Review of West Coast Groundfish Stock Assessments: sablefish and longnose skate

STAR Panel, May 7-11, 2007
Newport, Oregon

Prepared for:
University of Miami Independent System for Peer Review

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DRAFT, May 18, 2007

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1 EXECUTIVE SUMMARY

This report presents results of an independent peer review of two west coast groundfish stock assessments (sablefish and longnose skate), conducted for the Center for Independent Experts, University of Miami. The primary activity of the review was active participation in the May 7-11,2007 STAR Panel in Newport, Oregon. A major focus of the 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 sufficient time to review the two assessments. A STAR Panel report summarizing meeting activities and recommendations represents consensus views among the Panel.

The two stock assessments reviewed, sablefish and longnose skate, are based on theoretically sound analyses and the major axes of uncertainty were fully explored. As such they provide a reasonable basis to inform management decisions. Neither stock is currently overfished.

The sablefish stock assessment is based on a complex age- and length-structured model, and the level of complexity is not supported by the information in the available data. The primary source of uncertainty in the sablefish assessment is a trawl survey catchability parameter *q*, which determines the absolute estimate of biomass. The use of an informed prior for this parameter results in a relatively robust stock assessment. The 1999 and 2000 sablefish year-classes are strong, resulting in increased stock abundance in recent years.

The longnose skate stock assessment is as thorough and rigorous as possible, given this is a data-poor stock. All available fishery and survey data were evaluated and used in the assessment, as appropriate. The magnitude of historical fishery removals (landings and discard moralities) is uncertain. The major uncertainties in the assessment, catch history and trawl survey *q*, were fully explored and the conclusion that the stock is not overfished is robust to these uncertainties.

2 BACKGROUND

This document reports on an independent peer review of two west coast groundfish stock assessments (sablefish and longnose skate), conducted for the Center for Independent Experts (CIE), University of Miami. The primary review activity was active participation in the May 7-11,2007 Groundfish Stock Assessment Review (STAR) Panel in Newport, Oregon. 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.

To provide guidance on analytical procedures and data usage, four stock assessment improvement workshops were held in 2006 to deal with issues specific to west coast groundfish stock assessments. Recommendations from these workshops ensure standardized approaches are used so that there is consistency and objectivity in the west coast groundfish stock assessments.

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 sablefish and longnose skate stock assessment documents; the 2005 sablefish stock assessment document and STAR panel review; documentation of the Stock Synthesis model (SS2); and other ancillary material relevant to the review (Appendix B). Additionally, model code and data files were provided for the two assessments to allow independent stock reconstruction runs.

The primary focus for the STAR Panel members (Appendix C) during the May 7-11, 2007, 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 stock assessment teams (STAT) (Appendix C) to determine appropriate axes for expressing uncertainty and approaches for representing that uncertainty in decision tables.

During the STAR Panel meeting an iterative process was used to update the sablefish and longnose skate base case assessment models, alternating between written requests for additional analyses and evaluation of results of these requested analyses. Some additional model runs were conducted while meeting with the STAT, to expedite the process of evaluating alternative model formulations.

A STAR Panel report, summarizing meeting review activities and Panel recommendations, was prepared during and after the meeting. Members of the Panel agreed on all major issues and recommendations for the two assessments.

4 SUMMARY OF FINDINGS

4.1 OVERVIEW

Both stock assessments reviewed by the STAR Panel used the 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 model code is well tested and the common assessment framework allows a body of expertise in its use to develop. Recommendations for analytical approaches for using SS2, developed through the “off-year” stock assessment improvement workshops, assist in ensuring consistency and objectivity across the groundfish stock assessments.

SS2 is designed to allow all available data to be incorporated in the stock analysis, and as such there may be a tendency to use all available data without preliminary exploration or consideration of whether the data were likely to contain information rather than primarily noise. A potential problem with this approach is that noise in the data sets can outweigh signal and complex model structure may restrict potential solutions. The sablefish assessment is highly complex, and there likely are conflicting signals between the age and length frequency data that are fitted in the analysis.

Absolute abundance was not well determined in either the sablefish or longnose skate assessments so initial model runs assumed catchability coefficients, q, of 1 for one of the surveys (swept-area biomass estimates from the NWFSC slope survey for sablefish and the NWFSC shelf-slope survey for longnose skate). During the STAR Panel meeting a process for developing informative priors for q was conducted to obtain more plausible distributions for these parameters. The process involved seeking the opinion of meeting participants on the possible ranges for areal availability, vertical availability and vulnerability to the survey gear and “best guesses” for each of these components. The product of all components provide the overall “best guess” and the overall range of the distribution, and the “best guess” is taken to be the median of a lognormal distribution and the range to reflect 99% of that distribution. The resulting lognormal distribution is the prior on q. Details of the procedure and the resulting priors used for the sablefish and longnose skate stock assessments are described in the STAR Panel report. Both CIE reviewers have participated in similar processes for developing priors for fisheries stock assessments in New Zealand, and felt the use of an informative prior was superior to assuming a fixed *q*.

The sablefish and longnose skate stock assessments both used an iterative re-weighting procedure to “tune” the effective sample sizes of the length and age frequency data sets. The STAR panel felt that the procedure used, which involved iterative re-weighting of individual data sets within each data source (eg. trawl fishery length frequency), was inappropriate as it could lead to large disparity in individual sample sizes. An approach that used a common re-weighting for all data sets within a data source was suggested and adopted by the STAT. The SS2 code has built in functionality to facilitate the iterative re-weighting procedure.

The full four and a half days available for the STAR Panel review was needed to investigate model results and irregularities, to develop base case model configurations, and to develop approaches for bracketing uncertainty in the assessments. In fact, if additional time had been available it would have been used effectively to conduct further investigations of model performance. Neither the sablefish nor longnose skate assessments were as fully developed as might be expected before the STAR Panel review. As this is the first longnose skate assessment, the lack of a fully developed assessment is understandable. However, the sablefish assessment is mature and more detailed examination of model sensitivity to uncertainties could be expected. Both assessments would have been improved through a more thorough internal review process or working group approach prior to the STAR Panel meeting.

4.2 SABLEFISH

The sablefish assessment model is sex specific, the fisheries are partitioned into three gear types, and the model is fitted to four trawl survey abundance indices that span from 1980 to 2006. Additionally, environmental indices are related to recruitment deviations in the fitting procedure. The model is fitted to age frequency, length frequency and length-at-age data from the fisheries and surveys using complex parametric age and length selectivity functions. For most fisheries and surveys, both age based and length based selectivity is assumed, however many of the selectivity parameters are fixed to constrain the potential shape of the selectivity functions.

The 2007 sablefish assessment is simplified from that used previously (in 2005). The stratification used to calculate fishery landings and size frequencies is simplified where the quantity and quality of the data are not adequate to support more complex stratification. Two abundance indices, the AFSC pot survey and commercial fisher logbook CPUE estimates, were dropped for the current analyses. Both simplifications are warranted. In particular, the two abundance indices are contradictory and appear to contain more noise then signal. The CPUE indices are erratic and changes in the management regime likely influence the fishery catch rates. The pot survey did not consistently survey the entire range of sablefish and hence may not reflect population trends.

A number of concerns with the sablefish model were addressed during the STAR Panel meeting and modifications made to the base case model formulation. These included: using all available discard rate data; changing the NWFSC slope survey time series so that the Point Conception data were used consistently; excluding the zooplankton data series; redoing the sample size iterative re-weighting (see Section 4.1); modifying some selectivity parameterizations; down weighting the fishery age and length frequency data; and including an information prior on the NWFSC slope survey *q* parameter.

A primary focus of the STAR Panel review of the sablefish stock assessment related to the model fits to the NWFSC slope trawl survey data. Initial model runs had the catchability coefficient, *q*, for this survey fixed at 1 and most (8 of 9) model residuals were negative, a behaviour that was called "over the top" because predicted values of the survey index were higher than the observations. This behaviour was considered unacceptable because other than the NWFSC survey with fixed *q*, there should be virtually no information about absolute stock size in the data.

An informed prior was developed for *q* (see Section 4.1), but when *q* was estimated in runs that included the prior, the estimates were outside the range of the prior. Model runs which fixed *q* (at the median of it's prior) continued to exhibit the "over the top" behaviour.

Efforts to understand the reason for the "over the top" behaviour were unsuccessful. The model complexity, in particular the selectivity parameterizations and the simultaneous fitting to age frequency, length frequency, and length-at-age data for data set, made it virtually impossible to understand what aspect of the data or model structure was providing information about absolute stock abundance. A pragmatic solution was found when down weighting the fishery age and length frequency data eliminated the "over the top" behaviour.

A simplified sablefish assessment model, where all length frequency and length-at-age data were eliminated, was examined during the STAR Panel review. While there was not time to fully investigate this model formulation to see if it had potential for a base case, the simplified model was useful as an investigative tool. For example, this model formulation was used to identify the fishery data as problematic in creating the "over the top" problem. Also, a run was conducted with this model formulation and estimating sex-specific natural mortality. This produced a substantial improvement in model fit (greater than 35 log-likelihood units for one additional parameter) suggesting that sex-specific natural mortality should be investigated in future sablefish stock assessments.

The major source of uncertainty in the sablefish assessment is due to uncertainty in the NWFSC slope survey *q*. To bracket this uncertainty model runs with *q* fixed at a low value (the mean of the lower quartile of the *q* prior distribution) and *q* fixed at a high value (the mean of the upper quartile of the *q* prior distribution) were selected. These runs resulted in depletion estimates of 32.2% and 44.8% for the high and low *q*'s, respectively, indicating that the stock is not overfished. The stock appears to be increasing in recent years due to strong 1999 and 2000 year-classes.

4.2.1 Primary sources of uncertainty

The major source of uncertainty for the sablefish stock assessment is the NWFSC trawl slope survey catchability coefficient *q*. This model parameter determines the absolute stock abundance in recent years (surveys from 1998–2006) and hence should be the most influential parameter in reconstructing the stock history. The procedure used to develop an informed prior for *q* should be robust, in that the true value should be contained within the prior distribution. The approach used to capture uncertainty in the assessment, model runs with *q* fixed at the mean of the lower quartile and the mean of the upper quartile of the prior distribution, although *ad hoc*, should capture uncertainty in current stock depletion and short-term stock projections reasonably well.

Sources of model uncertainty, other than the NWFSC trawl survey *q*, were not explored in the assessment. Uncertainty in the stock recruitment steepness parameter, the natural mortality rate, and the form of fishery and survey selectivity functions (asymptotic versus domed) would likely influence the stock reconstructions and hence estimates of current depletion. Additionally, sensitivity runs that removed individual data sets would be useful to ascertain how each contributes to the overall assessment.

The solution to the “over the top” problem in fitting to the NWFSC trawl slope survey abundance indices was to down-weight the fishery age and length frequency data. While this approach resolved the “over the top” behaviour and resulted in adequate fits to the survey data, it is unsatisfactory because it did not allow us to identify the source of the problem. The fishery age and length data appear to contain information about the absolute size of the stock. When the NWFSC survey *q* was fixed the estimates of stock sizes were larger than ones consistent with the survey, except when the fishery data were down-weighted. This implies that the fishery data contains information supporting a larger stock size, which is unlikely given the fishery exploitation rates are low. There likely are interactions within the fishery selectivity functions (which are intended to be non-restrictive in the shapes they can take) or between the fishery and the survey selectivity functions, which result in apparent information about absolute stock abundance in the fishery size and age data.

4.2.2 Strengths and weaknesses of current approach

The sablefish assessment uses the SS2 model, which is a well-documented and well-tested piece of software. The assessment fits to abundance indices from four west coast trawl surveys that span the time period from 1980 to present. These surveys appear to be at least somewhat informative for sablefish, as the strong 1999 and 2000 year-classes are apparent initially in the shallower surveys and later in the deeper surveys.

Environmental data is included in the sablefish assessment model as an index that is related to the recruitment deviations. This approach differs from that used in the previous sablefish assessment where the environmental data were incorporated directly in the stock recruitment function. The current approach is superior because the previous approach presented problems for doing bias corrections for the unfished equilibrium calculations. The inclusion of environmental data is encouraged, as it can result in greater precision in the recruitment estimates used in model projections. However, statistically rigorous cross validation approaches (eg. Francis 2006) need to be used to ensure the environmental variables selected for inclusion in the model are not the result of spurious correlations which can result when multiple variables are evaluated.

The primary weakness of the sablefish assessment model is that it is unnecessarily complex relative to the information content of the data, and this complexity makes it difficult to interpret results. The rationale given for the fishery and survey selectivity functions having both age and length based components is that size-at-age varies by depth. But, the model is not depth stratified (with different growth morphs in each strata), so the model can't capture this differential growth. For example, differences in the mean lengths-at-age that could arise from shifts in the fishery depth distribution would be interpreted in the model as noise because there is only one growth model (for each sex).

The complexity of the selectivity parameterization may lead to unexpected and unwanted restrictions to the overall selectivity functions. For example, selectivity for the slope surveys is modeled as asymptotic by age and dome-shaped by length. This results in a higher selectivity for old females than for old males (because they grow larger), which may not be consistent with the actual observations (as suggested by the residual pattern for the plus groups).

The age frequency, length frequency, and length-at-age data are input to the model as if they were independent samples, which they are not. The age frequency data clearly contain more information than the length frequency data, and length frequency data should only be used in the assessment model where there are no age data or where the age data sample sizes are inadequate.

4.3 LONGNOSE SKATE

The longnose skate stock assessment is the first conducted for a west coast skate stock, and considerable effort went into compiling relevant catch data, survey time series and ancillary biological information. Longnose skate, modeled as a unit stock from the Mexican to Canadian borders, comprises more than 50% of the total skate in the survey catches and the fishery landings.

Longnose skate were assessed using a length-based formulation of SS2 and fitting to abundance indices from four shelf and slope trawl surveys that spanned the years 1980 to 2006. Length frequency data were available for the fishery (1995–2006) and surveys, and length-at-age data were available to inform estimation of growth model parameters.

For initial model runs, a catchability coefficient (*q*) of 1 was assumed for the NWFSC shelf-slope survey, though for later runs an informed prior was developed for this parameter.

Estimates of longnose skate fishery-induced mortality (landings and discard mortalities) are highly uncertain, making this a data-poor assessment. Uncertainty exists in: estimates of total skates landed; proportion of longnose skate in skate landings; discard rate (93% estimated in 1986/1986 and 53% estimated in 1996/1997 and in 2004/2005); and the mortality rate of discards. The catch time series (term catch used here to represent landings and discard mortalities) used for the assessment is based on the best available information. During the STAR Panel guesses were made about the possible range in values for each component that contributes to the total catch estimates (eg. proportion longnose in total skate landings, discard rate and discard mortality) so that "low historical catch" and "high historical catch" scenarios could be investigated.

During the STAR process, model runs were conducted with the objective of simplifying the model parameterization where appropriate and developing an objective basis for characterizing the uncertainty in this data-poor assessment. Additionally, some of the data sources and biological assumptions were examined and modified as appropriate.

Minor changes to the model formulation included: using a single-sex formulation with constant recruitment; removing the 1951-1979 Washington State landings which likely reflect catch in Puget Sound or Canadian waters; assuming asymptotic selectivity for the slope surveys; initializing the population at unfished equilibrium in 1916 rather than at equilibrium under constant F in 1950; redoing the sample size iterative re-weighting (see Section 4.1); changing the assumed M to 0.2. These changes are considered minor because they had little effect on the stock reconstructions. The higher value for M produced more credible estimates of growth parameters, as well as being more consistent with the maximum observed age. Initializing the population in 1916 rather than in 1950 allowed for reduced recruitment through the time series (stock recruitment effects) and provided a better fit to the data.

The longnose skate abundance estimated for the 2004 AFSC triennial survey appears anomalous, at double the value of other estimates in the survey series. Efforts were made to obtain data for other flatfish species captured in this survey to see if they also showed anomalous abundance in the 2004 survey, which would provide support for the hypothesis that the gear was fishing differently during this survey. It was not possible to obtain the additional data in the time available, so the 2004 AFSC triennial survey data point was retained in the analysis.

An informed prior was developed for the NWFSC shelf-slope survey longnose skate *q* during the STAR process (see Section 4.1). This approach is considered superior to fixing *q* at 1 because it considers the distribution of longnose skate relative to the distribution of the survey and accounts for vulnerability of longnose skate to the survey gear.

A full Bayesian analysis (MCMC) was performed on a model formulation that could be considered for the base case (prior on *q*, prior on M, no recruitment deviations, best catch series). Results were unsatisfactory, indicating a lack of MCMC convergence to the posterior distribution. Also, the range of *q* sampled in the posterior was small relative to it's prior, which is unacceptable given there is little information in the data about absolute abundance. Problems with the MCMC are likely the result of the selectivity parameterization. A short MCMC chain was run with all selectivity parameters fixed, and this run showed better behavior (good convergence properties and *q* posterior similar to it's prior). However, there was not enough time in the review process to fully investigate whether an MCMC approach could be used to characterize uncertainty in the assessment.

The major axes of uncertainty in the longnose skate assessment are uncertainty in the catch history and uncertainty in the NWFSC shelf-slope survey *q*. To capture the full range of uncertainty three runs were conducted: low *q* with low catch history; mid *q* with "best" catch history; and high *q* with high catch history. These runs resulted in depletion estimates ranging from 0.39 to 0.80, indicating that the stock is not overfished.

4.3.1 Primary sources of uncertainty

The major unresolved (and un-resolvable) source of data uncertainty for the longnose skate assessment is the magnitude of the historical fishery removals (landings and discard mortalities). Considerable effort went into reconstruction of the catch data series and the current analysis is based on the most likely time series of removals. The range in the catch data series explored likely bounds the uncertainty in historic removals.

An informative prior was developed for the NWFSC shelf-slope trawl survey longnose skate catchability coefficient *q* during the STAR Panel. This is a key parameter for the longnose skate assessment because it provides the only information about absolute abundance. The prior is broad and very likely encompasses the true *q*. Additional effort to refine the prior, bringing in individuals with greater knowledge about the trawl survey and fish behaviour, is warranted given the influence of this parameter on the longnose skate stock assessment.

An alternative maturation ogive to that used in the longnose skate assessment has been estimated for longnose skate in B.C. The alternative ogive suggests higher maturation rates at age and results in a higher proportion of mature females in the population.

The longnose skate catch in the 2004 AFSC triennial survey appears anomalous, being twice as high as any other estimate in the survey series. This warrants further investigation to see if other species (in particular, flatfish) also showed anomalous catches in the 2004 survey. If so, this may indicate differences in gear performance for the 2004 survey.

Four published studies of longnose skate ageing provide similar estimates of growth and maximum age. However, none of these studies have included ageing validation so there is uncertainty about the accuracy of the methodology.

4.3.2 Strengths and weaknesses of current approach

The longnose skate stock assessment was as comprehensive as possible, given it is a data poor stock. The major uncertainties in the assessment were fully explored, and the conclusion that the stock is not overfished is robust to these uncertainties.

5 CONCLUSIONS AND RECOMMENDATIONS

The two stock assessments reviewed, sablefish and longnose skate, are based on theoretically sound analyses and the major axes of uncertainty were fully explored. As such they provide a reasonable basis to inform management decisions. Neither stock is currently overfished.

The sablefish stock assessment is based on a complex age- and length-structured model, and the level of complexity is not supported by the information in the available data. The primary source of uncertainty in the sablefish assessment is a trawl survey catchability parameter *q*, which determines the absolute estimate of biomass. The use of an informed prior for this parameter results in a relatively robust stock assessment. The 1999 and 2000 sablefish year-classes are strong, resulting in increased stock abundance in recent years.

The longnose skate stock assessment is as thorough and rigorous as possible, given this is a data-poor stock. All available fishery and survey data were evaluated and used in the assessment, as appropriate. The magnitude of historical fishery removals (landings and discard mortalities) is uncertain. The major uncertainties in the assessment, catch history and trawl survey *q*, were fully explored and the conclusion that the stock is not overfished is robust to these uncertainties.

The recommendations in this section relate to issues that arose during the sablefish and longnose skate reviews. However, the recommendations are generic, that is, they reflect issues where further research and standardized approaches would benefit all west coast groundfish assessments.

The problem that absolute abundance is poorly determined by the available data is common to many fisheries assessments, not just the sablefish and longnose skate assessments reviewed here. An informative prior on the catchability coefficient *q* for a trawl survey swept-area biomass estimate can often limit the potential range of absolute biomass. The process for deriving the priors on *q* that was conducted during the STAR Panel review should be redone, bringing together all potentially relevant data sources and participants knowledgeable about the trawl surveys and fish interactions. Informative priors could be developed for many groundfish species or species groups.

The development of standardized methods for data weighting would be of value. Iterative re-weighting may be appropriate, in particular for length and age frequency data where there are many observations. An evaluation should be done on the effect of poorly specified initial sample sizes on the terminal sample size estimates (after the iterative re-weighting). This evaluation should be conducted under a range of actual sample sizes and process error assumptions.

Neither the sablefish nor longnose skate stock assessments were as fully developed as might be expected prior to the STAR Panel review process. Major sources of uncertainty and patterns in model residuals had not been explored. Both assessments would have been improved through a more thorough internal review process or working group approach prior to the STAR Panel meeting.

APPENDIX A. STATEMENT OF WORK

Consulting Agreement between the University of Miami and Vivian Haist

Statement of Work

April 21, 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 longnose skate and sablefish 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 sablefish and longnose skate 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 in 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 drafts of the sablefish and longnose skate stock assessments;

- Most recent previous stock assessments and STAR panel reports for sablefish (this is the first assessment for longnose skate);
- 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 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 Newport, Oregon from May 7-11, 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 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 May 25, 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 June 8, 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.

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 review materials were provided prior to the STAR Panel meeting:

I. Current Draft Stock Assessments

A. Status of the Sablefish Resource off the Continental U.S. Pacific Coast in 2007, Michael J. Schirripa. *DRAFT.*

B. Status of the Longnose Skate (*Raja rhina*) off the continental US Pacific Coast in 2007, Vladlena V. Gertseva and Michael J. Schirripa, *DRAFT.*

II. Background Materials

A. 2006 Workshop Summary Reports

1. A Summary Report from the NWFSC Bottom Trawl Survey Workshop held October 31 – November 2, 2006 in Seattle, Washington. NOAA Fisheries, NWFSC, FRAM Division.
2. A Summary Report from the WC Groundfish Data/Modeling Workshop held August 8-10, 2006 in Seattle, Washington. NOAA Fisheries, NWFSC, FRAM Division.
3. 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
4. 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.

B. Previous Sablefish Assessment and STAR Panel Report

1. Status of the Sablefish Resource off the Continental U.S. Pacific Coasts in 2005. Michael J. Schirripa and J.J Colbert, November 1, 2005.
2. Sablefish STAR Panel Meeting Report, June 20-24, 2005.
3. Summary Minutes from the Scientific and Statistical Committee September 19-21, 2005 Meeting in Portland, Oregon. Sablefish assessment discussed on page 9.

C. Manuscripts

1. Kosro, P. Michael, William T. Peterson, Barbara M. Hickey, R. Kipp Shearman, and Stephen D. Pierce. 2006. Physical versus biological spring transition: 2005. Geophysical Research Letters, Vol. 33.
2. Mackas. D.L., W. T. Peterson, M. D. Ohman, and B. E. Lavaniegos. 2006. Zooplankton anomalies in the California Current system before and during the warm ocean conditions of 2005. Geophysical Research Letters, Vol. 33.

D. SS2 Model Related

1. SS2 Zip File – includes User's Manual, example files, and powerpoint presentations

2. 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.

E. Terms of Reference (TORs) for the West Coast Groundfish Stock Assessment and Review Process for 2007-2008. The Scientific and Statistical Committee (SSC) of the Pacific Fishery Management Council. 2006.

F. GAO Report

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

III. Computer programs and data files:

Computer program: ss2.exe (Code version 2.00b; 03/22/07)

Data and control files: starter.ss2; sable07.dat; sable07.clt; vlada.dat; vlada.ctl.

IV. Additional References (documents available at STAR Panel meeting or used in this review):

Francis, R.I.C.C. 2006. Measuring the strength of environment-recruitment relationships: the importance of including predictor screening with cross-validations. ICES Journal of Marine Science. 63:594-599.

Frisk, M.G., T. J. Miller, and M.J. Fogarty. 2001. Estimation and analysis of biological parameters in elasmobranch fishes: a comparative life history study. Can. J. Fish. Aquat. Sci. 58: 969-981.

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APPENDIX C. PARTICIPANTS IN MAY 7-11, 2007 STAR PANEL.

Reviewers:
Martin Dorn, Scientific and Statistical Committee (SSC) Representative, STAR Panel Chair
Patrick Cordue, Center for Independent Experts (CIE)
Vivian Haist, Center for Independent Experts (CIE)

Advisors:
Heather Mann, Groundfish Advisory Subpanel (GAP) Representative
Mark Saelens, Groundfish Management Team (GMT) Representative

Stock Assessment Teams
Sablefish - Michael Schirripa, Northwest Fisheries Science Center (NWFSC)
Longnose skate – Vladlena Gertseva, Cooperative Institute for Marine Resources Studies (CIMRS) and Michael Schirripa (NWFSC)