Report on

Cowcod and Darkblotched rockfish STAR Panel

July 16-20, 2007

NOAA Western Regional Center

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Seattle

Washington

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***For* University of Miami Independent System for Peer Review**

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Executive summary

The cowcod and darkblotched rockfish STAR Panel met at the NOAA Western Regional Center, Seattle, from July 16-20, 2007. The Panel consisted of three reviewers (two CIE) and an SSC representative as the chair. This is the report of one reviewer and it should be read in conjunction with the other review report and the STAR Panel reports. The assessments accepted by the STAR Panel are technically adequate to provide management advice and, as such, represent the "best available science" on which to base management advice.

Draft assessments were distributed electronically to meeting participants two weeks in advance of the meeting. Although a revised document for cowcod was distributed soon afterwards, it only contained minor revisions. The two assessments were as well documented and as complete as any so far submitted in the 2007 assessment round.

This particular STAR Panel meeting was notable for the fundamental disagreements between Panel members on a number of questions of interpretation. The STAR Panel reports are being finalized under an agreement to “omit and delete” so that there is some prospect that the end product will be acceptable to all Panel members.

The cowcod assessment was conducted using SS2 and assumed a single stock in the Southern California Bight. The following data were used: catch history beginning in 1900; recreational fishery CPUE series (CPFV logbook) 1963-2000; and a single estimate from a visual survey in 2002 (with an informed prior on the survey *q*). A full assessment was last done in 2005 and this was updated for an SSC meeting in June 2007. The 2007 update revealed errors in the 2005 assessment. Given the extent of the changes required to correct the errors, the SSC recommended that a full assessment be completed and presented at the July 2007 STAR Panel meeting.

The catch history was substantially changed from that used in the 2005 assessment. A set of recently discovered CalCom landing sample records increased the estimated historical landings for cowcod considerably during the 1980s (and in earlier years as the cowcod proportion in these samples was applied to total rockfish landings). Sensitivities to assumed catch history were explored to a limited extent and the assessment results were robust to the alternatives considered.

Further dimensions of uncertainty were explored with regard to natural mortality, steepness, and the inclusion or exclusion of the CPFV time series and the visual survey estimate. The assessment results were generally insensitive to the assumed values of natural mortality and steepness, but were sensitive to the inclusion or exclusion of individual data sets. The visual survey suggests a higher abundance level (approximately 23% depletion) than the CPFV time series (approximately 4% depletion). The base model includes both data sets but the CPFV time series dominates the model resulting in low estimated depletion levels (and very high estimated exploitation rates in the late 1980s).

The STAR Panel encouraged the STAT to conduct an MCMC analysis to better quantify uncertainty in the assessment. The STAT made good initial progress, but did not complete a full MCMC analysis in time for review at the meeting.

The final assessment differs little from that brought to the meeting except that a much wider range of uncertainty is bracketed (an option with just the visual survey was included). The assessment was improved by the STAR Panel process but it is not an ideal assessment. The base model is unsatisfactory in terms of the plausibility of estimated exploitation rates and in the apparent contradiction between the CPFV time series and the visual survey estimate. Also, the assessment uncertainty is not adequately captured by the three presented runs. A full Bayesian assessment is needed for this stock but it was unable to be produced within the given timeframe.

A single stock was assessed for darkblotched rockfish off Washington, Oregon, and California using SS2. A catch history beginning in 1928 was input for a single fishery. Four abundance indices were used: triennial bottom trawl survey (1980-2004); the AFSC slope survey (1997, 1999-2001); the NWFSC slope survey (1999-2006); and the NWFSC shelf survey (2003-2006). Length frequencies were input for the fishery and abundance surveys. Conditional age-at-length data were also used from the fishery and surveys, but only from recently aged otoliths (post 2004) because of concerns with previous ageing.

The abundance indices had been recalculated since the last assessment using a GLMM approach. The Panel was initially concerned about the large differences in scale between the area-swept and GLMM indices for three of the four trawl surveys. However, the trends estimated by each method were similar so the question of what was driving the differences was not explored at the meeting, nor were GLMM diagnostics requested. The absence of detailed documentation of the derivation of these indices was noted.

Three issues arose with regard to the conditional age at length data: the appropriateness of initial effective sample sizes; the method of tuning the dependent length and age-at-length data; and the growth of fish during the sampling period for the fishery age-at-length data. These are all generic issues which need to be considered for a number of west coast assessments. However, for this assessment, the results were insensitive to alternative treatments of the age-at-length data.

The main dimensions of uncertainty explored for darkblotched were natural mortality and steepness. There was disagreement between the Panel and the STAT on how to choose a fixed value of steepness for the base model. The Panel recommended using the median of the darkblotched Dorn prior, but the STAT preferred to use the prior to estimate steepness within the model and then use the estimated value (despite agreeing that there was little or no information on steepness in the data offered to the model).

The darkblotched assessment has no major issues. Rather there are a lot of small issues, which if they were all addressed might have some impact on the assessment. Also, there are several rockfish-generic issues which, if all addressed, could substantially alter the assessment results: the reliability of the Triennial survey as an abundance index; a full

exploration of catch history uncertainty; the calculation of initial effective sample sizes; the joint tuning of age and length data; and the application of full Bayesian methods.

Background

The cowcod and darkblotched rockfish STAR Panel met at the NOAA Western Regional Center, Seattle, from July 16-20, 2007. This was the fourth of five 2007 STAR Panels in the biennial meeting schedule.

Two assessments were scheduled for presentation at the meeting; each species was assessed as a single west-coast stock. Each STAT consisted of a single scientist: Mr E.J. Dick (cowcod) and Dr Owen Hamel (darkblotched)

The STAR Panel had four members. My three colleagues were Dr Tom Jagielo, the SSC representative and Panel Chair, Dr Larry Jacobson, and Dr Stephen Smith, my fellow CIE reviewer. This report should be read in conjunction with the STAR Panel reports and Dr Smith's CIE report.

Review Activities

Pre-meeting

Meeting documents and materials were received in electronic form well in advance of the meeting (*see* Appendix 2). I familiarized myself with the background material and current assessments prior to the meeting. Paper copies of the assessment documents were also made available at the meeting, which was helpful.

I had a long telephone conversation with Dr. Elizabeth Clark with regard to the STAR Panel process and protocols. We discussed many aspects of the process and in particular the confidentiality of CIE reports on STAR Panel meetings. She feels that this enables CIE reviewers to be less circumspect than they might otherwise be were their reports made public. I have always held the opinion that if I am not willing to have my words made public then I should not be including them in a report (CIE review or otherwise). (After this meeting I have more sympathy for her position.)

We also discussed the role of the Chair and the rapporteurs during a STAR Panel meeting. It is difficult for an SSC Chair to fully chair the meeting if they also act as a reviewer. This difficulty had been apparent to me at previous STAR Panel meetings. The Chair's *dual* role is, I believe, an unfortunate aspect of the process. Also, it has been traditional for the rapporteur for each assessment to be chosen from amongst the STAR Panel. This dual role is also unfortunate as the requirement to take detailed notes of discussion precludes a reviewer from participating fully in the discussion. I was acutely aware of this difficulty when I had rapporteured at previous meetings. The problem was also been brought to my attention by another CIE reviewer.

Just prior to this meeting I discussed this issue with the Chair. I suggested that the requirement to take detailed notes of the discussion during the meeting should be

assigned to non-Panel members. I said that I would, of course, be taking notes for the purpose of writing my CIE report, and I was happy to be assigned the task, for one species, of drafting the written requests to the STAT (for required analyses during the meeting), but I wished to be fully involved in the discussion and so I would not take notes to the level required of a rapporteur. This breaking with tradition seemed somewhat difficult for the Chair to accept. However, he did agree to follow my suggestion.

Meeting

The meeting was convened at 12.30 pm on Monday, July 16, 2007 and closed Friday evening, July 20, 2007. I will only give a brief summary of the meetings activities. For both species, details of the requests to the STATs and their responses are contained in the STAR Panel reports. As per my suggestion to the Chair prior to the meeting, rapporteurs were assigned outside of the Panel. However, the task of drafting the formal requests to STATs (and their responses, subsequent main points of discussion, and our conclusions) were assigned to Panel members. I covered darkblotched rockfish and Dr Smith dealt with cowcod.

The assessment of darkblotched rockfish was presented on Monday afternoon by Dr. Hamel. There was a relatively long delay because the projector would not work with his computer – or indeed any computer – the problem was eventually tracked down to the projector cable. When it did begin, the presentation was straightforward and several tasks were identified for the STAT prior to adjournment at 5 pm.

On Tuesday morning the cowcod presentation was due to be presented. The unexpected, but temporary, absence of a projector meant that the PowerPoint presentation had be distributed to meeting participants (on a speed stick – due to the lack of a shared network) before the STAT, Mr E.J. Dick could proceed. The Chair briefly reminded the meeting of the history of the cowcod assessment. It was originally prepared as an update of the 2005 assessment for a June SSC meeting, but had failed the criteria for an update because a number of errors in the 2005 assessment had been corrected. The SSC requested that a full assessment be performed and the STAT had agreed to do what was possible for the July STAR Panel meeting.

There was some discussion as to whether the Panel should review the cowcod assessment as a full assessment or as something “less” than a full assessment – given the short timeframe that had been available to the STAT. It was agreed that it should be reviewed as a full assessment but that we should make some concessions to the circumstances. As with darkblotched, the issues that arose during the presentation lead to a set of requests for the cowcod STAT (drafted before lunch).

From Tuesday afternoon until Friday morning the meeting proceeded with alternate sessions with the two STATs as the Panel reviewed the responses to previous requests and submitted additional requests.

The base model for darkblotched rockfish was essentially agreed by Thursday afternoon (though some minor revision of this occurred on Friday by the STAT's choice). The base model for cowcod was not decided until Friday morning as the STAT was requested to explore MCMC runs on Thursday evening. Much of Friday was devoted to working on the STAR Panel reports. The meeting was concluded before 6 pm so that the remaining participants would be able to remove their cars from the Sand Point campus (gates lock at 6 pm). First drafts of the reports were completed before the meeting concluded but some of the sections, especially the recommendations, had not been discussed by the full Panel.

The meeting was notable for the numerous disagreements between members of the Panel with regard to questions of interpretation. The STAR Panel reports contain details of some of the areas of disagreement between the Panel.

Post-meeting

The STAR Panel reports were left largely with the Chair for the purposes of completing drafts for the Panel to review and revise by email. At the time of writing this report, full drafts of the STAR Panel reports have been circulated by the Chair, and each member has submitted their suggested revisions. I am less than happy with the reports but in order to have them accepted by the whole Panel I have taken a pragmatic approach. Rather than adding explanations and important generic recommendations, I have suggested deletion of spurious sentences and recommendations. An attempt to substantially improve the reports and the recommendations would lead, in my opinion, to a very prolonged and difficult email process. The differences of opinion within the Panel are such that the completion of reports agreed to by all Panel members will be a significant accomplishment by the Chair.

I drafted my third set of "suggestions to STATs" for distribution by email (*see* Appendix 1). My suggestions include recommendations concerning the use some SS2 options which were found to be incorrectly implemented or problematic in their use.

Review findings

The findings for each assessment are discussed below. For each stock, I summarize the draft assessment and the changes that were made to reach the final assessment. I then summarize the main uncertainties and finally summarize the merits and deficiencies of the accepted assessment. Much of the wording in the assessment summary for cowcod is taken from the "overview" in the STAR Panel report (for which I provided the first draft).

Cowcod rockfish

Assessment summary

The assessment was conducted using SS2 and assumed a single stock for cowcod in the Southern California Bight. The following data were used: catch history for 1900-2007 (ramp from 1900 to 1916, assumed 0.5 t catch each year since 2001); a recreational fishery CPUE series (CPFV logbook) 1963-2000; and a single estimate from a visual survey in 2002 (with an informed prior on the survey *q*). A full assessment was last conducted in 2005 and was updated for an SSC meeting in June 2007. The 2007 update revealed errors in the 2005 assessment. Given the extent of the changes required to correct the errors, the SSC recommended that a full assessment be prepared for the July 2007 STAR Panel meeting.

The main error in the 2005 assessment was that fishery selectivity had erroneously been set to female fecundity. When corrected, this apparently caused an enormous difference in estimated harvest rates. The Panel requested a fuller exploration of what was causing the differences and it was found that the comparison presented to the SSC was misleading. There had been another error in the 2005 assessment which had exaggerated the apparent difference. When consistently defined harvest rates were compared between the corrected and uncorrected runs they were similar (although other assessment results, such as estimated depletion, did show some notable differences).

The CPFV time series was constructed using a GLM analysis which used non-cowcod rockfish catch as an explanatory variable. The Panel had two concerns with this approach. First, the GLM approach does not allow “errors in variables” (i.e., explanatory variables must not be random variables). Second, non-cowcod rockfish catch could be correlated with cowcod catch rates in such a way that its inclusion as an explanatory variable could remove a valid signal in cowcod abundance. The STAT, while acknowledging these concerns, preferred to retain non-cowcod rockfish catch as an explanatory variable (as a proxy for cowcod habitat). The use of non-cowcod rockfish catch or not made little difference to the CPFV time series trend.

The catch history was substantially changed from that used in the 2005 assessment. A set of recently discovered CalCom landing sample records increased the estimated historical landings for cowcod considerably during the 1980s (and in earlier years as the cowcod proportion in these samples was applied to total rockfish landings). Strangely, one Panel member considered the updated catch history to be implausible. Their concern was that the commercial catches assumed in the 1925-1932 period were the same or higher than catches taken in the 1970s and 1980s (despite this being demonstrably true for *total* rockfish catch in the Southern California Bight). Their concern caused much discussion. Sensitivities to assumed catch history were explored to a limited extent and the assessment results were robust to the alternatives considered.

Further dimensions of uncertainty were explored with regard to natural mortality, steepness, and the inclusion or exclusion of the CPFV time series and the visual survey estimate. The assessment results were generally insensitive to the assumed values of

natural mortality and steepness, but were sensitive to the inclusion or exclusion of the two data sets. The visual survey suggests a higher abundance level (approximately 23% depletion) than the CPFV data series (approximately 4% depletion). The base model includes both data sets but the CPFV time series dominates the model resulting in low depletion levels (and very high exploitation rates in the late 1980s).

The STAR Panel encouraged the STAT to conduct an MCMC analysis to better quantify uncertainty in the assessment. The STAT made good initial progress, but did not complete a full MCMC analysis in time for review at the meeting. The STAT offered to complete an MCMC analysis, and noted it could be included as an Appendix in the final assessment document.

The final assessment differs little from that brought to the meeting except that a much wider range of uncertainty is bracketed (an option with just the visual survey was included). The assessment was improved by the STAR Panel process but it is not an ideal assessment. The base model is unsatisfactory in terms of the plausibility of estimated exploitation rates and in the apparent contradiction between the CPFV time series and the visual survey estimate. Also, the assessment uncertainty is not adequately captured by the three presented runs. A full Bayesian assessment is necessary for this stock but it was unable to be produced within the given timeframe.

Primary sources of uncertainty

Assumed stock structure and estimated or fixed values of natural mortality and steepness are sources of uncertainty in most stock assessments (including cowcod). In addition, the cowcod assessment also has the following major uncertainties:

- Catch history
- Reliability of CPFV series as an abundance index
- Reliability of visual survey index (fishery independent but the method needs to be validated through repeated application)
- Lack of recent abundance data (which means that the recent biomass trend is driven by model assumptions rather than data).

Strengths and weaknesses of current approach

The current assessment is inadequate in terms of capturing the nature of the assessment uncertainty, and the MPD estimates presented are unreliable. Although MCMC runs were very preliminary it was apparent that the MPD estimates from the base model were completely different to what would have been obtained from the medians of the marginal posterior distributions (i.e., the Bayesian estimates for the base model configuration). In a case where the MPD estimates and MCMC estimates differ the MCMC estimates are generally preferable. It is shame that there was insufficient time to produce a full Bayesian assessment as this is one of the few west coast assessments where it is possible given the current technology and process.

Merits:

- SS2 was used and as such brings the advantages of a standard and well tested package.
- The most reliable data sources were used (as opposed to all and sundry which went into the 1999 assessment).

Deficiencies:

- The base model contains potentially contradictory data and is potentially very unreliable.
- The bracketing runs do not fully capture the assessment uncertainty (MCMC runs are needed to do this).
- The full uncertainty associated with the historical catch history was not explored.
- External data sources that may have provided some qualitative corroboration of recent abundance trends were not available.
- The CPFV time series was standardized in a technically deficient manner (but with little consequence for the trend of the series).

Darkblotched rockfish

Assessment summary

A single stock was assessed for darkblotched rockfish off Washington, Oregon, and California using SS2. A catch history extending back to 1928 was input for a single fishery. Four abundance indices were used: triennial bottom trawl survey (1980-2004); the AFSC slope survey (1997, 1999-2001); the NWFSC slope survey (1999-2006); and the NWFSC shelf survey (2003-2006). Length frequencies were input for the fishery and abundance surveys. Age data were also used from the fishery and surveys, but only from recently aged otoliths (post 2004) because of concerns with previous ageing. Also, the ageing data were all input as conditional age-at-length.

The abundance indices had been recalculated since the last assessment using a GLMM approach. The Panel was initially concerned about the large differences in scale between the area-swept and GLMM indices for three of the four trawl surveys. However, the trends estimated by each method were similar so the question of what was driving the differences was not explored at the meeting, nor were GLMM diagnostics requested. The absence of detailed documentation of the derivation of these indices was noted.

Three issues arose with regard to the conditional age-at-length data: the appropriateness of initial effective sample sizes; the method of tuning the dependent length and age-at-length data; the growth of fish during the sampling period for the fishery age-at-length data.

Ian Stewart gave a presentation on the formulae which had been used to calculate initial effective samples size for the length and age data. A meta-analysis had been conducted on the 2005 assessment tuning efforts. While this was a worthwhile attempt to provide a standard approach to assessment authors for the calculation of initial effective sample sizes in 2007 assessments, the basis of the method was inappropriate. Initial effective sample sizes for age and length data should be based on the observation error inherent in the samples. This can be approximated by analytical methods or by bootstrapping the raw data. The final or intermediate effective sample sizes obtained in the 2005 assessments were not driven by the observation error inherent in the samples. Rather, they were the result of assessment author's choices with regard to initial input effective sample sizes, tuning methods, model structure, and the data included in the assessments (e.g., an age or length frequency which is in "conflict" with other data in an assessment will have a much lower tuned effective sample size than an age or length frequency which is not in conflict with other data).

The initial assessment applied the formula for initial effective sample size for fishery data to conditional age-at-length data *within* length bin (i.e., the number of trips were those that happened to deliver the fish within a given length bin). This was questioned by the Panel and an alternative of applying the formula to the annual age sample was tried. This gave a similar proportion of ages within length bin but the annual effective sample sizes for ages were much lower; thus changing the relative weight of the age data in the model and its weight, in particular, to the associated length data (from which it was a sub-sample). The issue of how best to tune the associated age and length data was not considered. The STAT maintained their original approach of decreasing effective sample sizes where indicated, but not increasing any sample sizes (this is consistent with increasing variances to account for "process error", but potentially changes the relative weights of dependent age and length data).

In the conditional age-at-length data for the fishery there were data for fish less than 30 cm in length. According to the growth curves, fish smaller than 30 cm were growing at perhaps 3 cm per year. Therefore, for these data, the assumption of constant proportion-at-age for given length was violated. The final model used expanded length bins for the smaller fish (rather than 1 cm bins), which perhaps alleviates but does not solve the problem. However, it makes little difference to the final results whether the age-at-length data for the small fish are used or not.

The main dimensions of uncertainty explored were natural mortality and steepness. There was disagreement between the Panel and the STAT on how to choose a fixed value of steepness for the base model. The Panel recommended using the median of the darkblotched Dorn prior, but the STAT preferred to use the prior to estimate steepness within the model, and then use the estimated value (despite agreeing that there was little or no information on steepness in the data offered to the model).

The darkblotched assessment was little changed from that which was brought to the meeting. A number of issues were explored and subsequent minor adjustments were made to the input data, but they were of little consequence for the assessment results.

Primary sources of uncertainty

Assumed stock structure and estimated or fixed values of natural mortality and steepness are sources of uncertainty in most stock assessments (including darkblotched). In addition, the darkblotched assessment also has the following major uncertainties:

- Reliability of the triennial series as an abundance index
- Catch history (I don't believe that this has been explored enough to know whether it is an important dimension of uncertainty).

Strengths and weaknesses of current approach

The final assessment is at the lower end of what I consider to be acceptable in a modern stock assessment. There is a base model and two sensitivity runs, none of which were taken forward to MCMC runs to obtain posterior distributions and an appropriate measure of within-run uncertainty (approximate confidence intervals will no doubt be obtained for each run using boot-strapping or likelihood profiles but these are poor substitutes). This is a fault with the process rather than a criticism of the STAT.

Merits:

- SS2 was used and as such brings the advantages of a standard and well tested package.
- The use of conditional age-at-length data is technically superior to the common practice of using dependent length and age frequencies (i.e., where the length data have been sub-sampled for age).
- The procedure used to specify initial multinomial effective sample sizes for age and length data was a useful attempt at standardization.

Deficiencies:

- The full uncertainty associated with the historical catch history was not explored.
- Conditional age-at-length data from the fishery were not appropriately scaled (i.e., each aged fish was given equal weight).
- Constant proportions of age-at-length were assumed for the fishery despite substantial growth in the smaller fish during the sampling period.
- The procedure used to specify initial multinomial effective sample sizes for age and length data has an unsound theoretical basis.
- No MCMC runs were done.

Conclusions and Recommendations

The cowcod and darkblotched rockfish assessments were technically improved, but altered little by the STAR Panel process.

The cowcod assessment presents a much more realistic range of uncertainty than the assessment initially presented to the meeting but remains far from ideal. The absence of abundance data since 2002 is problematic, as the recent trends are driven by model assumptions. It would be useful to have some qualitative corroboration of estimated trends, but what is really needed is a reliable abundance time series. The other assessment issues will not be resolved until a full Bayesian assessment is performed.

The darkblotched assessment has no major issues. Rather there are a lot of small issues, which if they were all addressed might have some impact on the assessment. There are also several rockfish-generic issues which, if all addressed, could substantially alter the assessment results (e.g., the reliability of the Triennial survey as an abundance index; a full exploration of catch history uncertainty; the calculation of initial effective sample sizes; the joint tuning of age and length data; and the application of full Bayesian methods).

I support the recommendations given in the STAR Panel reports albeit that they are incomplete and not prioritized. I give my own set of recommendations below.

Generic (all rockfish)

- Establish a *meta* database of all data relevant to rockfish stock assessment. The database should include enough detail about the nature and quality of the data that a stock assessment author can make a well informed decision on whether it could be useful for their stock assessment.
- Establish *accessible* online databases for all data relevant to rockfish stock assessment, so that assessment authors can obtain the *raw* data if required.
- Establish a database for historical rockfish catch histories, “best” guesses and estimates of uncertainty (and processes for updating and revising the database).
- Develop a concise set of documents that provide details of common data sources and methods used for analyzing the data to derive assessment model inputs.
- Develop fishery independent time series using fixed sites and volunteer fishers properly supervised using standard protocols.
- Publish a full descriptive analysis of the recreational fisheries and fleets for CPUE interpretation (not limited to “rockfish trips” – interactions with other target species are important).
- Develop standard and validated methods for producing recreational CPUE indices which deal with the peculiarities of the recreational data and regulation changes. (The method of Stephens and MacCall for filtering recreational fishing trips is promising but remains largely unvalidated.)

- Develop standard and appropriate methods for modeling age and length data, including choice of distribution, initial variance assumptions, and tuning methods (current methods can and should be improved).
- Routinely produce and present supporting documentation for any derived indices which are included in a stock assessment model (e.g., GLMM derived trawl survey abundance indices).

Cowcod rockfish

- The next assessment should be a full Bayesian assessment.
- The visual survey time series should be extended to at least two points (ideally the next visual survey should be designed to extend the time series and provide ancillary information on the survey *q*).
- The assumptions underlying the CPFV time series as an index of abundance should be explored in full (it is of concern that the trend is driven by the binomial component of the delta GLM).
- Fully capture the uncertainty in historical catch. At least three alternative catch histories should be constructed: a “best guess”, an upper bound and a lower bound. Alternative assumptions in the timing of small and large catches could also be explored.

Darkblotched rockfish

This should be aimed towards a fully Bayesian assessment when the process and technology allow. In the interim, there are various issues which should be addressed (although, some will have to await the resolution of generic problems):

- Fully capture the uncertainty in historical catch. At least three alternative catch histories should be constructed: a “best guess”, an upper bound and a lower bound. Alternative assumptions in the timing of small and large catches could also be explored.
- Properly stratify and scale the conditional age-at-length data from the fishery.
- Avoid violation of the assumption of constant proportion-at-age for given length by omitting data during periods of fast growth or by modeling seasonal growth.
- Maintain the logical relationship of joint age and length data (by appropriately calculating initial effective sample sizes and tuning the data jointly).
- Carefully consider the reliability of the Triennial time series as an abundance index.

Appendix 1: Suggestions distributed to STATs (3)

The following document was distributed to STATs and other relevant people by Stacey Miller, on my behalf, by email on 25 July 2007.

Suggestions for STATs (3)

Patrick Cordue
21 July 2007

Welcome to my third, and possibly final, set of suggestions (see A-I in "Suggestions (1) and (2)"). As before, the following are merely suggestions – many special cases arise for individual assessments and STATs may have good reason for taking somewhat different approaches. Some of the suggestions below relate to particular features in SS2 which I suggest should not be used. Please do not take this as a criticism of SS2 (or its creator(s)). SS2 is a wonderful resource and given its complexity it is not surprising that there are a few options that need to be fine-tuned.

J. Lognormal error structure

For any abundance time series that you have available you need to *fully* specify an error structure. In SS2, a lognormal error structure is typically used for abundance indices. The user is given an option of estimating q analytically (i.e., the q which minimizes the negative log-likelihood is calculated exactly from a formula) or estimating it as a free parameter. The latter option must be selected if there is an informed prior on q. If the analytical option is selected the user has the choice of "mean unbiased" or "median unbiased" "estimation of q". This is an error in terminology and points to an error in SS2.

The terms "mean unbiased" and "median unbiased" in this context relate to abundance indices (not the method of estimating q).

For simplicity, consider a single biomass index from a time series:

$$X = qB\varepsilon \quad \text{where } \varepsilon \sim \text{LN}(\mu, \sigma^2)$$

The definitions that I use are: index X is "mean unbiased" iff E(X) = qB and index X is "median unbiased" iff Median(X) = qB ("iff" = "if and only if"). The definitions extend naturally to a whole times series (where of course the q remains constant) and a time series is "mean unbiased" if each index in the time series is "mean unbiased". Similarly, this applies for a "median unbiased" times series.

For our lognormal example, we have,

$$X \sim \text{LN}(\ln(qB) + \mu, \sigma^2)$$

Therefore,

$$X \text{ is mean unbiased iff } \mu = \frac{-\sigma^2}{2}$$

and

$$X \text{ is median unbiased iff } \mu = 0 .$$

Currently in SS2 there is a single likelihood for lognormal abundance indices, which is the likelihood for *median* unbiased indices. Therefore, until the additional option for mean unbiased indices is added, you should not specify "mean unbiased" estimation of *q*.

K: When is an abundance time series mean unbiased?

Any fishery independent survey has almost certainly been designed to provide mean unbiased indices. E.g., a stratified random trawl survey is designed to provide an unbiased estimate of scaled mean density for each stratum; these are then scaled by stratum area and summed to provide an unbiased estimate of scaled biomass.

For indices which are derived by GLM methods, the assumptions will probably sit more easily as median unbiased (including GLMMed trawl surveys).

L: Red face test for exploitation rates

In a model with a single fishery it is always useful to look at the time series of exploitation rates (total catch over selected/vulnerable biomass). (Note, in SS2, that "harvest rates" are defined for each fishery as landings over selected/vulnerable biomass.) If exploitation rates are implausible during part of the time series it casts doubt on the whole model run. But what is implausible? This judgment can only be made with some knowledge of the fishery and the distribution of the fish. Pretty much, you know it when you see it. E.g., a fishery based on spawning fish during a two-month season which takes 99% of the spawning biomass; or, in a season when the fleet was working "flat out" and they caught only 1% of the spawning biomass.

When there are multiple fisheries in the model it is more difficult to apply a 'red face" test to the total catch which is now a sum over all of the fisheries. The harvest rates for each fishery should be examined for plausibility – but they may be difficult to judge, particularly if the selectivity pattern is domed. An alternative is to use a summary biomass set at the (approximate) age of 50% selection in the fishery which selects the smallest/youngest fish (amongst all substantial fisheries).

In SS2 there is a maximum harvest rate specified for each fishery – if you set these at appropriate levels then the model will keep harvest rates at "plausible" levels.

M: Pope vs Baranov

SS2 has an option to select continuous *F* in the catch equation (i.e., Baranov). However, this automatically invokes the estimation of an *F* in each year (for each fishery?) and the fitting of the input landings data. This option should be avoided as it introduces a large number of extra parameters and may result in an alternative landings history different from that intended. If you truly wish to treat the landings as a time series with observation error then you should wait until SS2 has an option for specifying annual CVs or SDs for the landings data. You do have the option to increase the lambda on the landings likelihood component, but currently no other control is available for the landings likelihood component.

If you need to use Baranov because of very high exploitation rates (where Pope's approximation may be inappropriate), then you should increase the lambda sufficiently to ensure that your landings are fitted almost exactly. An option to use Baranov with an iterative calculation of *F* rather than fitting annual *F*s may be perhaps be implemented at some time in the future (but I doubt that it is a high priority).

Appendix 2: Bibliography of supplied material

I. Meeting Materials

A. Terms of Reference for Stock Assessments and STAR Panels
B. Draft Agenda
C. Meeting Location Information
D. Driving Directions & Map
E. List of Panel Participants

II. Previous Assessments, STAR Panel Reports and SSC Reports

A. Status of the Darkblotched Rockfish **(***Sebastes crameri*) Resource in 2005. Jean Beyer Rogers. June 20, 2005.
B. Darkblotched Rockfish STAR Panel Meeting Report. May 16-20, 2005.
C. Scientific and Statistical Committee Report on Stock Assessments for 2009-2010 Groundfish Fisheries. *Please read the statement related to the June 9-10, 2007 review of the cowcod update on page 6-7.*
D. 2005 Stock Status of Cowcod in the Southern California Bight and Future Prospects. Kevin Piner, Edward J. Dick and John Field. May 25, 2005.
E. Cowcod STAR Panel Report. May 9-13 2005.
F. Stock Assessment of Cowcod. John L. Butler, Larry D. Jacobson, J. Thomas Barnes, H. Geoffrey Moser, and Robson Collins.
G. Cowcod STAR Panel Report. May 24-28, 1999.

III. 2006 "Off-Year" Workshop Reports

A. A Summary Report from the NWFSC Bottom Trawl Survey Workshop held October 31 – November 2, 2006 in Seattle, Washington. NOAA Fisheries, NWFSC, FRAM Division.
B. A Summary Report from the WC Groundfish Data/Modeling Workshop held August 8-10, 2006 in Seattle, Washington. NOAA Fisheries, NWFSC, FRAM Division.
C. Report of the Groundfish Harvest Policy Evaluation Workshop, Southwest Fisheries Science Center, La Jolla, California. December 18-20, 2006. A Workshop Sponsored by the Scientific and Statistical Committee of the Pacific Fishery Management Council
D. Pre-Recruit Survey Workshop. September 13-15, 2006. Southwest Fisheries Science Center, Santa Cruz, California. A Summary Report Prepared by Jim Hastie NOAA Fisheries, Northwest Fisheries Science Center and Stephen Ralston, NOAA Fisheries, Southwest Fisheries Science Center.

IV. SS2 Documentation

A. SS2 Zip File – Includes User's Manual, example files, powerpoint presentations and SS2 executable files (optimized and normal modes).

B. R Software Zip File – Code developed by Ian Stewart to perform model diagnostics and plotting of SS2 output. This is not an official SS2 add-on and is not part of the NOAA toolbox. File contains User's Guide, example files as well as powerpoint presentations.

V. Additional Background Materials

A. GAO Report: Pacific Groundfish: Continued Efforts Needed to Improve Reliability of Stock Assessments. United States General Accounting Office, Report to Congressional Requesters. June 2004.

B. ISM Research Memo 978: Minami, M., C.E. Lennert-Cody, W. Gao and M. Roman-Verdesoto. 2006. Modeling shark bycatch: the zero-inflated negative binomial regression model with smoothing. (This work also published in Fisheries Research Vol. 84(2), 210-221). Manuscript provided by EJ Dick.

Appendix 3: Statement of work

Consulting Agreement between the University of Miami and Patrick Cordue

Statement of Work

July 11, 2007

General

The Stock Assessment Review (STAR) meeting is a formal, public, multiple-day meeting of stock assessment experts who serve as a peer-review panel for one or more stock assessments. External, independent review of West Coast groundfish stock assessments is an essential part of the STAR panel process that is designed to make timely use of new fishery and survey data, analyze and understand these data as completely as possible, provide opportunity for public comment, and assure the best available science is used to inform management decisions.

The stock assessments will report the status of the darkblotched rockfish and cowcod resources off the west coast of the United States using age and/or size-structured stock assessment models. Specifically, the information includes a determination of the condition and status of the fishery resources relative to current definitions for overfished status, summaries of available data included in the models, and impacts of various management scenarios on the status of the stocks. The information is provided to the Pacific Fishery Management Council and NOAA's National Marine Fisheries Service to be used as the basis of their management decisions, which are subsequently approved and disseminated by the Secretary of Commerce through NOAA and NMFS.

The consultant will participate in the Stock Assessment and Review (STAR) Panel of the Pacific Fishery Management Council (PFMC) for the review of the darkblotched rockfish and cowcod stock assessments. The 2005 cowcod assessment was updated in June, 2007 and corrections and changes to the data and model specifications resulted in substantial changes in depletion and historical exploitation rates. The Pacific Fishery Management Council requested that a full assessment for cowcod be developed and considered for review during a STAR Panel.

The consultant should have expertise in fish population dynamics with experience in the integrated analysis type of modeling approach, using age-and size-structured models, use of MCMC to develop confidence intervals, and use of Generalized Linear Models in stock assessment models. The Pacific Fishery Management Council's Scientific and

Statistical Committee requests that "all review panelists should be experienced stock assessment scientists, i.e., individuals who have done actual stock assessments using current methods. Panelists should be knowledgeable about the specific modeling approaches being reviewed, which in most cases will be statistical age- and/or length-structured assessment models" (SSC's Terms of Reference for Stock Assessments and STAR Panel Process for 2007-2008)

Documents to be provided to the consultants prior to the STAR Panel meeting include:

- Current draft of the darkblotched rockfish and cowcod stock assessments;
- Most recent previous stock assessment and STAR panel report for darkblotched rockfish (2005);
- Cowcod stock assessment and STAR Panel report from 2005 as well as SSC groundfish subcommittee report and SSC statement on 2007 updated cowcod assessment;
- An electronic copy of the data, the parameters, and the models used for the assessments (if requested by reviewer);
- The Terms of Reference for the Stock Assessment and STAR Panel Process for 2007-2008;
- Summary reports from the West Coast Groundfish "Off-Year" stock assessment improvement workshops held in 2006;
- Stock Synthesis 2 (SS2) Documentation; and
- Additional supporting documents as available.

Specifics

Consultant's duties should not exceed a maximum total of 14 days: several days prior to the meeting for document review; the 5-day meeting; and several days following the meeting to complete the written report. The report is to be based on the consultant's findings, and no consensus report shall be accepted.

The consultant's tasks consist of the following:

1) Become familiar with the draft stock assessments and background materials.
2) Actively participate in the STAR Panel to be held in Seattle, Washington, July 16-20, 2007. Participants are strongly encouraged to voice all comments during the STAR Panel so the assessment teams can address the comments during the Panel meeting.
3) Comment on the primary sources of uncertainty in the assessments.
4) Comment on the strengths and weaknesses of current approaches.
5) Recommend alternative model configurations or formulations as appropriate during the STAR panel.
6) Complete a final report after the completion of the STAR Panel meeting.
7) No later than August 3, 2007 submit a written report consisting of the findings, analysis, and conclusions (see Annex I for further details), addressed to the

"University of Miami Independent System for Peer Review," and sent to Dr. David Die, via e-mail to ddie@rsmas.miami.edu, and to Mr. Manoj Shivlani, via e-mail to mshivlani@rsmas.miami.edu.

Submission and Acceptance of Reviewer's Report

The CIE shall provide via e-mail the final reports of the consultants in pdf format to Dr. Lisa L. Desfosse for review by NOAA Fisheries and approval by the COTR, Dr. Stephen K. Brown by August 17, 2007. The COTR shall notify the CIE via e-mail regarding acceptance of the report. Following the COTR's approval, the CIE shall provide the COTR with pdf versions of the final report with digitally signed cover letters.

ANNEX 1: Contents of Panelist Report

1. The report shall be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the report shall consist of a background, description of review activities, summary of findings (including answers to the questions in this statement of work), and conclusions/recommendations.

3. The report shall also include as separate appendices the bibliography of all materials provided by the Center for Independent Experts and a copy of the statement of work.