Review of West Coast Groundfish Stock Assessments: Pacific ocean perch, cabezon, and darkblotched rockfish

STAR Panel, May 16-19, 2005
Seattle Washington

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DRAFT, June 11, 2005

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1 EXECUTIVE SUMMARY

This report presents results of an independent peer review of three west coast groundfish stock assessments (Pacific ocean perch, darkblotched rockfish and cabezon), conducted for the Center for Independent Experts, University of Miami. The primary activity of the review was active participation in the May 16-19,2005 STAR Panel in Seattle, Washington. A major focus of this review was to ascertain that data, model, and assessment uncertainties were fully explored and that these uncertainties were appropriately carried through to the management advice.

The STAR process was thorough, rigorous, and allowed adequate time to review the three assessments. The Panel report summarizing meeting activities and recommendations represents consensus view. This report is consistent with the Panel report, though focused to those issues I feel are most relevant to the assessment uncertainties.

The three assessments, cabezon, darkblotched rockfish, and Pacific ocean perch, are based on theoretically sound analyses and the assessments investigate and discuss major data and model uncertainties. As such they provide a reasonable basis for management advice. Two of the stocks are currently *overfished* and have rebuilding plans in place (darkblotched rockfish and Pacific ocean perch). For all three stocks, as for other west coast groundfish, the 1999 and/or 2000 year-classes appear to be strong and this may facilitate rebuilding.

The cabezon assessment provides a thorough investigation of data and model uncertainties and numerous sensitivity runs were conducted to evaluate these. The major uncertainty, related to population structure, genetic mixing, and the appropriate geographic scales for stock management, is more difficult to deal with. Cabezon tend to be spatially discrete and susceptible to serial depletion, and the degree to which this confounds the stock assessment is unknown. For the current assessment the data is disaggregated to assess two California sub-stocks, and given the data limitations this is a substantial improvement to dealing with the finer-scale stock structure.

The major uncertainties in the darkblotched rockfish assessment revolve around estimates of the natural mortality rate (M), the longevity of the species, and the growth rates. For the current assessment, age-composition data were not fitted in the analysis because they did not allow consistent fits to the von Bertalanffy growth model. For future assessments alternate growth models should be explored, because it should be possible to have consistent fits to both the age and length composition data.

The Pacific ocean perch assessment, conducted using both Bayesian and MPD estimation, is an update so there were no changes to the analytical methods. The posterior distribution of natural mortality, given a reasonable CV on this parameter, is shifted to higher values than the prior distribution. This suggests there are contradictions between the model data and the assumed value for M, which warrant future exploration.

The recommendations I make relate to issues that arose during this review, however, they are intended to be generic. That is, they reflect issues where further research and standardized approaches would benefit all west coast groundfish assessments. Specific areas where standardization of analyses and procedures would improve the assessment process include: approaches and methods for presenting stock assessment uncertainties; methods for weighting between and within data sources; and forms and formats for evaluating model residuals (especially for composition data).

Additionally some recommendations are made about enhancements and developments to the SS2 code.

2 BACKGROUND

This document reports on an independent peer review of three west coast groundfish stock assessments (Pacific ocean perch, darkblotched rockfish and cabezon), conducted for the Center for Independent Experts (CIE), University of Miami. The primary review activity was active participation in the May 16-19, 2005 Groundfish Stock Assessment Review (STAR) Panel in Seattle, Washington. To prepare for the STAR Panel meeting, I reviewed draft assessment documents and other pertinent background materials.

The CIE *Statement of Work* (Appendix A) defines the scope of this review. In addition to participation in the STAR Panel, the *Statement of Work* requests comments on the primary sources of uncertainty in the assessments and the strength and weaknesses of the assessments. Additionally, focus for the review came from a United States General Accounting Office's (GAO) *Report to Congressional Requestors* on Pacific groundfish stock assessment reliability. That audit found that the reliability of the assessments were questionable, although based on the best available information at the time. The report recommended that 1) data used in stock assessments be evaluated for reliability and, 2) assessment reports should clearly represent the uncertainties in the assessment.

A record 20 west coast groundfish species will be assessed and reviewed through the Pacific Fisheries Management Council STAR Panel process in 2005. To provide guidance on analytical procedures and data usage, three workshops were held in 2004 to deal with specific assessment related issues. In addition to generating recommendations on data usage and a new GLM-standardization of slope trawl survey data to estimate abundance indices, a *Stock Assessment Modeling Workshop* provided guidance for analytical approaches. In particular, a new analytical stock assessment package was tested and available (SS2), and it was suggested that analysts transition to this software and move towards a Bayesian estimation approach to quantify uncertainty.

I would like to acknowledge Stacey Miller (NOAA) for organizing the review materials and obtaining additional data files for me prior to the meeting.

3 DESCRIPTION OF REVIEW ACTIVITIES

The activities undertaken for this review include; 1) assimilation of draft assessment documents and other pertinent background materials prior to the STAR Panel meeting, 2) participation in the STAR Panel, and 3) preparation of this report.

The materials provided to prepare for the STAR Panel meeting included: the draft stock assessment documents; previous assessment documents, reviews, and rebuilding plans; and other ancillary material relevant to the review (Appendix B). Additionally, model code and data files were provided for the three assessments to allow independent stock reconstruction runs. I ran only the Pacific ocean perch (POP) *base run* assessment model configuration to assess convergence of the MCMC.

The primary focus for the STAR Panel members (Appendix C) during the May 15-19, 2005, meeting included:

- Understanding the basis and rationale for data usage, model assumptions, and model configurations used in the assessments.
- Requesting runs with alternative model configuration, additional analyses, and additional model outputs to evaluate the reliability of the assessment and aid interpretation of results.
- Working with the STAT team members (Appendix C) to determine appropriate axes for expressing uncertainty and approaches for representing that uncertainty in decision tables.

A STAR Panel report, summarizing meeting review activities and Panel recommendations, was prepared during and after the meeting. The report presents consensus view, as there were no significant disagreements among Panel members. What I report here is consistent with the Panel report, though it reflects those issues that I feel are most relevant to reliability and uncertainty in the assessments.

4 SUMMARY OF FINDINGS

4.1 OVERVIEW

This was the first west coast groundfish STAR Panel that I participated in. I found the process provided adequate time for a thorough review of the three stock assessments, including the data sources, the analytical methods, and pertinent results. Two of the three preliminary assessment documents were particularly well prepared (cabezon and POP), with fairly comprehensive explorations of data and modeling uncertainties. Clearly this made the Panels work easier, and allowed us to focus on ways to express uncertainty in the projections. The Panel members had a broad range of stock assessment expertise, and this resulted in a broad-scoped review that included consideration of the biology, fisheries, and population dynamics relative to the model structures, as well as more statistical and analytical aspects of the modeling.

Two of the three assessments reviewed used the new age- and length-structured fishery assessment model, Stock Synthesis 2 (SS2). This model, designed specifically for west coast groundfish, can deal with aspects of the data and fisheries that are potentially unique (eg. high and largely unknown discarding rates because of trip limits). The new model code will facilitate the move to a common assessment framework and approach.

Many of the west coast groundfish stock assessments are relatively new, the available data are limited and often uncertain, and analytical methods are evolving. As such, I think it is reasonable to view the assessments that are reviewed here as works in progress. My comments are largely directed to areas where I believe future work will improve the assessments.

4.2 CABEZON

The 2005 cabezon stock assessment differs from the first (2003) cabezon assessment in a number of ways. The most significant changes are: 1) a new assessment model is used (SS2), and 2) data analysis and modeling is conducted for two California substocks - the Southern California Substock (SCS) and the Northern California Substock (NCS). The previous stock assessment presented analyses for a Washington/Oregon stock complex, but the 2003 STAR Panel rejected that assessment as implausible. No attempt was made to analyze data for the Washington/Oregon region in the current assessment.

The data fitted in the cabezon assessment model includes commercial and recreational fishery length frequencies, abundance indices from GLM-standardized recreational fishery CPUE logbook data, and spatially-restricted fishery-independent survey indices. The SS2 model is configured for two sexes to account for differences in male and female growth, however the length frequency data is not sex-specific so model fitting is to combined-sex length frequency data. Growth is assumed known (estimated outside the assessment model). Effective sample sizes assumed for the length frequency data (based on multinomial distributions) are determined through iterative re-weighting. Catch time series were reconstructed back to 1916, though there is considerable uncertainty in the historic recreational fishery catch estimates.

Point estimates of stock depletion, based on the maximum of the posterior density (MPD) model fits, are 40.1% for the NCS and 28.3% for the SCS. Both stocks appear to be increasing in recent years. For the NCS, uncertainty in the assessment was captured through fitting the model at alternative natural mortality values. For the SCS assessment, uncertainty is captured relative to the magnitude of the large 2000 year-class. Bayesian estimation was not conducted for this assessment.

The approach to presenting assessment uncertainty, developed by the Panel, was *ad hoc*. For both assessments a single axis was selected to reflect the full assessment uncertainty. For the NCS, variation in the natural mortality rate resulted in uncertainty in the overall stock dynamics, whereas for the SCS only uncertainty in the recent abundance trend was captured. Although the approaches are *ad hoc* and differ for the two stocks, the results likely capture uncertainty in current stock depletion estimates and short-term stock projections reasonably well.

4.2.1 Primary sources of uncertainty

The cabezon assessment document provides a thorough discussion of the sources of data and model uncertainty. Numerous sensitivity runs were conducted to evaluate these uncertainties including fits that: excluded individual data series; used alternative catch series; made alternative assumptions about sex-specific natural mortality rates; made alternative assumptions about stock-recruitment parameters; had a non-linear relationship between the recreational fishery CPUE series and stock abundance; and used alternative methods of weighting length frequency data.

The major unresolved (and unresolvable) source of data uncertainty for the cabezon assessment is the magnitude of the historic (pre-1980) recreational fishery removals. Considerable effort went into reconstruction of the catch data series and the current analysis is based on the most likely time series of removals. Sensitivity to error in this data, investigated by halving and doubling the historic recreational removals and by fitting to catch in numbers rather than catch in weight, resulted in depletion estimates from 38.7% to 47.0% for the NCS and from 21.0% to 31.6% for the SCS (base run estimates were 40.1% and 28.3% for NCS and SCS, respectively). The range in the catch data series explored likely bounds the uncertainty in historic removals. Another possible approach to dealing with this data uncertainty would be to initiate the analysis later (1980), assuming a non-equilibrium initial population.

For the cabezon assessment, there are numerous areas of uncertainty related to model structure and assumptions. Sensitivity runs were conducted to address the uncertainties that could be explored through alternative model runs. However, key unknowns for this assessment relate to population structure, genetic mixing, and the appropriate geographic scales for stock management. Like other nearshore reef fishes, cabezon tend to be spatially discrete and susceptible to serial depletion. The degree to which this confounds the stock assessment is unknown.

Other important areas of uncertainty in this assessment are the assumption of a linear relationship between the recreational fishery CPUE and stock abundance, and uncertainty in the assumed natural mortality rates. For the current assessment these were investigated through sensitivity runs. In future assessments these areas of uncertainty might be integrated into a Bayesian analysis with prior distributions for the natural mortality rates and for a power function for the CPUE-biomass relationship.

4.2.2 Strengths and weaknesses of current approach

Considerable work has gone into compiling and evaluating all potential data sources, in particular relative abundance time-series. A number of spatially-restricted cabezon abundance data series were investigated but not included in the final model formulation because they were not likely to reflect overall stock trends. Although much work has gone into collating and reviewing data sources, the assessment remains relatively data-poor. The assessment, as structured for two California sub-stocks, suffers from the lack of a broad-based fishery independent index. However, the recreational fishery logbook program (CPFV) abundance index is a long-term broad-based index that may adequately capture abundance trends. Further work to investigate this data, both for broad-based and finer-scale indices, would be useful.

The 2005 cabezon assessment transitioned to using the SS2 assessment software where previously a cabezon-specific model was used. I consider this as a positive step for the assessment because it does not appear that any cabezon-specific model structure was lost in the transition. Also, the use of the common software package ensures consistency in

analytical methods, use of verified code, and future gains as the model develops, in particular with respect to Bayesian estimation.

The dis-aggregation of the California data for two substocks is a significant step towards recognizing the finer-scale spatial structure of cabezon. Because there is no length frequency data for the SCS commercial fisheries, commercial fishery selectivity estimates for the NCS are assumed for the SCS. While this introduces further uncertainty in the SCS assessment, it provides an approach to conducting separate assessments for the two substocks.

For the 2005 assessment, growth rates of young cabezon were verified from mark-recapture data, adding confidence to the growth model and hence the assessment. Further work with this validation approach may allow verification of growth for older fish.

The iterative re-weighting approach used to determine *effective sample sizes* for the cabezon length frequency data requires further consideration, development, and documentation. For the NCS, the re-weighting procedure resulted in an *effective sample size* of >1900 for one length frequency (1996 commercial non-live fishery) while the remainder of the length frequencies had *effective sample sizes* that were generally less than 100, implying much greater precision for one data set than for all others. The initial sample size for the one "high precision" sample was large, and likely influenced the final iteratively re-weighted *effective sample sizes.* Given there is considerable process error that is not directly modeled (eg. lack of strict adherence to the modeled selectivity functions), it seems unreasonable to have such large differences in the assumed variances of the length frequency data sets. The effect of length frequency data weighting was investigated during the Panel meeting and found to have only minor influence on key model outputs of management interest, so the *base run* was not changed. However, it would be useful if standard approaches for weighting composition and other data were developed, as these will influence Bayesian posterior distributions even more than point (MPD) estimates.

4.3 DARKBLOTCHED ROCKFISH

An analytical assessment of the west coast darkblotched rockfish resource, using the age- and length-structured Stock Synthesis program, was conducted in 2000 and updated in 2003. The 2000 assessment led to "overfished" designation for this resource, and a rebuilding plan is in place.

The current darkblotched rockfish assessment uses the new SS2 model code, though analyses are limited to MPD rather than Bayesian estimation. Significant changes to the current assessment include: age-composition data are dropped from the model fits; growth parameters are estimated within the assessment model, simultaneously with other model parameters; the range of natural mortality rates explored in the analysis are higher than those evaluated previously; the time-series of catch data is extended back to 1928; and GLM-standardized slope survey abundance indices are used (rather than design-

based indices). The darkblotched rockfish assessment model is fitted to multiple data sources including fishery and survey length frequency data and a number of trawl survey relative abundance series.

Stock depletion (beginning year 2005) for west coast darkblotched rockfish was estimated at 17%, with a recent upward trend in abundance. Uncertainty in the natural mortality rate was used as to capture model uncertainty. The range in M values that were thought to span the possible range for this parameter (0.05 and 0.09), resulted in stock depletion estimates of 0.10 and 0.25. As with many west coast groundfish stocks, the 1999 and 2000 year-classes appear to be strong.

Although I have concerns that the age-composition data were omitted from the current assessment and that the M values evaluated were higher than in previous assessments, I believe the darkblotched rockfish assessment is sound and provides an adequate basis for management advice. The recent increasing stock abundance trend and estimates of strong year-classes are independent of the assumed value for natural mortality.

4.3.1 Primary sources of uncertainty

The major uncertainties in the darkblotched rockfish assessment revolve around estimates of the natural mortality rate (M), the longevity of the species, and the growth rates. Natural mortality estimates based on longevity data range from 0.025 to 0.05 (Hoenig's 1983 method using age-composition data). A more recent estimate based on a relationship with GSI predicts an M of 0.107. The current darkblotched rockfish assessment evaluates M over a range of 0.05 to 0.10, which is higher than the range explored in previous assessments (0.025 to 0.05 for the 1993 assessment, 0.05 for the 2000 and 2003 assessments). Results investigated during the STAR panel meeting indicate that the age-composition data is more consistent with the lower M values and the length-composition data, in conjunction with the von Bertalanffy growth model, is more consistent with the higher M values.

Consistency in darkblotched rockfish ageing is poor, in part because there are many growth checks that are difficult to interpret. Additionally, there appear to be ager and ageing year influences on age determination. Growth curves fitted to otoliths aged in 2002 suggest more rapid growth of younger fish than what had been previously estimated. However, otoliths aged in 2004 result in growth curves similar to those estimated for the earlier data. The real problem though, appears to be that the length-at-age data are inconsistent with a von Bertalanffy growth model, and there are no alternative approaches (eg. alternative growth models or direct input of length-at-age matrices) for generating predicted length frequencies and fitting to length data in the SS2 model.

The current darkblotched stock assessment deals with the above-noted contradictions by eliminating the age-composition data from the model fit (with the exception of the 2004 AFSC shelf survey which is retained to provide growth information). Potential impacts

of this were investigated during the Panel meeting by forcing fits to different growth parameters and by profiling over M.

Future darkblotched rockfish stock assessments should continue to explore issues around the ageing, longevity, and natural mortality questions. Alternative growth models or methods to input length-at-age distributions in SS2 should be developed and explored to see if consistent fits can be found to both age- and length-frequency data sets. Also, ageing consistency and repeatability should continue to be explored to understand the basis for the differences. Finally, current research using otolith core chemistry to validate ageing should continue with primary focus on validation (or invalidation) of longevity.

There is considerable uncertainty in early darkbloctched rockfish landings estimates, in particular the large catches taken by foreign fleets in the mid 1960's. This results from uncertainty in the both the total slope rockfish catch taken by the foreign fleets and in the proportion of catch that is darkblotched rockfish. Considerable work has gone into re-constructing the foreign catch time series, and estimates used appear to be the best possible. Uncertainty in key management quantities resulting from uncertainty in the historic catch estimates is explored in the assessment.

Appropriate methods to estimate survey length and age-frequencies, consistent with the new GLM standardization of slope rockfish surveys, have not been fully explored. It is possible that the methods currently used may over-weight the few large tows of darkblotched rockfish that co-incidentally tend to contain larger fish.

4.3.2 Strengths and weaknesses of current approach

A major strength of the darkblotched rockfish stock assessment is the relatively long time-series of data (beginning in 1977) that includes fishery and survey age and length composition data as well as relative abundance indices from a number of trawl surveys. These data provide a solid basis for the assessment. Though, as discussed previously discussed, I consider elimination of the age-composition data from the model's fit to detract from the current assessment.

The CVs of the various trawl survey indices are high, and there is no over-riding trend in them, thus somewhat weakening their value to the assessment. Investigation of spatial aspects of the darkblotched rockfish distributions may lead to alternative approaches to analyzing and using the data that decrease the variance of the survey-based abundance indices.

The darkblotched rockfish assessment uses the standard SS2 assessment software package, and will benefit from future development to the software. Development of alternative growth models or the ability to directly input length-at-age distributions in the SS2 code would be a major benefit for this assessment.

4.4 PACFIC OCEAN PERCH

The Pacific ocean perch stock assessment is an update, using the same model structure and assumptions as used for the 2003 assessment. The model, written in ADMB software, is age- and size-structured and fitted to multiple data including; catch, fishery and survey age-and size-compositions, fishery CPUE; and trawl survey abundance indices (triennial survey; AFSC and NWFSC slope surveys; POP survey). The model is formulated for Bayesian estimation based on an MCMC algorithm, though full Bayesian estimation was conducted only for the *base run.*

For Pacific ocean perch, uncertainty in the stock assessment was investigated using both Bayesian estimation and sensitivity analyses (MPD fits). Some sources of uncertainty are explicitly included in the assessment model and contribute to the uncertainty reflected in the posterior distribution. This includes uncertainty in; the natural mortality rate, the stock-recruitment parameters, and the survey catchability parameters. Sensitivity analyses (MPD fits) evaluated the effects of; alternative data weighting, excluding data sets, alternative selectivity parameterization, and an alternative maturity ogive. Greater uncertainty in key assessment outputs and quantities of management interest were obtained from the MPD-fit sensitivity analyses than from the uncertainty indicated by the marginal posterior distribution of the *base run.*

The point estimate (MPD) for spawning stock biomass depletion in 2005 is 23.4%. Pacific ocean perch have been declared *overfished,* with a rebuilding plan in place. For the current assessment, stock projections were conducted for each retained point from the posterior distribution (from the MCMC chain) at F levels of 0.01 and 0.02. Results of the projections are presented in a “decision table” format, that presents future depletion estimates for the “low”, “medium”, and “high” outcome ranges (lowest 25%, mid 50% and highest 25%). This is a different approach to presenting stock projection results in “decision tables”, to what I am accustomed to.

4.4.1 Primary sources of uncertainty

The Pacific ocean perch assessment document presents a fairly thorough investigation of sources of uncertainty, including data uncertainties and model structural assumptions. There are two areas of uncertainty that are noteworthy for this stock assessment – uncertainty in the magnitude of foreign fishery removals in the late 1960s and uncertainty in the natural mortality rate.

Historically, the highest removals from the Pacific ocean perch stock were taken by foreign fishing vessels in the late 1960s, with annual catches estimated as high as 16 Kt. While the best possible catch estimates are used in the current assessment, there is considerable uncertainty in the magnitude of the foreign fishery. These catches will influence the estimated unfished spawning biomass and the recruitment variability. Improved estimates of foreign removals are not likely, so stock reconstructions that begin

from non-equilibrium conditions in the early 1970s may be a useful approach to exploring this uncertainty.

For the Bayesian estimation, a very tight prior is placed on the natural mortality rate parameter (CV of 0.1). An MCMC analysis with a less informative prior (CV of 0.3), was conducted during the Panel meeting, and resulted in a major shift in the marginal posterior distribution to higher M values. Although the less informative prior seems more appropriate, given considerable uncertainty in M, the Panel decided a change to the CV should not be made without further investigation. The results clearly show contradictions between the data fitted in the model and assumed "best" value for M. This contradiction should be better understood prior to changing the CV, because the effect is to shift the median value of M higher.

4.4.2 Strengths and weaknesses of current approach

The Pacific ocean perch assessment benefits from multiple and longer time series of data (age composition data beginning in 1966), including a number of fishery-independent trawl survey abundance indices. Although earlier otolith *surface* ages appear to be biased, data comparing *surface* with *break-and-burn* ages allow for standardized usage of the data from the two ageing methods.

The Pacific ocean perch assessment is structured for Bayesian estimation which allows integration over many axes of uncertainty. It would seem that Bayesian estimation is ideal to account for uncertainty in fisheries assessment models, but there is considerable developmental work required to ensure consistent and appropriate usage of Bayesian estimation for highly complex age- and length-structured fisheries models.

The MCMC chain from the Pacific ocean perch *base run* showed excellent convergence properties, and this is a major strength of the assessment. I was somewhat surprised by the good MCMC behaviour because the model used certain forms of parameterization that have caused convergence problems in other assessments. Specifically, this includes: the use of penalty functions to create "smoothed" selectivity functions; the use of arbitrarily stepped changes in selectivity (i.e. every 5 years rather than at specific points where the fishery was known to change); and the use of ADMB *bounded-dev-vectors* which do result in mean-zero vectors but also contribute to the objective function in the MCMC in an non-Bayesian manner. I point this out not because of concern for the current assessment where the MCMC chain appears to be well converged, but because these points could be important in other Bayesian age-structured fisheries models.

5 CONCLUSIONS AND RECOMMENDATIONS

The recommendations in this section relate to issues that arose from review of the cabezon, darkblotched rockfish, and Pacific ocean perch stock assessments. However,

the recommendations are intended to be generic, that is, they reflect issues where further research and standardized approaches would benefit all west coast groundfish assessments.

Recommendations:

The development of standardized methods for data weighting would be of value, in particular for Bayesian estimation where absolute data weightings are often more important than relative data weightings. Some form of iterative re-weighting may be appropriate, but consideration should be given to the effect of both process and sampling error on posterior density estimates. Additionally, for iterative re-weighting schemes some evaluation should be done on the effect of poorly specified initial variance estimates on the terminal variance estimates (after the iterative re-weighting).

The development of standardized forms and formats for evaluating and presenting model residuals would be useful, in particular for composition (age or length) data. The output should be structured so that large and potentially influential residuals are apparent, and also so that residual patterns that may be indicative of model mis-specification are readily apparent.

While a standard set of statistics for investigating MCMC convergence have been specified (see *Stock Assessment Modeling Workshop* report), there are no guidelines for which statistics should be presented in assessment reports. The full suite of statistics is too large to include in the assessment documents, but a small, standard, subset would allow readers and review to assess the MCMC performance.

A standardized set of approaches for representing stock assessment uncertainty would have value so that managers can consistently interpret the assessment information they receive. Standardization should include consideration of whether to present uncertainty relative to model point estimates (MLE or MPD) or relative to statistics from the posterior distribution(s) when both are available. Also, some guidance on which uncertainty measures to present would be useful (medians, means, asymptotic variance estimates, specific quantiles of marginal distributions). Finally, a standard approach for constructing decision tables would be useful. The method used to generate the Pacific ocean perch decision table differs from methods I've seen used for other fisheries assessment, but it may be appropriate in the west coast groundfish stock management context.

A number of enhancements to the Stock Synthesis (SS2) model code have been requested (as reported in the *Stock Assessment Modeling Workshop* report), and I add a few more to the list. Specifically, the ability to initiate populations from non-equilibrium conditions, and the ability to use alternative growth models or the ability to input length-at-age distributions directly.

Conclusions:

The new stock assessment code, SS2, provides a solid analytical framework for the west coast groundfish stock assessments. Assessments appear to be transitioning to this software, and will benefit from future enhancements and from a growing network of users sharing experience with this assessment tool and approach.

While the *Stock Assessment Modeling Workshop* that occurred prior to the current round of west coast groundfish stock assessments suggested transitioning to Bayesian estimation, this movement appears to be slow. For this review only the Pacific ocean perch assessment used Bayesian estimation, which had been the case previously for the 2003 assessment. A slow transition to Bayesian estimation is likely wise as a new suite of considerations about model parameterization and approaches to presenting uncertainty arise for Bayesian estimation. Slow and well-rationalized transitions to this estimation form are reasonable.

The three stock assessments under review (cabezon, darkblotched rockfish, and Pacific ocean perch) are based on theoretically sound analyses and all assessments provided thorough investigations and discussions of data and model uncertainties. As such they provide a reasonable basis for management advice. Two of the stocks are currently *overfished* and have rebuilding plans in place (darkblotched rockfish and Pacific ocean perch). For all three stocks, as for other west coast groundfish, the 1999 and/or 2000 year-classes appear to be strong and this may lead to increased abundance over the next few years.

APPENDIX A. STATEMENT OF WORK

Consulting Agreement between the University of Miami and Dr. Vivian Haist

April 29, 2005

General

External, independent review of West Coast groundfish stock assessments is an essential part of the STAR panel process. The stock assessments will provide the basis for the management of the Pacific ocean perch, darblotched rockfish, and cabezon stock assessments.

The consultants will participate in the Stock Assessment and Review (STAR) Panel of the Pacific Fishery Management Council (PFMC) for the review of the Pacific ocean perch, darblotched rockfish, and cabezon stock assessments. 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 to process survey and logbook data for use in assessment models.

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

- Current drafts of the Pacific ocean perch, darblotched rockfish, and cabezon stock assessments;
- Most recent previous stock assessments for Pacific ocean perch, darblotched rockfish, and cabezon;
- An electronic copy of the data, the parameters, and the model used for the assessments (if requested by reviewer);
- The Terms of Reference for the Stock Assessment and STAR Panel Process for 2005-2006;
- Summary reports from the West Coast Groundfish data and modeling workshops held in 2004;
- 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 from May 16-20, 2005. . *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 assessment.
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 June 3, 2005, 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.

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.

APPENDIX B. BIBLIOGRAPHY

The following materials were provided prior to the STAR Panel meeting.

Draft assessment documents:

Cope, J.M. and A.E. Punt. (Draft, May 2,2005). Status of Cabezon (*Scorpaenichtys marmoratus*) in Calfornia Waters as assessed in 2005. 170p.

Hamel, O.S. (Draft, April 29, 2005). Status and future prospects for Pacific Ocean perch resource in waters off Washington and Oregon as assessed in 2005. 57p.

Rogers, J.B. 2005 (Draft, May 1, 2005). Status of the darkblotched rockfish (*Sebastes crameri*) resource in 2005. 47p.

Rogers, J.B. 2005 (Draft). Darkblotched rockfish: Tables revised 05-05-05. 3p.

Previous Assessments and Reviews:

Cope, J.M., K. Piner, C.V. Minte-Vera, and A.E. Punt 2003. Status and future prospects for the Cabezon (*Scorpaenichtys marmoratus*) as assessed in 2003. 147p.

Rogers, J.B., Methot, R.D, Builder, T.L., Piner, K. and M. Wilkens. 2000. Status of the darkblotched rockfish (*Sebastes crameri*) resource in 2000. *Appendix to:* Status of the Pacific Coast groundfish fishery through 2000 and recommended Acceptable Biological Catches for 2001. Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council, Portland, OR. 79p.

Rogers, J.B. (July 11, 2003) Darkblotched rockfish (*Sebastes crameri*) 2003 stock status and rebuilding update. 56p.

Hamel, O.S., Stewart, I.J. and A.E. Punt. (July 15, 2003). Status and future prospects for the Pacific ocean perch resource in waters off Washington and Oregon as assessed in 2003. 124p.

Punt, A.E., Hamel, O.S. and I.J. Stewart. (July 2003) Rebuilding analysis for Pacific ocean perch for 2003. 27p.

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Anon. 2004. Recreational CPUE statistics workshop. Workshop held June 29-30, 2004, Santa Cruz, California. 17p.
Anon. (February 16, 2005) Summary report from the West Coast Groundfish Data Workshop. Workshop held July 26-30, 2004, Seattle Washington. 24p.
Anon. (March 16, 2005) Summary report from the stock assessment modeling workshop. Workshop held October 25-29, 2004, Seattle Washington. 19p.
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Methot, R.D. (Draft April 4, 2005) User manual for the assessment program Stock Synthesis 2 (SS2), Model Version 1.17. 47p.
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Computer Programs and data-input files:

Program files: ss2.tpl, ss2.exe, pop_code.tpl

Data and control files: likegfish.ctl, likegfish.dat, SS2names.nam, forecast.ss2, cab05_NCS_BC.ctl, cab05_NCS_BC.dat, cab05_SCS_BC.ctl, cab05_SCS_BC.dat, pop1_data.ctl, pop2_parameters.ctl

APPENDIX C. PARTICIPANTS IN MAY 16-19, 2005 STAR PANEL.

STAR Panel:
Steve Ralston – NOAA Fisheries, SWFSC (Chair)
Paul Spencer – NOAA Fisheries, AFSC
Theresa Tsou – Washington Department of Fish & Wildlife
Bob Mohn – Center for Independent Experts
Vivian Haist – Center for Independent Experts

Pacific Fisheries Management Council:
Merrick Burden – Groundfish Management Team rep. (POP, darkblotched rockfish)
Rod Moore – Groundfish Advisory Panel representative
John DeVore – Groundfish Management Team representative (cabezon)

STAT Team:
Jean Rogers – NOAA, NWFSC (darkblotched rockfish)
Jason Cope – University of Washington (cabezon)
Owen Hamel – NOAA, NWFSC (POP)