Plan Teams (BPT and GPT, respectively) and the Scientific and Statistical Committee (SSC) made several recommendations relevant to this year's Pacific cod stock assessments. This document compiles, in the order of their occurrence, the recommendations from the September and November 2013 meetings of the BPT and GPT and the October and December 2013 meetings of the SSC.

Ordinarily, recommendations from the September Team meetings and the October SSC meeting would have been addressed in last year's final assessments. However, because of last year's October government shut-down, this did not occur, except in the case of the Aleutian Islands assessment.

Proposal numbering starts (or re-starts) at 1 for each stock (Bering Sea, Aleutian Islands, or Gulf of Alaska). For example, proposal SSC1 for the Aleutian Islands stock is not the same as proposal SSC1 for the Bering Sea stock. Recommendations that do not relate directly to development of a new model are labeled "comment" and are not numbered.

Although not listed here, it may also be important to note the SSC's recommendation from December 2011 suggesting that the performance of the 2011 model for each stock be evaluated over "several assessment cycles." The definition of "several" has not been determined.

Bering Sea

BPT minutes (September 2013)

BPT comment: "The Plan Team recommended that studies of the vertical distribution of Pacific cod continue in order to test the previous finding that the average product of survey catchability and selectivity across the 60-81 cm size range is 0.47 (based on vertical distribution from archival tags). These studies should include: 1) analysis of existing fish acoustic data (as recommended by Bob Lauth); and 2) depending on the results of that analysis, repeat the 2012 experiment in an area where Pacific cod are distributed farther off bottom and using an acoustic buoy to measure vertical response to the passing vessel."

BPT1: "The Team recommended the following candidate models for the November meeting, intended to provide a number of alternatives to the present standard Model 1:

a. Model 1: the standard for the last two years.
b. Model 2a: Model 2 from the September meeting, with fixed *M* and freely estimated survey *Q*.
c. Model 2b: Model 2 from the September meeting, with fixed *M* but annually varying survey *Q* (mean value and *dev* vector estimated freely).
d. Model 3a: Model 3 from the September meeting, with asymptotic survey selectivity and a prior on survey *Q*.
e. Model 3b: Like Model 3a but with *M* estimated.
f. Model 4: Same as last year's Model 4.

The Team recommended that the author feel free to apply the iterative tuning procedures to Model 4 only, and use the values of the iteratively tuned quantities from Model 4 for the remaining models (other than Model 1) because all of the models other than Model 1 involve labor-intensive iterative tuning, and given that all of these iteratively tuned models are based to some extent on Model 4."

SSC minutes (October 2013)

SSC1: "The SSC notes that all of the Pacific cod models are characterized by a large number of parameters and dome-shaped selectivities, features that were found to be associated with retrospective patterns and a higher risk of overfishing in the meta-analysis by Hanselman et al. (see separate section). The SSC has previously encouraged the authors to simplify the models when possible and appreciates the suggestion by Grant Thompson (AFSC) to consider omitting seasonal structure in one or more of these models in the future."

SSC2: "The SSC agrees with Plan Team recommendations regarding models to bring forward in December. In addition to the recommended model configurations, the SSC would like to see a model or models that fix survey catchability at Q=1. We suggest presenting variants of:

a. model 2a with Q=1 or
b. 2b with mean Q=1 and
c. model 3a with Q=1.

Our rationale for this request is based on the increasing evidence that catchability is higher and quite possibly much higher than the current standard assumption that selectivity in the 60-81 cm size range is 0.47, which is based on a limited study by Nichol (2007). Evidence from an unpublished study conducted in 2012 (Lauth) suggests that there is no difference in catchability between the low-opening (2.5 m) trawl used in the Bering Sea survey and the high opening (7 m) trawl used in the Gulf of Alaska survey. Moreover, observations of acoustic backscatter showed that Pacific cod tended to be near the bottom in the study area, consistent with a dive response to passing vessels commonly observed in other gadids. We note that the default assumption in most assessments is that survey catchability is 1, unless there is strong evidence to the contrary. The evidence to date consists of the vertical distribution of 11 tagged fish under undisturbed conditions over a period of one month (Nichol et al 2007)."

BPT minutes (November 2013)

BPT2: "The Team recommended … the following candidate models for next year's September meeting:

a. Model 1: 2011-2012 standard (rationale: standard practice)
b. Model 2b: Model 4 from the 2012 assessment with fixed M, free survey selectivity, and annually varying survey Q (freely estimated mean and *dev* vector; rationale: … survey data simply cannot be fitted with a constant survey Q)
c. Model 3a: Model 4 from the 2012 assessment with fixed M, asymptotic survey selectivity, and Q=1 (rationale: an asymptotic candidate, one of the models requested by the SSC)
d. Model 3b: Like Model 3a but with M estimated (rationale: a check on the effect of freeing M)"

BPT comment: "The Team also repeated its previous recommendation that studies of the vertical distribution of Pacific cod continue in order to test the previous finding that the average product of survey catchability and selectivity across the 60-81 cm size range is 0.47 (based on vertical distribution from archival tags). These studies should include: 1) analysis of existing fish acoustic data (as recommended by Bob Lauth); and 2) depending on the results of that analysis, repeat the 2012 experiment in an area where

Pacific cod are distributed farther off bottom and using an acoustic buoy to measure vertical response to the passing vessel."

SSC minutes (December 2013)

SSC comment: "The SSC re-iterates its concerns over the best value for the catchability coefficient (see December 2012 and October 2013 minutes), which prompted an SSC request for additional model runs in October with catchability fixed at 1. In addition to the models already requested by the Plan Team in September 2013, this resulted in a large number of requested models. The Plan Team reduced the suite of models to three models in addition to the current base model, implementing changes to both *Q* and survey selectivity simultaneously and, secondly, exploring the effect of estimating *M* freely. The SSC discussed the need for a more incremental approach to implementing changes to the model. The two main issues of concern at this time are the shape of the selectivity function and the appropriate value for catchability (Q). Therefore, the SSC suggests a modeling approach that evaluates changes to selectivity and Q separately and in combination. To limit the number of requested model configurations, the SSC suggests that the Plan Team request for a model that freely estimates *M* be deferred to a future assessment."

SSC3: "Therefore, the SSC requests the following models to be brought forward in the 2014 assessment cycle. These recommendations pertain to the overall model structure only and would not preclude updating any of the models with new information. For example, if new estimates of catchability from the proposed analysis of acoustic data become available in time, they should be included in any of the models that are tuned to an empirical estimate of catchability.

a. The current base model (same as 2011, 2012) for comparison.
b. Model 4 from the 2012 assessment. Rationale: This model implemented a large number of changes relative to the base model and produced a good fit to the data in the 2012 assessment. However, the model was not accepted in 2012 because it had not been fully vetted. Re-fitting the model with 2 years of new data would allow further vetting of the model as a potential new base model and can serve as a basis for exploring the effects of modifying the shape of the survey selectivity function and changing *Q*.
c. Model 4 with annually varying survey *Q* (freely estimated mean and *dev* vector). Rationale: This follows a Plan Team recommendation reflecting the senior author's conviction that the survey data cannot be fitted with a constant survey *Q*. The SSC also notes that time-varying catchability was recognized at a recent international meeting as a possible avenue for improving stock assessments.
d. Model 4 with survey catchability fixed at Q=1. Rationale: The default assumption in most assessments is that survey catchability is 1, unless there is strong evidence to the contrary. The evidence for a lower *Q* has been put into question based on recent work and is more fully detailed in our October 2013 minutes. This model will allow an evaluation of the effect of fixing *Q* without also changing the way selectivity is parameterized to help untangle effects of changing *Q* and changing selectivity.
e. Model 4 with fixed Q=1 and asymptotic survey selectivity. Rationale: This model was previously recommended by the SSC and recommended by the Plan Team in November 2013 to help understand the consequences of using dome-shaped versus asymptotic selectivity in the model."

SSC comment: "To improve our understanding of survey catchability and provide better empirical estimates of selectivity, the SSC endorses the Plan Team recommendations with regard to survey catchability, specifically studies of the vertical distribution of Pacific cod, including an analysis of existing acoustic data."

Aleutian Islands

BPT minutes (September 2013)

All of these recommendations were addressed in the final 2013 assessment.

SSC minutes (October 2013)

All of these recommendations were addressed in the final 2013 assessment.

BPT minutes (November 2013)

BPT1: "For continued development of a Tier 3 assessment, the Team recommended:

a. forcing the regime change recruitment offset to zero
b. examining the usefulness of IPHC longline survey data, and
c. continuing to monitor commercial CPUE."

(Note: subsequent conversation with Team members clarified that only item (a) in the above list was a model proposal; the other two items were comments not directly related to development of a new model.)

SSC minutes (December 2013)

SSC comment: "The SSC encourages further work on the age-structured models. Some of the issues are very similar to those in the Bering Sea, in particular the appropriate shape of the selectivity function. The SSC notes that selectivity was modeled differently in the AI model using an empirical and more flexible approach, although the model with asymptotic selectivity (and estimated Q) produced a better fit."

SSC1: "At this still early stage of model development, the SSC does not want to be overly prescriptive, but suggests bringing forward models that:

a. focus on exploring the effects of different shapes of selectivity-at-age,
b. including a model with asymptotic selectivity."

Gulf of Alaska

GPT minutes (September 2013)

GPT comment: "The Team recommended that the effects of parameter bounds continue to be explored for convergence-related issues. This should include which phases the parameters are estimated in."

GPT1: "A downward adjustment of the first reference age in the growth model (amin) was suggested for exploration to avoid the linear extrapolation of length-at-age below this value."

GPT comment: "The Team recommended including confidence intervals for plotted data points."

GPT2: "The Team recommended tuning input sample sizes by fleet to harmonic mean effective sample sizes, and checking that input variances are consistent with model results."

GPT3: "The Team recommended going forward with:

a. 2011 Model 3,

b. possibly with the 27- split into three groups…."

(Note: subsequent conversation with Team members clarified that the above reference to Model 3 from the final 2011 assessment is correct, even though that model was not the preferred model in 2012; also, "three groups" refers to three *periods*.)

GPT4: "The Team recommended two additional variations of Model 6:

a. Model 6b would use the growth parameters assumed in model 6 and include empirical weights-at-age.
b. Model 6c would resemble model 7 by excluding age composition data, and fit to length data only, but unlike model 7, model 6c would not estimate growth parameters."

(Note: subsequent conversation with Team members clarified that, although the full text of the above minute references Model 6 from the final 2012 assessment, the Team actually meant to refer to Model 6 from the preliminary 2013 assessment.)

GPT comment: "The Team recommended (but not necessarily by November) coordinating with ADFG to examine (age, length, maturity) data from the GHL fishery. Otoliths from Prince William Sound and Cook Inlet cod fisheries have been collected but not aged. The Team recommended determining how much catch occurred in these areas and coordinating with ADFG to analyze these data."

GPT comment: "The Team recommended that explorations of sex-specific models be postponed unless time permits."

SSC minutes (October 2013)

SSC1: "We agree with the Plan Team recommendations regarding the suite of models to bring forward in December."

SSC comment: "We note the large and increasing number of models and model variants being considered. While most of these models have a similar overall structure, the SSC cautions the analyst and Plan Team to carefully explore incremental changes to the model to evaluate their effects on model fits and reference points."

GPT minutes (November 2013)

GPT5: "The Team does not recommend setting recruitment to its average level as a general procedure for avoiding anomalous recruitment deviations at the end of a time series. A better approach is to use the optional multiplier for σ_r in Stock Synthesis, which provides a rough diagnostic for recruitment strength, and allows some uncertainty in recruitment to be projected forward."

GPT6: "The Team recommends continuing work on the September 2013 recommendations:

a. Using empirical weight-at-age without estimating growth parameters,
b. Exploring fewer fishery/survey selectivity blocks; different fishery and survey selectivity curves,
c. Working with ADFG to examine (age, length, maturity) data from the GHL fishery."

(Note: subsequent conversation with Team members clarified that only items (a) and (b) in the above list were model proposals; item (c) was a comment not directly related to development of a new model.)

GPT comment: “In addition, the Team recommends including plots of likelihood profiles over a population scale parameter.”

GPT comment: “In an effort to incorporate all of the survey data, the Team recommends analyzing the spatial distribution of smaller cod.”

GPT7: “Additionally, the Team recommends trying alternatives to the current truncation threshold being set at 27cm. This includes:

a. omitting length data and constructing a bin for age-1 fish,
b. smoothing data in the <27cm group outside the model,
c. examining correlations between age-1 and recruitment, and
d. investigating a smaller value for effective sample size for age-1 (with a larger effective sample size for the remaining age classes) so that additional uncertainty in the survey estimates for age-1 can be accounted for within the same likelihood for the entire survey age composition time series.”

(Note: subsequent conversation with Team members clarified that only items (a), (b), and (d) in the above list were model proposals, while item (c) was a comment not directly related to development of a new model; also, item (a) is supposed to pertain only to survey length data in the sub-27 group; finally, the correlation referenced in item (c) is supposed to be between *survey* estimates of age 1 abundance and *model* estimates of recruitment.)

SSC minutes (December 2013)

SSC2: “With respect to further development of the model, the SSC endorses the Plan Team recommendations in the GOA PT minutes and also refers to last year's SSC recommendations (December 2012 SSC minutes) with regards to down-weighting size-at-age data and parameterizing fishery selectivity.”

(Note: All of the SSC’s recommendations from December 2012 were addressed in the preliminary 2013 assessment.)

SSC3: “In addition, the SSC recommends exploring the use of both:

a. the ADF&G bottom trawl survey time series and
b. possibly the IPHC survey data as additional survey indices.

For example, a GLM approach could be used to develop an index suitable for inclusion in the assessment model. This approach was previously proposed in the December 2005 and December 2006 minutes but was not fully explored at the time because the focus shifted to other aspects of model development.”