Center for Independent Experts (CIE), Independent Peer Review Report on the Stock Assessment Review (STAR) Panel for Pacific Sanddab and Cowcod

by

Beatriz A. Roel (Cefas, UK)

Executive Summary

The Stock Assessment Review (STAR) Panel met in the Southwest Fisheries Science Center, Santa Cruz, California, between 5 and 9 September 2013 to review the assessments of Pacific sanddab (*Citharichthys sordidus*) and cowcod (*Sebastes levis*).

The cowcod assessment was carried out by means of Extended Depletion-Based Stock Reduction Analysis (XDB-SRA). The base model was fitted to four time series of relative abundance (California Cooperative Ocean Fisheries Investigations (CalCOFI) larval abundance survey, Sanitation District trawl surveys, Northwest Fisheries Science Center (NWFSC) NWFSC trawl survey, and NWFSC hook-and-line survey), and a single visual survey estimate of absolute abundance. A trip-based CPUE time-series derived from Commercial Passenger Fishing Vessel logbook records was also evaluated but not included in the final base model. The final model fitted the abundance indices within the model-predicted posterior confidence intervals and key model parameters were well estimated. Cowcod spawning biomass is increasing according to this assessment and a point estimate of spawning biomass in 2013 is predicted to be above MSST but below target SSBmsy. Depletion, SSB2013 relative to SSB0, was estimated at 0.34, less than the estimated target B_{msy}/ B_0 estimated at 0.42.

The Pacific sanddab stock in the waters of California, Oregon and Washington was assessed by means of Stock Synthesis (SS, version 3.24O, April 2013).This was the first assessment conducted for that stock. The assessment assumed a single stock and four fisheries: two commercial trawl fisheries, one recreational fishery, and one trawl fishery for mink food. Survey and index data included were the NWFS triennial bottom trawl survey (split into two periods), the NWFSC bottom trawl survey, and a California Commercial Passenger Fishing Vessels (CA CPFV) fishery CPUE index. Multiple model runs were conducted and reviewed to examine the sensitivity to model assumptions and structure, and to uncertainty in the data sources. The major uncertainty in the assessment was the scale of the population, where the model estimated a much lower biomass than the area swept surveys. As it was not possible to reconcile this discrepancy before or during the review, the STAT and STAR panel could not be confident in the model estimates of biomass. However, all model scenarios indicated a healthy stock. Further, if the survey estimates of biomass and catches were to be correct, the stock would still be lightly exploited.

Background

The Stock Assessment Review (STAR) Panel consisted of a compilation of data, an assessment of the stocks, and an assessment review conducted for Pacific sanddab and cowcod. The STAR review was scheduled for 5–9 September 2013, with the deadline for submission of the Peer Review Report feeding into it as 23 August 2013. The Center for Independent Experts (CIE) peer review is ultimately responsible for ensuring that the best possible assessment, given the data and knowledge available, has been provided through the STAR process. The stocks assessed through STAR are managed under the Pacific Coast Groundfish Fishery Management Plan and Management Plan for coastal pelagic species (CPS). The assessment of cowcod applies to the stock in the Southern California Bight (SCB), defined as US waters off California and south of Point Conception (latitude 34°27'N). The assessment of Pacific sanddab reports its stock status off the coast of California, Oregon, and Washington, and this is the first time that it is being conducted.

Two CIE reviewers with the requisite qualifications to complete an impartial and independent peer review in accord with the statement of work (SoW) tasks and terms of reference (ToRs) specified herein participated in the process. They were selected on the basis of their expertise in stock assessment, statistics, fisheries science and marine biology being deemed sufficient to complete the tasks of the peer review described herein. The CIE reviewers were part of the STAR panel that met at the Southwest Fisheries Science Center, Santa Cruz, California 5th to 9th September 2013.

Description of the Individual Reviewer's Role in the Review Activities

I participated in all aspects of the review. In particular, conducting the necessary pre-review preparations, including reviewing background material and reports provided by the NMFS Project Contact in advance of the peer review. I then conducted an impartial and independent peer review in accordance with the tasks and ToRs specified herein, focusing on data analyses, parameter estimation and the associated uncertainties, and the implications for management.

Summary of Findings for each ToR in which the weaknesses and strengths are described

Pacific Sanddab

1) *Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.*

Draft stock assessments, background documents, and a draft agenda were posted on the Pacific Fishery Management Council's ftp site and were available to participants with plenty of time for them to become acquainted with the material prior to the meeting. Pertinent literature was also uploaded during the meeting (e.g. Francis 2011).

2) *Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.*

Strengths. The Stock Assessment Team (STAT) carried out a detailed analysis of input data and model performance. Being the first stock assessment for this species, the selection and analyses of the input data were thorough and, in my opinion, both appropriate and to a good internationally acceptable standard. The fit to the primary abundance index was good and fits to the compositional data were generally acceptable. The use of the conditional age-at-length data resulted in reasonable estimates of growth.

Weaknesses. The major uncertainty in this assessment is the scale of the population, a critical uncertainty that was unresolved in this STAR panel. Swept area biomass estimates from fishery-independent sources resulted in 4–22 times the model estimates. The STAT and STAR panel discussed mechanisms that might explain these differences. While there were numerous sensitivity analyses provided to explore the uncertainty, the mechanisms could not be identified.

Concerns were expressed about the uncertain historical trawl catch data in the early 1900s. There were questions regarding the catch data in the base model. The historical landings prior to 1930 (first year of the CA catch reconstruction) appeared to be implausibly high (up to 1,200 mt in CA

trawl in 1917). These landings were taken from a 1949 report (Staff of the Bureau of Marine Fisheries 1949). However, the data could not be reconciled with early catch reconstructions for petrale sole, which had lower landings (~500 mt) despite evidence in the assessment of that species that it was the main species landed in the CA trawl fishery during that period. Further, there is uncertainty associated with the assumed discard rate applied throughout the historical catch series and in the size compositions used to construct historical removals. Sensitivity runs regarding these catch assumptions were carried out.

There is also great uncertainty as to whether the stock is subject to time-varying life history parameters. For example, evidence was presented that indicated a 6 cm shift in the size at 50% maturity between the 1950s (Arora 1951) and the recent period (Lefebvre 2012). The model assumed the results from the Lefebvre (2012) study to be correct for the entire time-series.

Although a number of key model parameters such as steepness (h), natural mortality (M), virgin equilibrium recruitment (R_0), and growth are estimated, there is a strong correlation between model parameters. In particular, steepness and natural mortality were estimated with informed priors, and it is questioned whether this is the best parameterization given the confounding nature of the two parameters.

3) *Evaluate model assumptions, estimates, and major sources of uncertainty.*

Model. The stock was assessed by means of Stock Synthesis (SS, version 3.24O, April 2013). The base case assessment model assumed that the stock was in an unfished condition in 1888 and subject to exploitation by the four fisheries included in the assessment. This assumption seemed appropriate, but the decision to start the model in the late 1800s is questioned given the uncertainty in the historical catch, as mentioned above.

Both sexes were used in the model given evidence of sexually dimorphic growth. Selectivity functions for all surveys and fisheries were assumed to be asymptotic and sex-specific. This was considered a strong assumption, so sensitivity tests considering a dome-shaped functional form for selectivity were conducted during the meeting.

Time-invariant catchability coefficients (*Q*) were assumed for all surveys, and that was appropriate in my opinion. When changes in catchability were suspected, i. e., from the triennial survey, the series was split into two and, two separate *Q*s were estimated.

Estimates and major source of uncertainty. All key parameters were estimated in the assessment. The approach could be questioned, however, given strong correlations among the parameters. Uncertainties in parameter estimation were explored through sensitivity and profile analyses. Asymptotic confidence intervals were estimated and reported for all key parameters and management quantities.

Natural mortality was estimated in the model based on an informative prior derived from a meta-analysis that included temperature, asymptotic length and growth, and the approach follows accepted standard practice. Constant natural mortality (M) across ages was assumed, and sensitivity tests assuming a Lorenzen form were conducted.

A Berverton-Holt stock recruitment function was assumed where steepness (h) and virgin recruitment (R_0) were estimated internally by the model. The steepness prior was based on the results from various flatfish species; this seemed to be appropriate although the model was highly sensitive to the prior and a less informative prior resulted in a lower value for h and a higher R_0. Recruitment variability (σ_R) was fixed based on the results from preliminary runs. Sensitivity to this assumption was not explored, but the value assumed was effectively larger than the corresponding mean square error estimated by the model.

A major source of uncertainty in this assessment is the actual scale of the stock biomass. This is linked to the high estimates of trawl survey catchability (Q_i), where swept area biomass estimates from fishery-independent sources resulted in 4–22 times the model estimates. Although factors such as herding behaviour of the gear and inappropriate extrapolation to areas unsuitable for Pacific sanddab were identified as possibly contributing, these considerations were not sufficient to explain the inconsistency. Moreover, it was my and the other experts' general view that trawl surveys provided an effective means of estimating flatfish abundance. Several sensitivity tests were conducted in an attempt to identify the mechanisms explaining this. Although none of the results of these tests were conclusive, the tests did reveal that the conditional age-at-length information appeared to have a disproportionate effect on the model scale. Having said that, the stock has been just lightly exploited and, although discards may be underestimated, catch is the only absolute measure of biomass the model can use currently to scale itself up.

4) *Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.*

The mismatch between survey and model estimates of biomass was identified as a major source of uncertainty in the assessment. Exploration of the biomass estimates derived from trawl surveys, especially the NWFSC shelf/slope survey to address the discrepancy between survey- and model-based estimates of biomass, is suggested. On this issue too, it is suggested that the influence of the individual data sources on model results be further investigated.

5) *Determine whether the science reviewed is considered to be the best scientific information available.*

This is the first assessment for Pacific sanddab, and the data collation and analyses and the modelling approaches implemented constitute, in my opinion, the best scientific information available for the stock at the moment. However, given unresolved discrepancy between survey and model estimates of biomass the assessment is appropriate to determine stocks status (depletion = 76%) but not for determining harvest limits since the scale cannot be adequately estimated.

6) *When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.*

Short and medium-term

- The underlying assumptions and area-swept methods used to estimate Pacific sanddab biomass in the trawl surveys need to be looked into carefully in future, in more detail than was possible before and at the review. An independent review of the survey methods may provide useful insights and improve the output.

- Further, historical reconstructions of landings and discards need to be examined in detail and attempts made to reconcile them with what is known about the fishery.
- It is necessary to explore the possibility of time-varying the life history parameters (e.g. where regime shifts potentially might influence maturity, M, and growth).
- It is also necessary to explore ways to index the abundance of sanddab in nearshore areas (i.e., waters shallower than 55 m) where the trawl surveys cannot operate.
- More can be done to explore the overall potential stock structure of the population, expanding the evaluation to the waters of Mexico and Canada.
- Pacific sanddab appear to be an important prey item for a number of predators, suggesting that they represent an important source of energy transfer from lower to higher trophic levels. As such, their role in the ecosystem may be worth further consideration when determining management targets.

Cowcod

Background

Dr E.J. Dick led the presentation of the draft assessment document, and, together with Dr Alec MacCall, presented subsequent analyses carried out during the week. For the assessment, the modeled stock was restricted to the Southern California Bight, as assumed in previous assessments. Full stock assessments of cowcod were conducted in 1998, 2005, and 2007, with an update in 2009. The species has been classified as overfished since 2000 and has been subject to PFMC rebuilding plans since then.

The 2013 stock assessment uses Extended Depletion-Based Stock Reduction Analysis (XDB-SRA) to estimate stock status, scale, and productivity, with all model parameters estimated within a fully Bayesian framework. The base model is fitted to four time-series of relative abundance (CalCOFI larval abundance survey, Sanitation District trawl surveys, NWFSC trawl survey, and NWFSC hook-and-line survey), and a single visual survey estimate of absolute abundance. A trip-based CPUE time-series derived from Commercial Passenger Fishing Vessel logbook records was also evaluated but not included in the final base model.

1) *Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.*

See comments above on sanddab section.

2) *Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.*

<u>*Strengths.*</u> The cowcod stock status, as indicated by the spawning stock biomass depletion ratio (SSB2013/SSB0 = 0.34), is more optimistic than that reported in the 2009 assessment update (SSO2009/SSO0 = 0.045). The principal reason for this difference in stock status is driven primarily by the inclusion of fishery-independent surveys suggesting increases in stock abundance and the exclusion of a fishery-dependent index (CPFV logbook) with a strong pattern of hyperdepletion.

The XDB-SRA model is fully Bayesian. Given the relatively sparse data informing the assessment, a Bayesian approach allows incorporation of other sources of data in a statistically rigorous framework. This approach also allows fuller characterization of uncertainty, which results in the best estimates of parameter distributions, which could be particularly useful for future modelling work such as Management Strategy Evaluation (MSE).

Weaknesses. The assessment is data-limited. Length and age composition data were not included because they do not appear to provide reliable information on year-class strength. Historical catch uncertainty was great and the model was sensitive to the assumptions used in reconstructing the catch series.

The CalCOFI larvae index appears to be very influential in setting the trend in stock biomass, but the number of cowcod-positive tows is very low and of those, the majority consist of 1 or 2 larvae only. It is possible therefore that the sampling intensity of the survey is too low to estimate cowcod larval abundance with even moderate precision. This should be reflected in large input CVs, which were estimated to be between 30 and 80 %.

All removals were combined into one fleet that assumed knife-edge selectivity equal to 50% age at maturity (*A*). The model results were sensitive to the assumed age at 50% maturity.

3) *Evaluate model assumptions, estimates, and major sources of uncertainty.*

The model assumes that the stock was at unfished equilibrium at the start of the assessment period, which is helpful if historical removals can be estimated. The dynamics were modelled by means of a production function that allows production to be adjusted on the basis of the biomass *A* years earlier. In my opinion, this appropriately reflects the situation on the ground given the data sparseness mentioned already.

4) *Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.*

A CPFV CPUE index was used in earlier assessments of cowcod. An aggregate partyboat log-index had been derived covering the years 1963-2000, but that index seemed to exhibit patterns of hyperdepletion, so a new CPFV index, based on individual trips, was extensively evaluated in the present assessment, but ultimately not included in the final base model. The STAT process did identify properties of hyperstability in the new index, which were investigated by alternative data-filtering to refine the definition of effective cowcod effort. The STAT ultimately rejected the index, however, because they were unable to resolve the concern effectively. As part of the STAR panel, I agree with the STAT recommendation to remove this index. Doing so results in a much improved estimate of B_{msy}/B_0 posterior distribution.

I concurred with the STAT that the implementation XDB-SRA resulted in an improvement compared to the previous assessment where Beverton and Holt assumptions of stock and recruitment over-constrained the shape of the productive function.

5) *Determine whether the science reviewed is considered to be the best scientific information available.*

I support the Panel conclusion that this cowcod assessment was based on the best available data; the new assessment results constitute the currently best available information on stock status, and are suitable to serve as the basis for fishery management decisions and stock status determinations. Further, I commend the STAT for excellent presentations, well-written and complete documentation, their willingness to respond to the Panel's requests for additional analyses, and their dedication in finding possible solutions to intricate assessment problems.

6) *When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.*

Short-term

- I suggest that the CPFV data be reinvestigated to attempt to produce a CPUE time-series for use as an index of relative abundance. CPFV has a historical basis for inclusion and produces time-series that have less interannual variability than other indices.
- There would also be value in re-examining the methods used to reconstruct historical catches of cowcod and other rockfish.
- I see value too in considering including uncertainty in the historical catches within the model. This would almost certainly result in more realistic estimates of uncertainty in the stock productivity trends.
- The CalCOFI larvae index needs to be revisited. The number of positive tows was very low and the majority of the positive ones had only a single cowcod larva. These low occurrences could easily be qualified as incidentals. Apparently, cowcod is a fish with relatively high fecundity and although the stock is depleted, larval occurrence seems to be very low even during years when the abundance was above MSST. If this index is used in future as indicative of cowcod SSB, the appropriateness of the CalCOFI gear and gear deployment (speed, depth, etc.) for cowcod larvae needs to be examined.
- Age-at-maturity and other life history parameters are inherently uncertain for cowcod and require more investigation even though data (catches) are few. Future assessments should consider incorporating the uncertainty associated with age at 50% maturity.
- The development of prior distributions for life-history parameters based on rockfish would be beneficial for the assessment.

Longer time-frame

- Although no information is available regarding dispersal between US and Mexican waters, a recent study has identified co-occurring genetic lineages in the Southern California Bight (SCB). There would therefore be value in investigating the stock structure of cowcod in the SCB and adjacent areas, especially the population in waters off Mexico. Without a doubt, the greater knowledge likely attained would benefit the overall stock assessment.
- The STAT team expressed the most confidence in the NWFSC Hook-and-Line and visual surveys. I agree, and along with the STAT and STAR panels, recommend continuing these

indices into the future and extending the survey into the Cowcod Conservation Areas (CCAs).

7) *Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.*

Panel review proceedings consisted of STAT presentations followed by questions and comments from the STAR panel. Questions of clarification were also allowed in the course of the presentations. A number of requests were put to the STAT by the STAR panel to investigate the sensitivity of the results to data and model assumptions. Questions were advanced in writing and the rationales justified, which resulted in a rigorous, well-documented process. A first draft of the STAR panel report was reviewed by the STAT too, and that allowed clarification of some issues and better specification of others, particularly those in relation to the responses to panel requests.

Conclusions and Recommendations in accordance with the ToRs

I support the conclusions and recommendations of the STAR Panel as reflected in the consensus report. Additional comments and key outcomes from the review process are outlined in the text above. However, further to the recommendations provided by the STAR Panel, other recommendations arising from my own comments and understanding are:

a. To run the assessments for the period where reliable landings data are available (probably from the early 1970s for both stocks) and to compare the estimates as well as the uncertainty on recruitment parameters and on MSY-related benchmarks.
b. To run the sanddab assessment using an age-aggregated model such as XDB-SRA to investigate the influence of the composition data on the model scale.
c. To consider providing estimates of uncertainty for the reconstructed historical catch series so that they can be taken into account in the assessment model.
d. To explore the age-disaggregated indices of abundance available for sanddab by means of year-class curve models to check their internal consistency.
e. In the case of cowcod, to perform long-term predictions to evaluate recovery and management plans. This would best be done in the context of Management Strategy Evaluation (MSE), which uses computer simulations to identify strategies that can satisfy multiple objectives and are robust to uncertainty (Butterworth and Punt, 1999; De Oliveira *et al.*, 2008).
f. In terms of the interval for the next assessment and given the status of cowcod, where the assessment workshop base model estimates that stock size is close to the overfished threshold, the interval needs to be shorter than anticipated under “normal” circumstances. Further, for Pacific sanddab, an updated assessment in the near future to keep track of the development of the stock is, I believe, warranted.

Appendix 1: Bibliography of materials provided for review

Draft Stock Assessment Documents:

Dick, E.J. and MacCall, A. 2013. Status and Productivity of Cowcod, Sebastes levis, in the Southern California Bight, 2013. DRAFT Pre-STAR version.

He, X., Pearson, D.E., Field, J.C., Lefebvre, L. and Key, M. 2013. Status of the U.S. Pacific Sanddab Resource in 2013

Background Material

Data-Moderate STAR Panel Review Report. 2013.

Dick, E.J. and MacCall, A.D. 2011. Depletion-Based Stock Reduction Analysis: A catch-based method for determining sustainable yields for data-poor fish stocks. Fisheries Research 110: 331–341.

Francis R.I.C. C. 2011 - Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat. Sci. 68: 1124‑1138 (2011).

Hamel, O. Development of prediction intervals and priors for the natural mortality rate using multiple meta-analyses using life-history correlates. NOAA Fisheries, Northwest Fisheries Science Center, Seattle. 4/28/2013.

Harms, J.H., J.A. Benante, and R.M. Barnhart. 2008. The 2004–2007 hook and line survey of shelf rockfish in the Southern California Bight: Estimates of distribution, abundance, and length composition. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-95, 110 p.

Ralston, S., Pearson, D.E., Field, J.C., and Key, M. 2010. Documentation of the California Catch Reconstruction Project. U.S. Dep. Commer., NOAA Tech Memo. NMFS-SWFSC-46, 80p.

Methot, R. D. 2012. User Manual for Stock Synthesis Model Version 3.24f. Updated October 3, 2012. NOAA Fisheries, Seattle, Washington.

Methot, R. D. Stock Synthesis Technical Description.

NWFSC Observer Program. 2013. Data Products for Stock Assessment Authors. 8Jan. 2013.

Stierhoff, 2013. 2012 Southern California Bight Cowcod Assessment Survey Cruise Report.

Thorson, J. T. and Ward, E. Accounting for space-time interactions in index standardization models.

Wallace, J. R. Applying the U.S. West Coast's First Major Trawl Bycatch and Mesh Size Studies to Fishery data using Post-hoc Fishing Strategies and Geographical Area. DRAFT. June 28, 2013.

Walters, C. and Kitchell, J. F. 2001. Cultivation/depensation effects on juvenile survival and recruitment: implications for the theory of fishing. Canadian Journal of Fisheries and Aquatic Sciences. 58: 39–50.

Ward, E. and Thorson, J. 2013.Bayes GLM Summary.

Yoklavich, M.M., Love, M.S., and Forney, K.A. 2007. A fishery-independent assessement of an overfished rockfish stock, cowcod (Sebastes levis), using direct observations from an occupied submersible. Canadian Journal of Fisheries and Aquatic Sciences. 64: 1795-1804.

Appendix 2: A copy of the CIE Statement of Work

Attachment A: Statement of Work for Dr. Beatriz Roel (CEFAS)

External Independent Peer Review by the Center for Independent Experts

Stock Assessment Review (STAR) Panel for Pacific Sanddabs and Cowcod

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: A benchmark assessment will be conducted for cowcod which is a species that is considered "overfished" or below their minimum stock size threshold and is currently managed under a rebuilding plan. A new assessment will be conducted for Pacific sanddabs, which are harvested by the trawl fleet and are regularly encountered by the west coast bottom trawl survey.

Assessments for these two stocks will provide the basis for the management of the groundfish fisheries off the West Coast of the U.S. including providing scientific basis for setting OFLs and ABCs as mandated by the Magnuson-Stevens Act. The technical review will take place during a formal, public, multiple-day meeting of fishery stock assessment experts. Participation of external, independent reviewer is an essential part of the review process. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Two CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. One of the CIE reviewers will participate in all STAR panels held in 2013 to provide a level of consistency between the STAR panels. The CIE reviewers shall be active and engaged participants throughout panel discussions and able to voice concerns, suggestions, and improvements while respectfully interacting with other review panel members, advisors, and stock assessment technical teams. The CIE reviewers shall have excellent communication skills in addition to working knowledge and recent experience in fish population dynamics, with experience in the integrated analysis 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. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Santa Cruz, California during the dates of 5-9, August 2013.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Documents to be provided to the CIE reviewers prior to the STAR Panel meeting include:

- The current draft stock assessment reports;
- Previous cowcod stock assessments and STAR panel review reports;
- The Pacific Fishery Management Council's Scientific and Statistical Committee's Terms of Reference for Stock Assessments and STAR Panel Reviews;
- Stock Synthesis (SS) Documentation
- Additional supporting documents as available.
- An electronic copy of the data, the parameters, and the model used for the assessments (if requested by reviewer).

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting in Santa Cruz, California during the dates of 5-9 August, 2013 as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 23 August 2013, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and to Dr. David Die, CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

July 1, 2013	CIE sends reviewer contact information to the COR, who then sends this to the NMFS Project Contact

July 22, 2013	NMFS Project Contact sends the CIE Reviewers the pre-review documents
August 5-9, 2013	Each reviewer participates and conducts an independent peer review during the panel review meeting
August 23, 2013	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
September 6, 2013	CIE submits CIE independent peer review reports to the COR
September 13, 2013	The COR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:

(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,

(2) each CIE report shall address each ToR as specified in **Annex 2**,

(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review

   Appendix 2: A copy of the CIE Statement of Work

   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Stock Assessment Review (STAR) Panel for Pacific Sanddabs and Cowcod

1. Become familiar with the draft stock assessment documents, data inputs, and analytical models along with other pertinent information (e.g. previous assessments and STAR panel report when available) prior to review panel meeting.
2. Discuss the technical merits and deficiencies of the input data and analytical methods during the open review panel meeting.
3. Evaluate model assumptions, estimates, and major sources of uncertainty.
4. Provide constructive suggestions for current improvements if technical deficiencies or major sources of uncertainty are identified.
5. Determine whether the science reviewed is considered to be the best scientific information available.
6. When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame.
7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Appendix 3: Panel Membership or other pertinent information from the panel review meeting

STAR Panel Members

Tom Jagielo, Scientific and Statistical Committee, (Panel Chair)
Kevin Piner, NMFS Southwest Fisheries Science Center
Beatriz Roel, Center of Independent Experts
Yan Jiao, Center of Independent Experts

Pacific Fishery Management Council (PFMC) Advisors

Bob Leos, California Department of Fish and Wildlife, GMT
Gerry Richter, Point Conception Groundfishermen's Association, GAP
John DeVore, Pacific Fishery Management Council

Stock Assessment Team (STAT)

Xi He, NMFS Southwest Fisheries Science Center
John C. Field, NMFS Southwest Fisheries Science Center
Lyndsey Lefebvre, NMFS Southwest Fisheries Science Center
Meisha Key, California Department of Fish and Wildlife, SSC