

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON
FINAL STOCK ASSESSMENTS AND CATCH REPORTS

I. Catch Reports, Update Assessments and Data-Moderate Assessment

The Groundfish Subcommittee met in Spokane on June 10 to review the catch reports and assessment documents. Representatives from the stock assessment teams (STATs) (Dr. Jason Cope – NWFSC, Felipe Hurtado-Ferro – UW, Dr. Melissa Haltuch – NWFSC, Kelli Johnson – UW, Christine C. Stawitz – UW) also attended the meeting, presented results from the assessments, and answered questions from the subcommittee. The Scientific and Statistical Committee (SSC) was briefed by its Groundfish Subcommittee regarding the following groundfish stock assessment items informing 2017-2018 management decision-making: (1) catch reports for three rockfish species managed under rebuilding plans (yelloweye rockfish, Pacific ocean perch (POP), and cowcod) (Agenda Item D.8, Attachment 9), (2) updated assessments for chilipepper rockfish, petrale sole, and sablefish (Agenda Item D.8, Attachments 6, 7, and 8), and (3) a data-moderate stock assessment for arrowtooth flounder (Agenda Item D.8, Attachment 5.)

The petrale sole and sablefish updates were conducted as a graduate course in applied stock assessment at the University of Washington, with Drs. Owen Hamel (NWFSC) and Melissa Haltuch providing training and guidance. The SSC would like to acknowledge the work by both the teachers and the students that went into these update assessments, which were very comprehensive and carefully prepared.

Catch Reports

The catch reports provide updated information on the rebuilding progress of yelloweye rockfish, POP and cowcod off the U.S. Pacific coast using data through 2014. The 2012-2014 total catches (landings plus dead discards) for all three species are estimated to be less than the annual catch limits (ACLs). Catches for all these species have declined since the start of the catch share program.

Update Assessments

Chilipepper Rockfish

The most recent full assessment of chilipepper rockfish was conducted in 2007. The current assessment represents the first update of that 2007 assessment. Changes from the 2007 assessment include using an updated version of the Stock Synthesis model, which results in better treatment of time-varying growth; updated historical catch estimates; a new 2003-2014 time block to account for changes in recreational fishery selectivity; updated maturity and fecundity relationships; updated ageing error estimates; and 8 additional years of data. Each of these changes is within the terms of reference (ToR) for updates, and caused minor changes to model results, which were consistent with the 2007 assessment. Recent recruitments have been higher than those seen in the early 2000s (following the strong 1999 year class), resulting in an upward trend in biomass.

The assessment update estimates a depletion in 2015 of 64%. The chilipepper rockfish update assessment represents the best available science for use in developing 2017-2018 management measures as a category 1 assessment. The SSC recommends that the next assessment of this stock be a full assessment due to the length of time since the last full assessment.

Petrale Sole

The most recent full assessment of petrale sole was conducted in 2013; therefore, this update includes only two years of additional data. The draft petrale sole assessment update in the briefing book was revised slightly by the STAT to include additional age composition data and to account for several other minor adjustments. The subcommittee reviewed the revised model, which will ultimately be documented in a revised assessment document. The subcommittee requested that the STAT also include additional information to more fully document the transition from the 2013 model to the base 2015 assessment update.

The assessment update estimates a depletion in 2015 of 30.8%. The ten year projections, assuming that the ACL's are attained, predict that the relative depletion will range between 28 and 30% of the unfished level. Improvement in the estimated stock status (relative to the 2013 model projection) is attributed to greater strength of the 2006-2008 year classes, and a consistent increasing trend in the NWFSC trawl survey index.

The petrale sole update complies with the ToR for assessment updates and represents the best available science for use in developing 2017-2018 management measures as a category 1 assessment. The base update model indicates that the stock is above the B_{MSY} proxy of $B_{25\%}$. Since the SSC has previously recommended that a stock can be declared rebuilt based on an assessment update, the SSC recommends that petrale sole be declared rebuilt. The NWFSC trawl survey appears to be an excellent indicator of petrale sole trends, and should be monitored to evaluate the need for a new assessment. The SSC recommends the next assessment of petrale sole be an update assessment.

Sablefish

The last full assessment of sablefish was in 2011. There were only minor changes to the 2011 assessment when updating to the new version of Stock Synthesis. All data inputs were updated, additional corrections to data were made (e.g. discards), and new software was used to generate survey indices using delta-GLMM models.

A more thorough review is needed of standardized procedures and new software used to produce fishery size and age compositions, used for the first time in the current assessment cycle, especially in the context of sablefish. Port sampling data for sablefish are more complicated than for other groundfish species because there is a complex set of size-graded market categories for sablefish and many of the fish are landed in dressed condition.

The draft sablefish assessment update in the briefing book was revised slightly by the STAT to add additional age data and to improve the data weighting procedures. The subcommittee reviewed the revised model, which will ultimately be documented in a revised assessment document. The assessment update estimates a depletion in 2015 of 34.5%. The assessment shows similar trends to that of the 2011 assessment. Data reweighting and model tuning caused the largest differences in biomass from the last full assessment, but these procedures followed current best

practice and are permissible in update assessments. The sablefish update complies with the ToR for assessment updates and represents the best available science for use in developing 2017-2018 management measures as a category 1 assessment. The SSC recommends the next assessment of this stock be a full assessment.

Data-Moderate Assessment

The SSC was briefed on the subcommittee's review of the data-moderate assessment of arrowtooth flounder that was conducted by Dr. Jason Cope. These types of assessments are informed by data on catches as well as one or more indices of abundance. The SSC has endorsed two data-moderate assessment methods, extended Simple Stock Synthesis (XSSS) and Extended Depletion-Based Stock Reduction Analysis (XDB-SRA). A stock assessment review (STAR) Panel in April 2013 identified a set of review criteria for assessments conducted using XSSS and XDB-SRA (Agenda Item F.5.a, Attachment 2, June 2013).

The last assessment of arrowtooth flounder was conducted in 2007. The assessment of arrowtooth flounder presented to the SSC this year involved fitting a population dynamics model using three approaches: maximum likelihood estimation (MLE), Markov Chain Monte Carlo (MCMC) and XSSS. The latter two methods are Bayesian, which is the estimation framework on which past data-moderate assessments have been based. However, the assessment of arrowtooth flounder differed from past data-moderate assessments in that results of the 2007 assessment were used to inform stock depletion and selectivity was set based on the results of the 2007 assessment.

The SSC identified model scenarios in MLE and XSSS configurations of the assessment that merited further exploration. However, the SSC was unable to endorse any of the model runs presented in the draft assessment report as providing a suitable basis for management decision making for the 2017-18 management cycle. This is because the Bayesian analyses all exhibited results that were unexpected given the observed data or had reused the data inappropriately, and MLE-based approaches are not endorsed for data-moderate assessments. The difficulty in obtaining robust results using data moderate methods may be due to the history of light exploitation of arrowtooth flounder, and survey indices that show flat or increasing trends. The SSC commends Dr. Cope for the extensive work undertaken on the assessment of arrowtooth flounder, which will inform refinement of how data-moderate assessments are to be conducted in the future.

The 2007 assessment could be used as the basis for projecting overfishing limits (OFLs) for arrowtooth flounder. The SSC recommends providing new OFL projections using actual catches since 2007. These new projections will provide the best available science to support management decision making for 2017-18 fisheries. While the analyses included in the assessment report were not endorsed for management decision-making, there was no evidence that the stock is below the management target of 25% of unfished biomass. The SSC recommends that the next assessment of arrowtooth flounder be a full assessment given that the current assessment is eight years old.

II. Full Stock Assessments

The Scientific and Statistical Committee (SSC) reviewed the full assessments of canary and darkblotched rockfish and received the reports from the STAR panel review that took place during April 27-May 1. Representatives from the assessment teams (Drs. James Thorson and Vladlena Gertseva—NWFSC) presented results from the assessments and answered questions.

Canary Rockfish

The last full assessment of canary rockfish was conducted in 2007. Stock assessment updates were done in 2009 and 2011. A number of revisions were made to the data used for stock assessment, including 1) a new method of index standardization for NWFSC trawl survey using a geo-statistical delta-GLMM model, 2) a new steepness value (0.773) based on an updated meta-analysis of steepness, 3) a re-estimated relationship for maturity, 4) new ageing error tables, and 5) a re-estimated length-weight relationship. Ageing data based on surface otolith reads were added to the assessment using an ageing-error table appropriate to surface reads. This added about 10 years of historical ageing data to the model.

The new assessment is an innovative spatial model with three areas corresponding approximately to the waters off the states of Washington, Oregon, and California. Population trends by area can differ according to exploitation histories and deviations from a shared stock recruit relationship. Best practices for spatial models are not well developed; however, the SSC regards the model as a promising development. In future assessments, the SSC requests that greater attention be given to examining results by spatial areas in addition to the overall assessment, since results should be plausible locally as well as globally.

Dr. Thorson provided an addendum to the stock assessment that corrects an error in NWFSC trawl survey size composition used in the model. The annual size compositions were replicated in each area rather than using area-specific information. The correction had relatively little effect on assessment results (depletion in 2015 changed from 56.0% to 55.5% of unfished). A revised document will be made available in September with revised tables and figures.

Stock status is estimated to be at 55.5% depletion in 2015, which represents a substantial improvement in status from previous canary rockfish assessments. The primary factors driving the improvement in stock status are the use of a higher steepness value, the reduction in harvest due to the rebuilding plan, and above average recruitments in 2001-2003, and in 2007 and 2010. The relatively strong effect of steepness on estimated stock status is a reason for concern about the reliability of model results, since steepness is a relatively uncertain parameter value. However it should be noted that even a relatively low steepness of 0.6 (e.g., the low state of nature in the steepness decision table) results in a biomass estimate above the rebuilding target.

The SSC endorses the use of the 2015 canary rockfish assessment as the best scientific information available for status determination and management as a category 1 assessment. The canary rockfish spawning stock biomass is estimated to be above the B_{MSY} proxy of $B_{40\%}$, and has therefore achieved the rebuilding target. Two decision tables were provided in the executive summary, a table for different levels of steepness, and another for different levels of natural mortality of males and young females. Both of these parameters are relatively uncertain and strongly affect assessment results, and therefore both decision tables should be considered by the Council when setting the ACL. Canary rockfish is recommended for an update when it is next assessed.

Darkblotched rockfish

The last full assessment of darkblotched rockfish was conducted in 2013. Revisions that were made to the data used for stock assessment included 1) a new method of index standardization for

NWFSC trawl survey using a geo-statistical delta-GLMM model, 2) a new steepness value based on an updated meta-analysis of steepness, 3) a new value for natural mortality, 4) an updated maturity at length relationship, 5) a re-estimated length-weight relationship, and 6) additional ageing data. Changes to the assessment model were relatively minor, but included a change from two fleets to three fleets, with at-sea hake fishery now modeled as a separate fishery, and a change from asymptotic selectivity for the shore-based fishery to dome-shaped selectivity.

The SSC identified a potential issue related to the inclusion of shrimp trawl size composition data with the shore-based fishery data, since these are very different fisheries. There was concern that these data had a large influence on the estimated selectivity of the shore-based fishery, which showed that the smallest fish (< 20cm) were about 10% selected. Dr. Gertseva presented results from a sensitivity run that demonstrated that even when the shrimp trawl data were excluded the selectivity of smallest fish was greater than zero, indicating the small darkblotched rockfish are also caught in other components of the shore-based fishery. While this result helped to alleviate the SSC concerns, the SSC nevertheless recommends that future darkblotched rockfish assessments explore models in which the shrimp trawl fishery is modeled separately.

The base model estimate for 2015 spawning depletion is 39%. Several factors were identified as being responsible for the slower than expected rebuilding of darkblotched rockfish, which were projected to be rebuilt by 2015. The model results were very sensitive to the addition of the 2014 NWFSC survey age composition data, which showed strong recruitment but reduced numbers of older mature fish. Furthermore, biomass index in the NWFSC survey for darkblotched rockfish has shown a slight downward trend during 2003-2014, with consistent drops in 2013, and again in 2014.

The SSC endorses the use of the 2015 darkblotched rockfish assessment as the best scientific information available for status determination and management as a category 1 assessment. Darkblotched rockfish is recommended for an update assessment during the next assessment cycle.

SSC Notes:

Catch reports: For clarity, it would be useful if the catch reports could use the terminology “total catch” (landings plus dead discards) in lieu of “fishing mortality”, which is typically associated with fishing rate, not volume.

Chilipepper rockfish: In Figure 27, “extend time block” is the BASE model. The STAT should make that clear in the captions.

Petrable sole:

Additional information is needed to track the transition of the 2013 base model to the base 2015 assessment update, including comparison of the 2013 and 2015 delta-GLMM indices, sequential tracking of changes to the model structure, a clear statement regarding how compositional data weighting was conducted regarding state-specific expansions, and documentation of the commercial age compositions added since the draft document was circulated.

Research recommendations: The fact that this is a transboundary stock and greater consideration and/or coordination of data collection and modeling with Canada would be beneficial, a management strategy evaluation which focused on potential shortcomings of not accounting for stock structure (U.S./Canada) and in which harvest control rules vary would be a strong research priority, and additional studies into maturity and fecundity (some of which are ongoing) are additional priorities.

Sablefish: The next STAT should consider separating the hook and line fleet into sectors fished under trawl IFQ, where full retention is required, and for the other hook and line fleets, where discarding may occur.

There is a relatively new way of processing sablefish onboard fishing boats. New conversion factors are needed to maintain data quality and consistency. This could affect size composition estimates and catch weights.

Final document should include area swept to plot of slide 7 of presentation. Comparisons should be made routinely between the delta-GLMM estimates and area-swept biomass estimates for all surveys.

In the final version of the document, include a sensitivity including the 1997 data point from the EDCP study that was dropped.

Arrowtooth flounder: The performance criteria for evaluating the adequacy of data-moderate assessments identified by the April 2013 STAR Panel are:

| Performance criteria for evaluating data moderate assessments |
|---|
| <i>1. Do the diagnostics for the posterior sampling algorithm indicate that the model has converged?</i> |
| <i>2. Are the indices used in the assessment sufficiently precise to provide a signal for the assessment?</i> |
| <i>3. Is an adequate fit achieved to indices of abundance used in the assessment?</i> |
| <i>4. Does the model capture the evident trends in the abundance indices, or, if not, can the residual pattern be explained by model's inability to account for increases in recruitment? This would only occur when the index is trending more strongly upwards than the model predictions.</i> |
| <i>5. Do sensitivity analysis indicate the results are robust to uncertain model assumptions?</i> |
| <i>6. In comparison to catch-only assessments (SSS and DB-SRA), does the addition of index data update the prior distributions in a sensible way, rather than giving strongly divergent results?</i> |
| <i>7. Is the updating of the distribution of key parameters from prior to posterior reasonable given the likely information content of the indices? For example, a posterior distribution of B_{MSY}/B_0 that is very different than the prior distribution could be a concern because the data are not likely to be very informative about this quantity.</i> |
| <i>8. Are the estimates of catchability for survey indices within reasonable limits ($0.1 < q < 3$) for assessments that use survey indices?</i> |
| <i>9. In cases where a previous assessment has been accepted for the stock, are results reasonably consistent with the previous assessment?</i> |

Future assessments of arrowtooth should explore whether the reported WA historical catches include catches from British Columbia and Canada and should exclude such catches if the current WA catch series includes catches from outside of the US west coast.

Model selection for predicting discard should be based on AICC and not AIC because of small sample sizes. Application of AICC will lead to selection of a simpler model than that included in the assessment. In addition, it is necessary to provide fit diagnostics (observed versus predicted values; deviance tables) to enable the predictive skill of the model to be evaluated.

The selection between splitting the triennial survey into two indices or creating a single triennial survey index should be based (inter alia) on whether densities change across the deepest strata. In the case of arrowtooth flounder, the highest densities occur at 366m and densities decline with increasing depth. In contrast, mean weight increases with increasing depth. Both of these observations imply that the assumption that the triennial survey data pre- and post-1995 can be combined is questionable for arrowtooth flounder. Consequently, the SSC prefers scenario 8 over the base-case scenario.

The choice between splitting or not splitting the triennial survey should be based on a multispecies analysis of the available data.

The geo-statistical delta-GLMM model was based on default assumptions. However, for completeness, the assessment report should include full details of how the model was applied.

If a Bayesian analysis is to be conducted for arrowtooth flounder it should be based on a prior for stock status (2006 depletion) based on the 2007 assessment and update the priors using data not included in the 2007 assessment (i.e. the NWFSC shelf-slope survey index). This is scenario 14 in the draft assessment report. In addition, the SSC would like to see a straightforward application of XSSS that is completely uncoupled from the 2007 assessment, with the standard depletion prior of 0.4, and the standard selectivity assumption that selectivity equals maturity.

There is marked difference between the prior for depletion and the posterior for this quantity from the Bayesian analysis. This is likely a consequence of the shape of the joint posterior surface. The SSC encourages more work to identify when Bayesian methods will lead to updating of the prior for depletion and R_0 when this is unexpected as this will help future analysts applying data-moderate assessment methods.

The SSC should reconsider whether MLE-based assessments can form the basis for data-moderate assessments rather than Bayesian methods.

Canary rockfish: Recent recreational size composition data in California show a shift to smaller sizes which the assessment model is unable to fit. Shifts in size composition are likely to be due of management restrictions on the depths and areas open for recreational fishing. In future canary rockfish assessments, models with shifts in recreational fishery selectivity should be considered. Under the stock assessment TOR, changes in selectivity can be considered for assessment updates as well for full assessments.

Size compositions for discard should have been compared to retained size compositions to justify the decision not to model discard separately.

In evaluating models with spatial structure, the STAT should look at the correlations in the residuals of recruitment and other annually-changing parameters across areas.

It is unclear whether it is better to do separate spatial analyses of survey data by area, or to do combined area analysis and then to extract indices for each area. Future assessment should compare these methods and evaluate assessment impacts.

Darkblotched rockfish: Do likelihood profiles on R_0 with and without the 2014 NWFSC survey composition age data to evaluate why the model scale is so sensitive to these data. Likelihood components should be kept separate as much as possible in the plots and tables, rather than lumping age and length composition likelihoods together.

Stock Synthesis: Ballpark F has been used in previous versions of SS3 to stabilize estimation in early phases, but was not included in the final phase of estimation. However, in the current versions of SS3, including v3.24u, ballpark F is not turned off in the final phase and thus affects the final fit and likelihood of the model. This appears to be a newly introduced bug in SS3. Therefore, ballpark F should be turned off in assessments using the current versions of SS3 (by setting the associated year to a negative value).

Terms of Reference: For future reference, revisions to the terms of reference should include that STAT's should supply both R4SS summary outputs (pdf files) and SS3 (or relevant) report files for updates to facilitate review.

For terms of reference more generally, one additional suggestion is to include the equilibrium relative abundance reference points in each row of the decision table associated with each run (to facilitate an understanding of when and why relative spawning biomass is or is not converging to the expected value under respective control rules).

Provide a table that lists all changes to data input and model changes, why the change was made, etc. A set of future should also be provided. An example of what is expected should be included in the TOR. "Good" species specific examples could be identified, for both updates and full assessments.

A recommendation should be added to the TOR that STATs should contact past STATs whenever the procedures and assumptions in old stock assessments are unclear. This could be important in documenting changes from previous assessments to the current assessment or update.