Pacific Mackerel

STAR Panel Meeting Report

NOAA / Southwest Fisheries Science Center
La Jolla, California
September 18-21, 2007

STAR Panel
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PFMC
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1) Overview

The Pacific Mackerel STAR Panel (Panel) met at the Southwest Fisheries Science Center, La Jolla, CA Laboratory from September 18-21, 2007 to review a draft assessment by the Stock Assessment Team (STAT) for Pacific Mackerel. Introductions were made (see list of attendees, Appendix 1), and the Panel chair (André Punt) reviewed the Terms of Reference for CPS assessments with respect to how the STAR Panel would be conducted.

The focus for the review was methodological (to determine whether the 2008 assessment should be conducted using SS2 rather than ASAP) because the harvest guideline for 2007-08 has already been set by the Council based on a 2007 assessment conducted using ASAP. Draft assessment documents, model input and output files, and extensive background material (previous assessments, previous STAR Panel reports, SSC statements, etc.) were provided to the Panel. The draft assessment document was only provided to the Panel on 13 September, well after the two-week deadline for the submission of documents. This did not, however, preclude a thorough review of the material.

The May 2007 Mackerel STAR Panel reviewed an updated ASAP model, and an alternative model in SS2 provided by the STAT. However, despite the relatively close agreement of many of the outputs from the ASAP and SS2 model runs, detailed scrutiny of the diagnostics and outputs from the SS2 modelling runs revealed that the SS2 model invariably ran up against the harvest rate limit (0.9 and 0.95) in a number of years. Attempts to mitigate this problem were unsuccessful and the May 2007 Panel was unable to recommend the use of SS2 for the 2007 assessment. The May 2007 Panel recommended that work continue to examine the possibility of using SS2 as the assessment platform. The analyses presented to the May 2007 Panel suggested that ASAP and SS2 lead to similar results. However, SS2 is to be preferred (at least in principle) because it deals better with indices that are not tied directly to a fishery, can include age-reading error, and allows weight-at-age in the catch to differ from weight-at-age in the population. In principle, it should be easier to represent uncertainty using the MCMC algorithm for assessments based on SS2.

Emannis Dorval (NOAA, SWFSC) gave a presentation on the draft assessment, with assistance from Dr Kevin Hill (NOAA, SWFSC). This assessment addresses several of the recommendations from the May 2007 Panel, namely: (a) the model operates on a quarterly time-step, (b) allowance is made for age-reading error, (c) allowance is made for the weight-at-age in the catch to differ from that in the fisheries, (d) the assessment estimates growth (multiple time blocks) by fitting to catch length-frequency data and conditional age-at-length data, (e) selectivity for the CPFV index is set to that for the recreational fishery, which is now estimated. The draft assessment presented to the May 2007 Panel started in 1935 (the earliest year for which catch-at-age data are available). However, the present assessment started in 1962, the first year for which index data are available.

The Panel focused on differences between the ASAP and SS2 models, in particular, why the initial SS2 base-model estimates much larger 1976 and 1978 cohorts than appears to be plausible. The Panel requested that the STAT examine models with many selectivity and growth time-blocks, in particular because the 1976 cohort was spawned during a period when growth was much faster than is the case at present, meaning that age-selectivity may have been higher for the 1976 than for subsequent cohorts.

The STAT provided several model runs based on SS2 to attempt to identify a base-model which fits the indices adequately, which are consistent with the patterns in the catch-at-age data, and which lead to plausible levels of biomass. 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 fitted the data adequately. Appendix 2 provides a subset of the results considered during the Panel, illustrating some of the difficulties with the models examined.

The Panel concludes 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. 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.

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).

The Panel commended the STAT for their excellent presentations, well-written documentation, and their willingness to respond to the Panel's requests for additional analyses. The number of requests that could be accomplished during the Panel meeting was, however, limited by the focus on Pacific sardine and because the analysts for mackerel were also members of the sardine STAT.

2) Discussion and Requests Made to the STAT during the Meeting

Set #1

A. Reduce the plus group for ages from 14 to 12 yr, reduce the plus group for lengths from 60 to 45 cm and truncate the length data used in the assessment at 11 cm.

Reason: There are no age data for 60 cm fish, and few fish greater than 45 cm are found in the commercial and recreational catches. Also, this will speed up the model runs.

Response: The STAT completed this task as requested.

B. Conduct a sensitivity analysis to examine assumptions regarding selectivity and growth on the sizes of the 1976 and 1978 year classes based on the assumption σ_R = 0.8. Assume that all selectivity patterns are dome-shaped.

Reason: The Panel was concerned that the sizes of the extremely large 1976 and 1978 cohorts were due to the choice of how selectivity and growth were parameterized.

Response: The STAT provided results based on time-varying *K*, but pre-specified the initial length of each cohort. The sizes of the 1976 and 1978 year-classes remained unrealistically high.

C. Compare the implied age-structure of the catch for the commercial fleet to the observed catch age-structure for this fleet.

Reason: This would show how well the model is matching the age data (visual examination of the fits to the conditional age-at-length data is difficult).

Response: The estimates of recruit strength were very implausibly high so the Panel did not consider these results in detail as the reasons for the unrealistic estimates of recruitment needed to be resolved before detailed examination of model residuals was warranted.

D. Move the fit of the model to the spawning index from quarter 1 to quarter 4.

Reason: The model needs to be self-consistent concerning the timing of spawning. Since spawning actually occurs in quarter 4, this would also eliminate the need to account for mortality between the two periods.

Response: The STAT completed this task; there was no major change to the results.

E. Set effective sample size for the length-frequency and conditional age-at-length data to the number of landings sampled, or as the number of fish divided by 25.

Reason: The STAT intended to define the effective sample sizes as the number of fish divided by 25, but this was not done in the base run supplied to the Panel.

Response: The effective sample sizes used in the SS2 analyses were updated to reflect the intended effective sample sizes.

Set #2

F. Conduct an age-based run using the re-weighted catch-at-age data pre-specifying length-at-age [e.g. from run G4] (i.e. ignoring the length-frequency data and

conditional age-at-length data). Create selectivity blocks for 1962-68, each year for 1969-85, and 1986-2006. Set σ_R =0.8 and A_{min} = 0.25.

Reason: The Panel wished to assess whether the reason for the strong 1976 and 1978 year-classes was related to the length data and misspecification of growth.

Response: The STAT conducted an analysis with three time blocks (1962-68, 1969-85, and 1986-2006). The 1976 and 1978 cohorts remained unrealistically large.

G. Conduct a length-based run using the re-weighted length-frequency data. Estimate a single selectivity pattern and time-varying growth (time blocks as for request #F); treat all three growth parameters as estimable. Set σ_R =0.8 and A_{min} = 0.25.

Reason: The Panel wished to assess whether the reason for the large 1976 and 1978 year-classes was time-varying growth.

Response: The pattern of length-at-age followed the empirical data on length-at-age. The sizes of the 1976 and 1978 were much reduced compared to the initial base model, but still appeared to be unrealistically large. The model still failed to fit the index points for the 1970s.

H. Conduct three model runs based on model G4 (except σ_R =0.8 and A_{min} = 0.25): a) remove the length-frequency data for 1976, b) remove the length-frequency data for 1976-77, and c) remove the length-frequency data for 1976-78.

Reason: The Panel wished to assess whether the reason for the very strong 1976 and 1978 year-classes related to the length-frequency data for particular years.

Response: Leaving out the 1976 length-frequency data led to a qualitative change to the assessment outputs. In particular, the magnitude of the 1976 cohort was reduced substantially from model G4, selectivity for recent years was asymptotic, and the fit to the CPFV and CalCOFI indices was improved. Leaving the 1976 and 1977 data out of the assessment led to asymptotic selectivity for the first selectivity block, and even more reduced abundance of the 1976 cohort. The fit to the CPFV index also improved. Leaving out the 1976-78 length data led to lower estimates of the 1976 cohort, but not the 1978 cohort. Visual examination of the catch-at-age data does not support a very strong 1976 cohort.

The STAT provided an additional model run in which selectivity is age-specific (estimated separately for each age), there is one growth curve, and the model is fitted to conditional age-at-length data. However, this analysis also led to implausibly large estimates of recruitment.

3) Technical Merits and/or Deficiencies of the Assessment

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.

4) Areas of Disagreement
There were no areas of disagreement between the STAT and Panel.

5) Unresolved Problems and Major Uncertainties
Despite considerable effort by the STAT, none of model runs presented to the Panel led to adequate fits to the index data or to plausible levels of biomass. In addition, the SS2 results were very sensitive to changes to the specifications of the model (e.g. time-varying growth, and time-varying selectivity) and to changes to the data (e.g. removing length-composition data for one year substantially changed the relative pattern of recruitment strength as well as recruitment in absolute terms).

The Panel wishes to highlight that all three indices of abundance are subject to considerable uncertainty and there are major concerns regarding the suitability of each as an index of relative abundance for mackerel. The May 2007 Panel report provides a detailed discussion of these concerns (see Appendix 3). Another major uncertainty associated with the assessment is the lack of data for the Mexican fishery. In particular, there are no composition data for the Mexican fisheries, and the length and age-compositions of the Mexican landings consequently had to be assumed to be the same as those of the U.S. fishery. The extent to which the length-frequencies (particularly those for the moratorium years) are representative of the fishery landings is also uncertain (and is consequential – leaving the 1976 length-frequency out of the assessment changed the relative strengths of 1976 and 1978 cohorts markedly).

6) Concerns raised by the CPSMT AND CPSAS representatives during the meeting
The CPSMT and CPSAS did not have additional concerns.

7) Research Recommendations
The Panel identified research recommendation, 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:
    1. 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.]

2. 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.]
3. 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.]
4. 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 coastwide 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 coastwide stock.

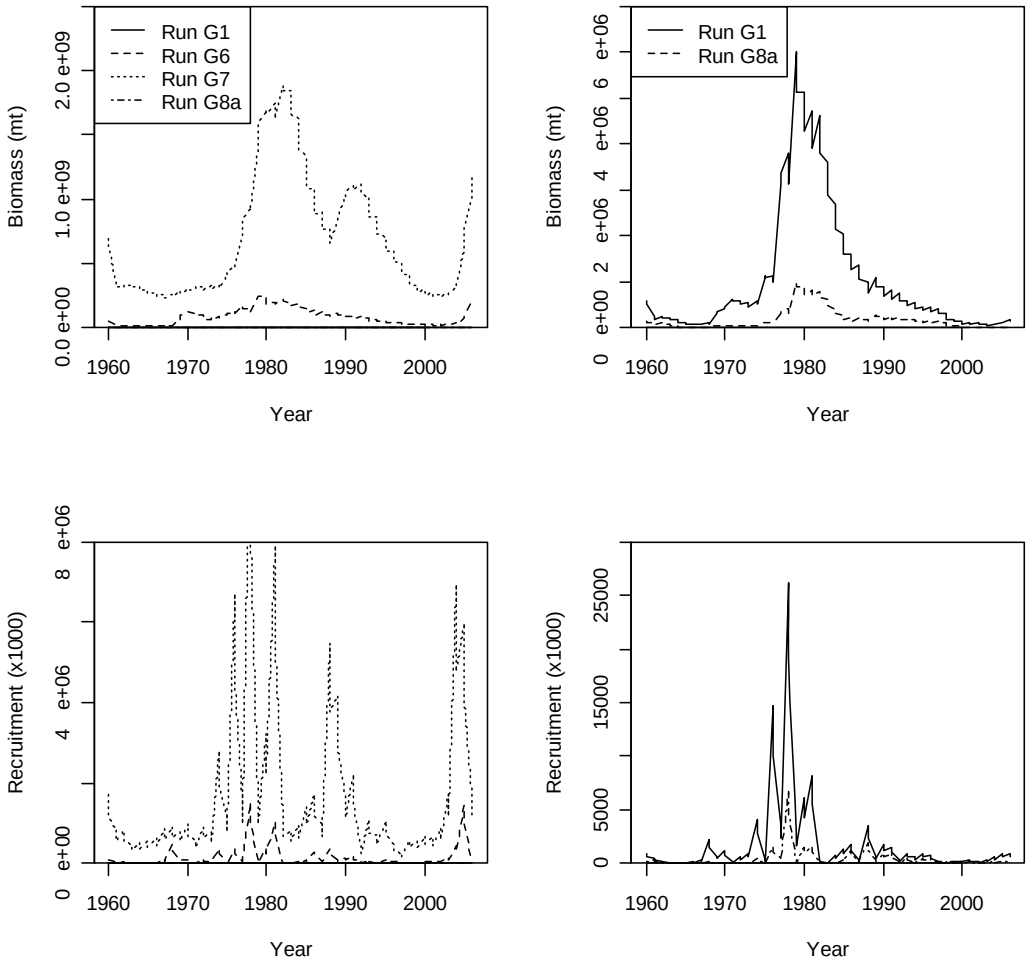
Appendix 1

STAR Panel Members in Attendance
Dr. André Punt, (Chair), SSC - University of Washington
Mr Tom Barnes, SSC – CDF&G
Dr John Casey, CIE – CEFAS (UK)
Mr Brian Culver, CPSMT - WDFW
Ms. Diane Pleschner-Steele, CPSAS - California Wetfish Producers Association

STAT Members in Attendance
Dr Kevin Hill, NMFS, SWFSC
Dr. Emmanis Dorval, NMFS, SWFSC
Dr. Nancy Lo, NMFS, SWFSC
Ms. Jennifer McDaniel, NMFS, SWFSC

Others in Attendance
Mr. Dale Sweetnam, CDF&G
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
Example results from four of the model configurations presented to the Panel



Model G1: time-varying length-based selectivity (blocks 1962-69; 1970-77; 1978-06); time-varying growth (1962-69; 1970-77; 1978-06); length compositions based on 57 bins (4-60+cm); age-at-length compositions based on ages 0-11+; spawning biomass is in season 4. This was the initial base-model.

Model G4: as for model G1, except that growth for 1962-68 and 1986-06 is pre-specified and growth for 1969-85 is estimated separately for each year, the length compositions are based on 35 bins (11-45+ cm), the age-at-length compositions are based on ages 0-11+, A_{min} =0.5, and the spawning biomass is in season 1;

Model G7: as for model G4, except that selectivity is age-specific, there is a single growth curve with pre-specified parameters, and model is fitted to length composition data for CPFV fleet and the age-composition data for commercial fleets (ages 0-11+).

Model G8a: as for model G4, expect that growth is estimated for all three time-blocks, and the length-frequency data for 1976 are ignored.

Appendix 3
Except from the May 2007 Pacific Mackerel STAR Panel Report

There is currently no true fishery-independent index of relative abundance for the whole stock and there are concerns with the three indices used in the present assessment.

1. The CalCOFI larval surveys are often relatively poor at finding Pacific mackerel larvae. Whether these surveys and the estimates of larval production at hatching constitute representative estimates of the spawning stock size of mackerel is uncertain, especially because the area surveyed is only a fraction of the total spawning region. Obtaining access to the Mexican larval survey data (IMECOCAL) may help solve this problem. In addition, the occurrence of larvae can be limited to one or two size classes in years of relatively low abundance, which compromises the estimation of the larval production at hatching for those years.

2. The aerial spotter index, up until 2002, provides an opportunistic method for estimating relative abundance. The structure of the index includes an estimate of area based on the number of 10' x 10' blocks surveyed, but this number varies from year to year, and includes coastal blocks which are not strictly 10' x 10'. This acts as a source of uncertainty among years. A further problem with the spotter plane index of abundance is that the design of the sampling changed after 2002. Specifically, a fishery-independent aerial survey was begun in 2004 using a grid search pattern with the added freedom to search for more fish if a school of fish is found. However, the adherence of the pilots to the sampling grid has yet to become stable. The very different sampling strategy used prior to 2003 means that it is questionable whether this new time series can be combined in a meaningful way with the earlier one.

3. The CPFV index is based on the logbook data from the CPFV fleet for California (although limited data do exist for Mexico). Given that it is fishery-dependent data, its use in the assessment as an index of stock abundance is predicated on the assumption that catchability has not changed over time. While this is a concern for all indices of abundance based on fishery-dependent data, the fact that mackerel is not a target species for the CPFV fleet suggests that this assumption may be acceptable in this case.