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**CIE Reviewer's Report on the STAR Panel for Pacific sardine  
and Pacific mackerel, held from 18-21 September 2007, in La  
Jolla, California.**

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*Prepared for*

Independent System for Peer review

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## Executive Summary

The STAR Panel for Pacific sardine and Pacific Mackerel was held at the NMFS Southwest Fisheries Science Center (SWFSC), in La Jolla, California from 10.00 am Tuesday 18 September 2007, through 3.00 pm Friday 21 September 2007. Originally, the STAR panel was scheduled to review the assessment for pacific sardine only, but following the STAR panel for pacific mackerel held in May 2007, the STock Assessment Team (STAT) was able to respond to some of the recommendations and technical comments made by that Panel and prepare a revised assessment report.

Preparations for the meeting were excellent and although there was some delay in preparing the assessment reports to the agreed schedule, the panel's ability to conduct a thorough review work was not compromised, largely due to the analysts' expert presentation of data and results, the expertise of the Panel Chair in conducting the meeting and the resolve of all participants to undertake a comprehensive evaluation. The meeting was conducted in comfortable surroundings, with satisfactory facilities and with a spirit of co-operation from all participants. SWFSC staff extended a warm and hospitable welcome to all.

The review benefited from having not only technical reviewers and analysts but also members of the PFMC and observers who were able to add value to discussions on the fisheries through their expert knowledge.

This was my first encounter with the STAR process and although the overall aim is generally similar to the SARC and SEDAR process I have been involved with before, the approach was somewhat different. Instead of having specific stock-related terms of reference the STAR had more general terms of reference. In some ways this was helpful since it gave the panel the freedom to explore whatever it felt necessary, without being required to address specific pre-determined issues. On the other hand, the onus was on the Panel itself identify the problems and issues associated with the assessment. On balance I think that having general terms of reference with the associated freedom is preferable.

However, in order to minimise the Panel requests with regard to basic data, I recommend that consideration be given to the production of a data report similar to that provided under the SEDAR process. My experience is that a full understanding of the input data and how it was derived is a great help in trying to understand assessment model output. It not only helps the review panel but also provides a useful record for future STATs.

I was impressed by the format for dealing with Panel requests. The STAR report documents such requests under three headings: request, reason and response. I see this as a very positive way of keeping track of Panel thinking and development of ideas and issues and the STAT are in no doubt what is being asked of them and why. It also provides a clear record of what has been explored by the Panel in its attempt to conduct a thorough evaluation and produce a consensus report.

My findings and conclusions on the assessments are as follows:

### **Pacific sardine**

The SS2 model configuration identified by the Panel performed adequately and better represents the historic trends in the stock and fishery than the previous assessment using ASAP. The SS2 model provides the best available estimate of biomass in 2007 and should form the basis of the PFMC's harvest guideline for 2008. The SS2 modelling approach is appropriate for the assessment of Pacific sardine and is superior to the ASAP approach used previously. It is recommended that this approach be retained for future assessments.

### **Pacific mackerel**

The focus of the mackerel review was methodological and aimed to determine whether in the Panel's opinion, the 2008 assessment for Pacific mackerel should be conducted using the SS2 modelling environment rather than ASAP. Despite the extensive investigations on alternative model configurations, the Panel was unable to identify an acceptable base model using SS2. SS2 is an appropriate model for the assessment of Pacific mackerel and further investigations should be undertaken in an attempt to identify an acceptable configuration that can form the basis of the 2009-10-harvest guideline.

### **General statement**

The STAR Panel reports contain a list of recommendations and suggestions for future investigations. I fully concur with all of the points included in the STAR Panel's Consensus Reports.

This was an interesting and enjoyable review in which to participate. I was impressed by the professionalism of all participants in the review, especially the STAT, whose professionalism and dedication to dealing with Panel requests was remarkable.

## 1. BACKGROUND

For an overview of the STAR process see Appendix 3 (Statement of work).

In accordance with the STAR process, Cefas was contracted by the Center for Independent Experts (CIE) to participate as an independent review panellist for the STAR Panel for Pacific sardine (*Sardinops sagax caerulea*) and Pacific mackerel (*Scomber japonicus*) to contribute to the Review Panel's Consensus Summary Report and to comment on strengths, weaknesses of current approaches, propose improvements and recommend alternative methods and or modifications of proposed methods. This is my independent report.

## 2. REVIEW ACTIVITIES

The STAR Panel for Pacific sardine (*Sardinops sagax caerulea*) and pacific mackerel (*Scomber japonicus*) held at the NMFS Southwest Fisheries Science Center (SWFSC), in La Jolla, California, from 18-21 September 2007. The general Terms of Reference for STAR Panels are given in Appendix 2 and my statement of work is given in Appendix 3.

Prior to the Review Workshop, I was provided with draft stock assessment reports for both stocks and web access to numerous relevant supporting documents and papers (See Section 4, Bibliography). Although the assessment documents for sardine and mackerel were not available until four days prior to the Panel meeting, I still was able to devote sufficient time to studying the documents ahead of the review and to gain a sufficiently thorough understanding of the data and methods used for the assessments and to develop a preliminary list of points for discussion at the workshop.

Participants in the review are given in Appendix I. The meeting was open to the public, and was attended by several observers. For each stock, the results of the assessments were presented to the STAR Panel and other attendees, and the input data, assessment approach, results and utility of the findings for management were evaluated through open discussion. In the course of discussions, the Review Panel requested that additional analyses and evaluations be carried out by the STAT. These requests were documented and presented to the STAT who undertook the analyses requested and provided appropriate feedback to the Panel.

The main output from the review is contained in the Panel's consensus summary reports. As requested in the format for STAR reports, each of the reports for sardine and mackerel lists the requests to the STAT, the reason for the request and the response. In addition, technical merits and/or any deficiencies of the assessment, unresolved problems and major uncertainties and a list of research recommendations are also documented. I fully concur with the conclusions and recommendations contained in STAR Panel Reports for Pacific mackerel and Pacific sardine. The reports for both stocks were completed in draft by the end of the meeting and agreed by correspondence on 4 October.

The Chair did an excellent job in maintaining focus on the pertinent points for discussion, and the STAT are to be congratulated for their excellent preparation and presentation of their assessments and their willingness, drive and enthusiasm to respond to the numerous panel requests.

### **3. FINDINGS**

This section gives a summary of the main findings. Detailed discussions and recommendations are contained in the Review Panel's Consensus Report and the Advisory Report and are not repeated in detail here. I deal with each of the stock reviews separately.

#### **3.1 Pacific sardine**

The stock assessment document was comprehensive, well presented and easily understood. The 2007 base model for the assessment of pacific sardine to inform the PFMC was undertaken utilising SS2. The previous sardine assessment employed a forward projection age-structured assessment model (ASAP). SS2 was preferred over ASAP since it is more flexible and in principle, can account for variations in certain biological and fishery-related parameters that ASAP cannot. A number of specific shortcomings of the ASAP model with respect to pacific sardine are listed in the STAR report.

The Panel evaluated the base model with respect to a number of issues, particularly those relating to the following:

- (a) why there were differences from the ASAP base-model used for the 2006 assessment, in particular why the 1997 and 1998 year-classes were much stronger in the SS2 assessment than in the ASAP assessment (these year-classes are also strong in the catch-at-age data), and
- (b) whether it is possible to remove the patterns in the residuals about the fit to the length-frequency data.

After considerable work by the STAT in responding to panel requests, the Panel identified a SS2 model configuration that performed adequately and recommended that this model configuration form the basis for the 2007 assessment and hence harvest guideline for 2008. The Panel also agreed that SS2 provides a better basis than ASAP for the assessment for pacific sardine and recommended that it be retained for future assessments. I fully agree with this conclusion.

A list of research recommendations regarding the future assessment of Pacific sardine is given in the STAR Panel Report.

The accepted 2007 SS2 assessment is less optimistic about stock status than the 2006 ASAP assessment. Specifically, SS2 estimates that the 1997 and 1998 cohorts were stronger and the 2003 cohort was weaker than ASAP does.

Recent cohorts also appear to be weak. The reasons for the differences between the two modelling approaches could not be fully determined.

I note that although extremely flexible, SS2 requires skilled and experienced analysts to both use and explain the output. In addition, the output from SS2 is considerable, and the work of the STAT and the Panel was significantly helped by the “R” code developed by Dr Ian Stewart (NWFSC) and modified for seasonal SS2 models by Ms Christina Show (SWFSC).

A number of the panel requests were related to data issues either associated with the catch or the survey indices. Specific recommendations from the panel are given in the Panel Report. I suggest that many of the queries regarding basic fishery data could be addressed if the STAT prepared a data report along the lines of that used in the SEDAR process. My experience is that a full understanding of the input data and how it was derived is a great help in trying to understand assessment model output.

I therefore add an additional recommendation that in future, the STAT consider producing a data report documenting all relevant model input data and parameters, how they were derived and any assumptions made. This will not only help the panel understand the input information but will provide a convenient record for future STAT teams.

### **3.2 Pacific mackerel**

Taking into account the comments and recommendations of the May 2007 STAR Panel report on the assessment of pacific mackerel, The STAT prepared a revised assessment report and provided supporting documentation. The harvest guideline for 2007-08 had already been set based on a 2007 assessment conducted using ASAP. Hence this review was primarily methodological, to determine whether in the Panel’s opinion, the 2008 assessment for pacific mackerel should be conducted using the SS2 modelling environment rather than ASAP. In principle, the SS2 model should perform better than SASP because of its increased flexibility. The May 2007 STAR panel reviewed both an ASAP and an SS2 assessment for Pacific mackerel, but despite both model configurations giving rise to similar results, the May 2007 Panel identified a number of problems with the SS2 configuration that could not be resolved at that time.

The revised SS2 assessment addressed several of the recommendations from the May 2007 Panel and provided several model runs based on SS2 to attempt to identify a base-model. However, the SS2 results were very sensitive to changes to model specifications (e.g. time-varying growth, and time-varying selectivity) and to changes to the data (e.g. removing length-composition data for one year changes the relative pattern of recruitment strength as well as recruitment in absolute terms substantially), and none of the model configurations gave adequate fits to the data.

I fully agree with the Panel’s conclusion that although considerable progress has been made toward implementing the Pacific mackerel assessment in SS2,

it seems likely that much work remains before an acceptable model configuration is identified. I also concur with the Panel, that further work on an SS2-based mackerel assessment should be supported, but that the assessment for mackerel (and hence the basis for management advice) continue to be based on the ASAP platform until a future STAR Panel reviews and approves an SS2-based assessment that is better and more robust than the current ASAP-based assessment.

Generally, the STAT had undertaken a tremendous amount of work in trying to arrive at an acceptable SS2 model configuration for Pacific mackerel and the results and documentation was excellent. As for Pacific sardine, I note that much of the Panel's time was spent dealing with data-related issues. The Panel recommended that standard data processing procedures be developed for CPS species, similar to those developed for groundfish species. I am not familiar with the CPS procedures for groundfish, but recommend that some form of data report such as those produced under the SEDAR process be prepared ahead of future assessments and that this form part of the STAR Panel's documentation.

In principle, the SS2 modelling environment should be appropriate for the assessment of Pacific mackerel and I agree that further work to identify a suitable SS2 configuration should be undertake I also agree that if progress is sufficient and a suitable SS2 configuration is identified, another STAR Panel for mackerel could be scheduled for May 2009, so that the management advice for the 2009-10 harvest guideline could be based on a new assessment platform).

The number of requests that could be addressed during the Panel meeting was restricted because of the focus on pacific sardine, but overall, the amount and quality of analyses undertaken by the data and assessment workshops and the supporting documentation was impressive and thorough. The STAT should be commended for their thorough work and willingness to respond to Panel requests

## **4 Conclusions/Recommendations**

I agree with the findings and recommendations in the Review Panel's Consensus Report as presented below and have no further comments or recommendations.

### **4.1 Pacific sardine**

1. The Panel identified a model configuration that performed adequately and recommends that this model configuration form the basis for the 2007 assessment and hence harvest guideline for 2008.
2. The stock assessment methodology for Pacific sardine has changed substantially in recent years. The Panel notes that, given this, as well as its recommendations for further model development, consideration should be given to holding the next STAR Panel for this species in 2009 rather than 2010 as envisaged in the Terms of Reference for CPS assessments.

3. The 2007 SS2 assessment is less optimistic about stock status than the 2006 ASAP assessment. Specifically, SS2 estimates that the 1997 and 1998 cohorts were stronger and the 2003 cohort was weaker than ASAP does. Recent cohorts also appear to be weak. The reasons for the differences between the 2007 SS2 and 2006 ASAP assessments are partially data-driven, but could not be fully determined as it is not possible to move from ASAP to SS2 by making incremental changes. However, they relate (to varying degrees) to: (a) different weightings, (b) different model structure, (c) revised index data, (d) a different way of entering the composition data, and (e) allowance for ageing error. The Panel supported SS2 as the preferred assessment platform for the 2007 assessment: a) because it allows for features identified as missing from ASAP at the May 2007 STAR Panel, b) because it better captured the cohorts that were strong based on a visual examination of the data, and c) because it fitted the indices of relative abundance better.
4. The Panel recommended that uncertainty be bracketed by runs in which  $M=0.3\text{yr}^{-1}$  and  $0.5\text{yr}^{-1}$ . The Panel and STAT could not assign probabilities to the base-model and the two bracketing runs.

### ***Specific research recommendations for Pacific sardine***

- I. Much of the Panel's time was spent dealing with data-related issues (see Section 2, requests A, B, E, F, G, K, and L) and the Panel recommends that standard data processing procedures be developed for CPS species, similar to those developed for groundfish species.
- II. A sensitivity run of SS2 assuming no ageing error resulted in compression of the range of spawning biomass and recruitment estimates compared to those estimated assuming ageing error (i.e. strong year-classes were estimated to be lower and weak year-classes were estimated to be larger when ageing error is ignored). This highlights the importance of the precision of the age data on model outputs. The Panel therefore recommends that ageing comparisons be continued to determine the most appropriate estimates of ageing precision.
- III. The results of SS2 runs which treated the egg survey data either as an index of egg production or as an index of spawning biomass did not affect the outcome of the assessment, although estimates of survey  $q$  were, unexpectedly, markedly different. The Panel recommends that SS2 be adapted to enable indices of egg production and spawning biomass to be fitted simultaneously.
- IV. Noting that there is potential for sardine from different stock subcomponents to recruit to adjacent stock areas, it would be desirable to account for this in the assessment model. To do so requires development of a new assessment model or modification of an existing one, and hence the Panel recommends that, if feasible, SS2 be amended to include such an enhancement. Further, tagging experiments (or other means to facilitate the estimation of movement rates) should be considered.
- V. The catch history for the Mexico and southern California fisheries should be examined to estimate the catch from the southern subpopulation. For example, use temperature and/or seasonality to separate catches by

subpopulation. Based on the results of this analysis, determine the biological data (length- and conditional age-at-length) by subpopulation. The analysis of subpopulation structure should ideally be conducted in conjunction with a re-evaluation of the current harvest control rule.

- VI. The estimate of the catchability coefficient for the DEPM estimates was 0.4 (for the base model). This value seems low to the Panel. Analyses should be conducted, for example, based on prior distributions for the factors leading to differences between DEPM estimates and spawning biomass to assess the plausibility of values for DEPM-q of this magnitude.
- VII. Development of alternative (preferably coastwide) indices will enhance the ability to monitor changes in the abundance Pacific sardine. At present, the assessment relies on the indices of abundance from southern and central California, although these regions constitute the core of the distribution when the population is low, a substantial fraction of the catch is now taken from other areas.
- VIII. Develop an index of juvenile abundance. The indices used in the assessment pertain only to spawning fish. An index of juvenile abundance will enhance the ability to identify strong and weak year-classes earlier than is the case at present.

#### **4.2 Pacific mackerel**

1. Conducting the assessment using SS2 (potentially) addresses many of the concerns identified by previous STAR Panels with the ASAP model. However, the STAT could not identify a model configuration that was a viable base-model.
2. The Panel concluded that although considerable progress has been made toward implementing the Pacific mackerel assessment in SS2, it seems likely that much work remains before an acceptable model configuration will be identified.
3. The Panel continues to support further work on an SS2-based mackerel assessment, but recommends that the assessment for mackerel (and hence the basis for management advice) continue to be based on the ASAP platform until a future STAR Panel reviews and approves an SS2-based assessment that is better and more robust than the current ASAP-based assessment.
4. The Panel believes that the Pacific mackerel assessment will be improved not only by exploring alternative models, but also by: a) refining the indices of abundance (which are all currently subject to considerable uncertainty), b) a more thorough review of the basic age- and length-composition data on which the analyses are based (e.g. to ensure that the length-frequency information is representative of the fishery removals), and c) modifying the SS2 modelling environment (e.g. allowing for cohort-specific growth parameters). The opinion of the Panel is that it could be possible to complete these tasks by 2009. If progress is sufficient, another mackerel Panel could be scheduled for May 2009 (so that the management advice for the 2009-10 harvest guideline could be based on a new assessment platform).

### ***Specific research recommendations for Pacific mackerel***

The Panel identified research recommendations, and endorsed the recommendations from the May 2007 Panel that are still outstanding.

#### *Recommendations arising from the current Panel*

- a) Much of the Panel's time was spent dealing with data-related issues and the Panel recommends that standard data processing procedures be developed for CPS species, similar to those developed for groundfish species.
- b) There is a need to review the raw data on which the length-frequency distributions are based to ensure that the data included in the assessment are representative of the catches.
- c) The following additional sensitivity tests were identified during the Panel meeting, but were not completed given the other concerns with the draft assessment. The Panel recommends that these sensitivity runs form part of any future analyses:
  - i. Re-compute the CPFV Delta GLM using data for those years that are included in the assessment [The Delta GLM currently starts in 1935. The data on which the CPFV index is based therefore includes data for years not included in the assessment. It is possible that the stock may have been behaving differently in the past than in more recent years.]
  - ii. Initialize the model by estimating the initial age structure rather than by specifying an equilibrium catch. [The assumption that the population was in equilibrium given a pre-specified catch in 1962 seems unrealistic, and leads to a very high exploitation rate in the first quarter of the assessment period.]
  - iii. Reduce the additive CVs for each index to zero for each index in turn. [The current base model adds a CV of 1.5 to the CalCOFI and spotter indices, which effectively means that they are little more than noise. Consequently, the CPFV index is the only one being fit (to some extent). This exercise would show how each index would influence the results if it were given more weight.]
  - iv. Start the model in 1970. [1962 is the middle of a period of fairly high catches]

#### *Recommendations arising from the May 2007 Panel*

- a) There are currently very few otoliths that have been read multiple times so additional readings need to be made. In the longer-term, an age validation study should be conducted for Pacific mackerel. Such a study should compare age readings based on whole and sectioned otoliths and consider a marginal increment analysis.
- b) The construction of the spotter plane index is based on the assumption that blocks are random within region (the data for each region is a "visit" by a spotter plane to a block in that region). The distribution of density-per-block should be plotted or a random effects model fitted in which block is

- nested within region to evaluate this assumption (e.g. examine whether certain blocks are consistently better or worse than the average).
- c) The data on catches come from several sources. The catch history from 1926-27 to 2006-07 should be documented in a single report.
  - d) Conduct a study to update the information used to determine maturity-at-length (and maturity-at-age).
  - e) A large fraction of the catch is taken off Mexico. In particular, catches of mackerel have been as large as those off California in recent years. Efforts should continue to be made to obtain length, age and biological data from the Mexican fisheries for inclusion in stock assessments. Survey data (IMECOCAL program) should be obtained and analyses conducted to determine whether these data could be combined with the CalCOFI data to construct a coast-wide index of larval abundance.
  - f) The CalCOFI data should be reviewed further to examine the extent to which CalCOFI indices for the “core” area can be used to provide information on the abundance of the coast-wide stock.

## **5. Bibliography of materials provided for the 2007 STAR Panel on Pacific sardine and Pacific mackerel.**

### **Pacific sardine**

1. CPS. 2007. Terms of reference for a coastal pelagic species stock assessment review process 2007.
2. Dereiso, R.U., Barnes, T., Jacobsen, L.D. and Arenas, P. 1996. Catch at age analysis for Pacific Sardine (*Sardinops sagax*) 1983 –1995. CalCOFI Report, 1996, Vol. 37, 175-187.
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4. Hill, Kevin T., Emmanis Dorval, Nancy C. H. Lo, Beverly J. Macewicz, Christina Show, and Roberto Felix-Uraga, 2007. Assessment of the Pacific sardine resource in 2007 for U.S. management in 2008. Preliminary draft for STAR review Panel.
5. Hill, Kevin T., Nancy C.H. Lo, Beverly J. Macewicz, Roberto Felix-Uraga. 2007. Assessment of the Pacific sardine (*Sardinops sagax caerulea*) population for U.S. management in 2007. NOAA Technical memorandum NMFS: NOAA-TM-NMFS-SWFSC-396.
6. Lo, N. Chyan-huei, Larry D. Jacobson, and James L. Squire. 1992. Indices of Relative Abundance from Fish Spotter Data based on Delta-Lognormal Models. Can. J. Fish. Aquat. Sci., Vol. 49. 2515-2526
7. Lo, N. Chyan-huei, Beverly J. Macewicz, David A. Griffith. 2005. Spawning biomass of Pacific sardine (*Sardinops sagax*) from 1994-2004 off California. CalCOFI Rep. 2005, Vol. 46, 2005, 93-112.
8. Lo, N. Chyan-huei, Beverly J. Macewicz, David A. Griffith, Richard L. Charter. 2007. Spawning biomass of Pacific sardine (*Sardinops sagax*) of U.S. and Canada in 2006. NOAA Technical memorandum NMFS: NOAA-TM-NMFS-SWFSC-401.
9. Methot, Richard D. 2005. Technical Description of the Stock Synthesis II Assessment Program Version 1.17 – March 2005.
10. Methot, Richard D. 2005. User Manual for the Integrated Analysis Program Stock Synthesis 2 (SS2). Model Version 2.00c. NOAA Fisheries Service, Washington, Feb. 2007, Updated March 2007.
11. STAR Panel report on Pacific sardine held in La Jolla, California, 21-24 June 2004.

## **Appendix 1: Participants in the 2007 STAR panel for Pacific sardine and pacific mackerel held from 18-21 September, SWFSC, La Jolla Ca. USA.**

### **Pacific sardine review:**

#### *STAR Panel:*

André Punt, University of Washington (Chair)  
Tom Barnes, CDF&G (SSC representative)  
John Casey, Cefas (CIE)

#### *PFMC:*

Diane Pleschner-Steele (CPSAS)  
Brian Culver (CPSMT)

#### *STAT:*

Kevin Hill, NOAA / SWFSC  
Emmanis Dorval, NOAA / SWFSC  
Nancy Lo, NOAA / SWFSC  
Bev Macewicz, NOAA, SWFSC  
Christina Show, NOAA / SWFSC

#### *Others:*

Mr. Dale Sweetnam, CDF&G  
Mr Richard Carroll, Ocean Gold Seafoods  
Mr Steve Joner, Makah Tribe  
Dr. Ray Conser, NMFS, SWFSC  
Dr. Paul Crone, NMFS, SWFSC  
Ms. Jennifer McDaniel, NMFS, SWFSC  
Dr. Sam Herrick, NMFS, SWFSC  
Mr Kevin Piner, NMFS, SWFSC

### **Pacific mackerel review:**

#### *STAR Panel:*

André Punt, University of Washington (Chair)  
Tom Barnes, CDF&G (SSC representative)  
John Casey, Cefas (CIE)

#### *PFMC:*

Diane Pleschner-Steele (CPSAS)  
Brian Culver (CPSMT)

#### *STAT:*

Emmanis Dorval, NOAA / SWFSC  
Kevin Hill, NOAA / SWFSC  
Jennifer McDaniel, NMFS, SWFSC  
Mr. Dale Sweetnam, CDF&G

#### *Others:*

Mr Richard Carroll, Ocean Gold Seafoods  
Mr Bev Macewicz, NMFS, SWFSC  
Dr. Ray Conser, NMFS, SWFSC  
Dr. Paul Crone, NMFS, SWFSC  
Dr. Sam Herrick, NMFS, SWFSC

## **Appendix 2: STAR Panel Terms of Reference:**

### **Terms of Reference for STAR Panels and Their Meetings**

The principal responsibility of the STAR Panel is to carry out the following terms of reference.

The STAR Panel's work includes:

1. reviewing draft stock assessment documents and any other pertinent information (e.g.; previous assessments and STAR Panel reports, if available);
2. working with STAT Teams to ensure assessments are reviewed as needed;
3. documenting meeting discussions; and
4. reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the SAFE document.

STAR Panels normally include an SSC chair, at least one "external" member (i.e., outside the Council family and not involved in management or assessment of West Coast CPS), and one additional member. The total number of STAR Panel members should be at least "n+2" where n is the number of stock assessments and "2" counts the chair and external reviewer. In addition to Panel members, STAR meetings will include CPSMT and CPSAS advisory representatives with responsibilities as laid out in their terms of reference. STAR Panels normally meet for one week. The number of assessments reviewed per Panel should not exceed two.

The STAR Panel is responsible for determining if a stock assessment document is sufficiently complete. It is the Panel's responsibility to identify assessments that cannot be reviewed or completed for any reason. The Panel's decision that an assessment is complete should be made by consensus. If a Panel cannot reach agreement, then the nature of the disagreement must be described in its report.

The STAR Panel's terms of reference concern technical aspects of stock assessment work. The STAR Panel should strive for a risk neutral approach in its reports and deliberations. Confidence intervals of indices and model outputs, as well as other measures of uncertainty that could affect management decisions, should be provided in completed stock assessments and the reports prepared by STAR Panels. The STAR Panel should identify scenarios that are unlikely or have a flawed technical basis.

Recommendations and requests to the STAT Team for additional or revised analyses must be clear, explicit and in writing. A written summary of discussion on significant technical points and lists of all STAR Panel recommendations and requests to the STAT Team are required in the STAR Panel's report. This should be completed (at least in draft form) prior to the end of the meeting. It is the chair and Panel's responsibility to carry out any follow-up review work that is required.

Additional analyses required in the stock assessment should be completed during the STAR Panel meeting. If follow-up work by the STAT Team is required after the review meeting, then it is the Panel's responsibility to track STAT Team progress. In particular, the chair is responsible for communicating with all Panel members (by phone, email, or any convenient means) to determine if the revised stock assessment and documents are complete and ready to be used by managers in the Council family. If stock assessments and reviews are not complete at the end of the STAR Panel meeting, then the work must be completed prior to the CPSMT meeting where the assessments and preliminary HG levels are discussed.

The STAR Panel, STAT Team, and all interested parties are legitimate meeting participants that must be accommodated in discussions. It is the STAR Panel chair's responsibility to manage discussions and public comment so that work can be completed.

STAT Teams and STAR Panels may disagree on technical issues. If the STAR Panel and STAT Team disagree, the STAR Panel must document the areas of disagreement in its report. The STAR Panel may request additional analysis based on alternative approaches. Estimates representing all sides of the disagreement need to be presented in the assessment document, reviewed, and commented on by the SSC. It is expected that the STAT Team will make a good faith effort to complete these analyses.

The SSC representative on the STAR Panel is expected to attend CPSMT and Council meetings where stock assessments and harvest projections are discussed to explain the reviews and provide other technical information and advice.

The chair is responsible for providing Council staff with a camera ready and suitable electronic version of the Panel's report for inclusion in the annual SAFE report.

## **Suggested Template for STAR Panel Report**

- Minutes of the STAR Panel meeting, including name and affiliation of STAR Panel members.
- List of analyses requested by the STAR Panel.
- Comments on the technical merits and/or deficiencies in the assessment and recommendations for remedies.
- Explanation of areas of disagreement regarding STAR Panel recommendations: among STAR Panel members (majority and minority reports), and between the STAR Panel and STAT Team.
- Unresolved problems and major uncertainties, (e.g., any special issues that complicate scientific assessment, questions about the best model scenario).
- Prioritized recommendations for future research and data collection.

## **Appendix 3: Statement of Work**

**SUBCONTRACT**  
**Between**  
**Northern Taiga Ventures, Inc. (NTVI)**  
**And**  
**The Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS)**

### **STATEMENT OF WORK**

#### **General**

The consultant will serve as a member of a Stock Assessment Review (STAR) Panel of the Pacific Fishery Management Council (PFMC) during 18-21 September 2007 in La Jolla, California. This review will focus on a new stock assessment of Pacific sardine. Under the PFMC's Coastal Pelagic Species Fishery Management Plan (CPS FMP), the assessment provides the basis for setting annual harvest levels of Pacific sardine off the west coast of the United States.

The consultant should have hands-on experience in conducting fish stock assessments. Expertise with age-structured modeling is particularly important. Experience with coastal pelagic species assessment is desirable.

The consultant's duties shall not exceed a maximum total of 13 days: Several days prior to the meeting for document review; the three-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 will be provided with the following:

1. Recent stock assessment reports for Pacific sardine, including the last full stock assessment (2004) and the assessment updates carried out in 2005 and 2006.
2. Additional background material including the PFMC's Terms of Reference for CPS STAR Panels; report of the last CPS STAR Panel (2004); and documents describing the models used in both the past and current stock assessments.
3. Draft report on the new stock assessment – including additional sources of data and methodology improvements – which, after review and modification, will provide the basis for management during the fishing year beginning on 1 January 2008.
4. An electronic copy of the data and the models used for the new assessment (if requested by reviewer).

#### **Specific**

- 1) Become familiar with the Pacific sardine stock assessments; proposed methodological improvements; and background materials.
- 2) Participate in the STAR Panel meeting in La Jolla, California during 18-21 September 2007.
- 3) Comment on the strengths and weaknesses of current approaches and proposed improvements.
- 4) Recommend alternative methods and/or modifications of proposed methods, as appropriate during the STAR Panel meeting.

- 5) No later than October 5, 2007, submit a written report<sup>1</sup> consisting of the findings, analysis, and conclusions, addressed to the “University of Miami Independent System for Peer Review,” and sent to Dr. David Die, via email to [ddie@rsmas.miami.edu](mailto:ddie@rsmas.miami.edu), to Mr. Manoj Shivilani, via email to [mshivilani@rsmas.miami.edu](mailto:mshivilani@rsmas.miami.edu), and to Mr. Roger Peretti, via email to [rperetti@ntvifed.com](mailto:rperetti@ntvifed.com). See Annex I for additional details on the requirements for the report.

### **1.1 Submission and Acceptance of CIE Reports**

The CIE shall provide the consultant’s final report for review for compliance with this Statement of Work and approval by NOAA Fisheries to the COTR, Dr. Stephen K. Brown ([Stephen.K.Brown@noaa.gov](mailto:Stephen.K.Brown@noaa.gov)), no later than October 19, 2007. The COTR shall notify the CIE via e-mail regarding acceptance of the consultant’s report. Following the COTR’s approval, the CIE shall provide a pdf format version of the approved report to the COTR.

### **ANNEX I: REPORT GENERATION AND PROCEDURAL ITEMS**

1. The report should be prefaced with an executive summary of comments and/or recommendations.
2. The main body of the report should consist of a background, description of review activities, summary of comments, and conclusions/recommendations.
3. The report should also include as separate appendices the bibliography of materials provided by the Center for Independent Experts, including any additional literature cited, and a copy of the Statement of Work.

Please refer to the following website for additional information on report generation:  
[http://www.rsmas.miami.edu/groups/cimas/Report\\_Standard\\_Format.html](http://www.rsmas.miami.edu/groups/cimas/Report_Standard_Format.html)

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<sup>1</sup> The written report will undergo an internal CIE review before it is considered final.