Pacific Mackerel

STAR Panel Meeting Report

NOAA / Southwest Fisheries Science Center
La Jolla, California
June 21 – 24, 2004

STAR Panel
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Andre Punt, University of Washington (SSC Representative)
Rodolfo Serra, IFOP, Valparaiso, Chile
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PFMC
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1) Overview

On June 21st to 24th, 2004, a STAR Panel (hereafter the Panel) met in La Jolla, CA for the first formal PFMC-sponsored stock assessment review of Pacific mackerel. The STAR Panel terms of reference were adhered to, in that the Panel worked with the STAT to ensure that the assessment was reviewed as needed and that meeting discussions were documented. However, it was noted that a recent SSC report on Pacific mackerel (June 2004, Supplemental SSC Report F.2.b.) recommended a separate future STAR panel to deal with issues of yield and harvest formula for CPS species. Therefore, summaries of stock status and harvest guidelines were not reviewed by this STAR panel as the focus of the meeting was to review assessment methodologies and not results.

The STAR Panel members received copies of all documentation approximately one week prior to the meeting, which provided sufficient time for review. The meeting commenced on June 21st with introductions (see list of attendees) followed by a brief overview by the Chair (Tom Barnes). Kevin Hill, with assistance from Paul Crone, led the presentation on assessment methodology. Nancy Lo gave a presentation on the aerial spotter program, an abundance index in the assessment.

The CPS fishery in California takes market squid, sardine and mackerel. The fishery has progressed from one focused primarily on squid and mackerel in the early 1980's, to one that focuses substantially on sardine and squid, although the fishery still relies on all three species.

The most recent mackerel assessment, intended for PFMC management decisions for the period July 1, 2004 to June 30, 2005, used a modified virtual population analysis model (ADEPT) to estimate Pacific mackerel biomass. During the meeting, the Panel briefly reviewed the method and results from the ADEPT model. However, most discussion focused on a forward-projection age structured assessment program (ASAP) model which the STAT proposed for future assessments of Pacific mackerel. The ASAP model is intended as an alternative statistical model to evaluate more fully the relationship between the species' population dynamics and associated fishery operations than is possible using ADEPT.

For illustrative purposes and to provide a basis for discussion, the STAT presented two ASAP models. The baseline model attempted to mimic the ADEPT formulation for the 2004 assessment. It included the four indices used in ADEPT and fixed selectivity over the entire period (1929-2003). The alternative approach eliminated one index, combined two other indices, and separated selectivity into two time periods.

In examining the results of the illustrative ASAP models, it was noted that results from both the baseline and alternative approach are very similar. Population numbers and biomass increased through the late 1970's and early 1980's similar to the ADEPT model, but peaked at much lower levels.

The Panel and the STAT agreed that ASAP should form the basis for the 2005 assessment. For continuity purposes, future assessments should include an ADEPT analysis as a sensitivity test.

The Panel commended the STAT for their excellent presentations, well-written and complete documentation, and their willingness to respond to the Panel's requests for additional analyses.

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

a. There were questions regarding the length of the time series to be included in the ASAP model, given uncertainties regarding earlier landings data. **Request:** the Panel requested that a sensitivity analysis be conducted to compare starting the model in the 1920's versus starting it when the stock rebounded in 1978. **Response:** the STAT provided numerous runs during the meeting comparing model outputs based on the entire time series and a truncated time series commencing in 1978.
b. There were concerns regarding biological sample sizes on which the catch at age data for some years is based, in particular during the 1970's when the fishery was closed. There were also concerns regarding the temporal and spatial variability of sampling. **Request:** the Panel requested that sample sizes by year be provided. **Response:** these were provided during the meeting and it was decided that it was not necessary to conduct a sensitivity analysis since there are several sources of uncertainty associated with the catch at age data other than sampling error, such as potential seasonal sampling bias. However, given the small sample sizes during the 1970's, it was suggested that this may be a further reason to begin the ASAP model subsequent to this period.
c. Weight at age data exhibited considerable variability over time, in particular during the mid 1970's when landings were low and sampling was reduced. It was suggested that this is another reason to start the ASAP model subsequent to this period. No requests or recommendations were made.
d. There were questions regarding the comparability of the new aerial spotter index and the historical fishery-based spotter index. No requests or recommendations were made.
e. In examining abundance indices, it was difficult for the Panel to compare one index with another. **Request:** the Panel requested that the abundance indices be plotted against each other (X-Y plots) to examine the degree of agreement between them. **Response:** three plots were provided during the meeting: 1) aerial spotter index vs. CalCOFI index, 2) aerial spotter index vs. CPFV index, and 3) CalCOFI index vs. CPFV index. These plots (see Figure 1) suggest that the relationship between the aerial spotter index and the CalCOFI and CPFV indices is not linear.
f. There were questions regarding the use of the northern CPFV index in ADEPT because its trend is contradictory with that of the southern CPFV index. The Panel and STAT agreed that a single combined index be used in the ASAP model.
g. There was a discussion regarding the use of the triennial and impingement indices. The Panel and STAT agreed that these indices be eliminated from the ASAP model.
h. In discussing the CalCOFI and aerial spotter indices, it was noted that there are zero values in the indices. However, the ASAP model replaces zero values by 0.0001 after the indices are rescaled to 1. **Request:** the Panel requested that a sensitivity analysis be conducted to examine the impact of adding a small value to the zero values in the ASAP input file. **Response:** the STAT provided numerous runs that illustrated that the ASAP model was highly sensitive to the addition of small values to the zeros. It was suggested, that in the long term, a negative binomial error structure be incorporated in the model to

allow for zero values. However, after much discussion, it was concluded that, in the short term, zero values in an index be replaced with the smallest observed value in that index.

i. After an extensive discussion, several other issues were identified that required further evaluation and review. **Request:** the Panel requested that the following ASAP sensitivity analyses be conducted: 1) three indices (CalCOFI, CFPV, and aerial spotter) vs. two indices (CalCOFI and CFPV), and 2) the full time series vs. a truncated time series commencing in 1978. **Response:** the STAT presented each of the above sensitivity analyses. The exclusion of the spotter index did not change the model fit substantially. It was concluded that all three abundance indices be included in the model, that the full time series be used, that zero values in indices be replaced with the minimum estimate from the index, and that the same coefficients of variation be assigned to all data points.

j. The baseline model of ASAP did not mimic the catch in 1998. **Request:** the Panel requested that the STAT conduct analyses in which the weight assigned to the catch data was increased (lambda values of 100, 300, and 1000) and provide a table with predicted 1998 catch, and 1+ biomass in 2003. A bubble plot was also requested to examine residual patterns. **Response:** the STAT provided this information (Table 1 and Figure 2).

3) Technical Merits and/or Deficiencies of the Assessment

The lack of catch at age and weight at age data from the Mexican (Ensenada) fishery is a major source of uncertainty, especially in recent years when Mexican landings have been as large as or larger than Californian landings.

Pacific mackerel range from the Gulf of California to southeastern Alaska and are harvested from Ensenada to British Columbia. However, the abundance indices used in the assessment are all derived from the Southern California Bight, a relatively small area compared to the distributional range. It was also noted that even within this area, there may be a spatial bias as most abundance indices are derived from the northern part of the spawning range, which is thought to range from central Baja California to the Southern California Bight.

The Panel could not fully review the age composition data due to a lack of information on how they were developed. There is considerable inter-annual variation in the proportion of catch in different age classes and this results in systematic patterns in the residuals about the fit to the catch-at-age data. The ASAP model is based on the assumption that all of the discrepancy between the observed and model – predicted age proportions is due to observation error. There are, however, alternative explanations: ageing error (both systematic and random), non-random sampling of the landings, the impact of seasonal variation in the fishery, and random changes in availability. The Panel strongly recommends examination of the basis for the age composition data and the possible benefits of allowing for time dependent selectivity. The Panel noted that variance in age composition data could be partitioned into component parts to estimate observation error and process error. The fishery was not conducted year-round in all years, which may have introduced a source of variability in the annual catch-at-age data. A sensitivity analysis could be conducted by down-weighting years with only a partial year of fishing.

4) Areas of Disagreement

There were no areas of disagreement between the Panel and STAT.

5) Unresolved Problems and Major Uncertainties

Problems unresolved at the end of the meeting form the basis for the research recommendations in Section 6.

6) Research Recommendations

The following recommendations are not given in priority order.

a. There was a discussion regarding the overall lack of fishery independent survey data, in particular outside of the Southern California Bight. **Recommendation:** the Panel recommended a concerted approach to develop a coastwide synoptic survey, ideally on an annual basis, to estimate an index of mackerel biomass.
b. There was a discussion regarding the survey design of the new aerial spotter index. **Recommendation:** the Panel recommended that the survey design incorporate rigorous protocols. Attempts should be made to estimate school surface area. The Panel also recommended that an aerial spotter survey be initiated in the Pacific Northwest in conjunction with industry.
c. The Panel endorsed and encouraged overall greater collaboration with industry in the collection and analysis process for coastal pelagic species, including Pacific mackerel.
d. There is a lack of biological sampling data available from Mexico for inclusion in the assessment. The lack of Mexican catch-at-age data is more critical in recent years when the Mexican catch has been as large as or larger than that of California. **Recommendation:** the Panel recommended that fishery and survey (IMECOCAL) data be acquired from Mexico and incorporated into future assessments.
e. **Recommendation:** the Panel recommended that spawning biomass be defined in terms of the numbers at the end of the year.
f. There were questions regarding the length of the time series to be included in the ASAP model, given uncertainties regarding earlier landings data. Although it was decided to use the entire time series, it was considered that the use of a truncated time series be evaluated further. **Recommendation:** the Panel recommended that consideration be given to using the ASAP model for 1978 to the present.
g. There were questions regarding the use of fishery-based weights at age to estimate population parameters as they are derived from only part of the population. **Recommendation:** the Panel recommended that this be examined and that a Von Bertalanffy curve be used if it includes samples from throughout the stock range.
h. **Recommendation:** the Panel recommended that all indices be plotted with confidence intervals in future assessments.
i. **Recommendation:** the Panel recommended that the STAT evaluate year – area

interactions in the GLM used to standardize the catch – effort data.

j. There was a discussion regarding selectivity patterns for the CPFV index which were estimated outside of the ASAP model. **Recommendation:** the Panel recommended that selectivity within the model be estimated by treating CPFV as a separate fishery using available biological data.

k. There were questions regarding how the catch-at-age (in number) is developed. **Recommendation:** the Panel recommended that this requirement should be included in the STAR terms of reference.

l. There was a question whether the CPFV index includes estimates of discards. It was noted that discard rates were only available in logbooks since 1994. **Recommendation:** the Panel recommended that the magnitude of discards be examined for the next assessment.

m. There was a brief discussion on the catch at age matrix, whether it should be extended beyond age 5+. It was noted that this may be more feasible if a truncated time series is used in the ASAP model. **Recommendation:** the Panel recommended that these issues be examined for the next assessment.

n. The Panel strongly recommends examination of the basis for the age composition data and the possible benefits of allowing for time-dependent selectivity.

o. The spotter index was not fit well. **Recommendation:** the trade-offs for leaving this index in or out of the assessment are complex and not readily apparent, and this decision should be left to the STAT as work progresses on the next assessment.

p. There were questions regarding how an assumed birth date of July 1st is accounted for in a model with a calendar year basis. **Recommendation:** the Panel recommended that, if practicable, the model year commence on July 1st to match the assumed birth date.

q. Noting the lack of a linear relationship between the aerial spotter index and the remaining indices, there was a discussion whether the aerial spotter index should be included in the ASAP model even though it is the only "recruitment index" available. This index assumes full selectivity across all ages. **Recommendation:** the Panel requested that selectivity within the model be estimated by creating a 'fleet' with no catch and no sampling. It was considered that this may not work but would at least provide selectivity estimates that could then be examined.

r. Observed vs. predicted catch proportions were presented, derived from the baseline ASAP model. Problems were identified with data through the 1970's, as residual patterns were not random. **Recommendation:** the Panel requested that this or a similar plot be used as a standard diagnostic in the assessment report.

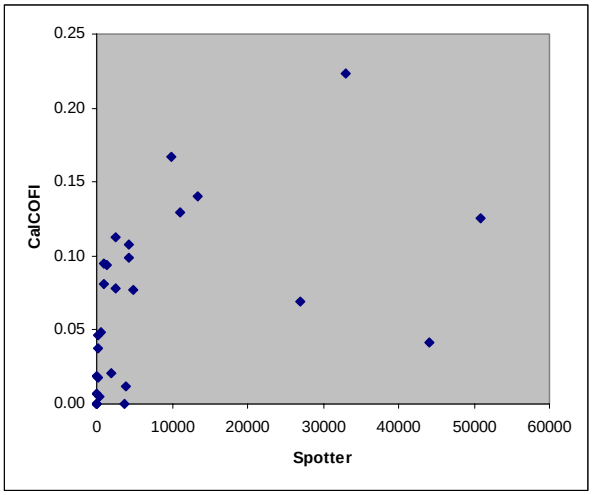
s. The specific details of the method used to develop catch-at-age data were not provided. **Recommendation**: the Panel requested that the STAT document how catch-at-age was estimated.

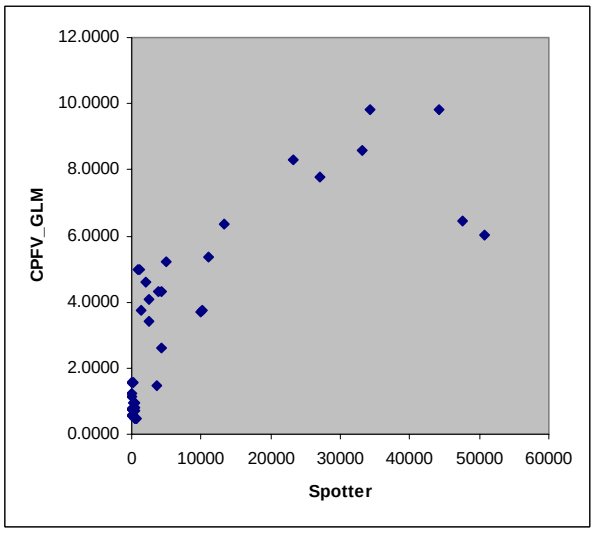
t. An error was made in summing catch-at-age data for annual estimates, due to misapplication of the July 1st birth date that is used in assigning ages. **Recommendation:** a correction needs to be made to account for the July 1 birth date that is used in assigning ages, when aggregating catch-at-age data over calendar year time periods.

u. Certain modifications are required to the ASAP model:
   - make allowance for fleet-specific weights-at-age (specifically the fishery weights-at-age for the fishery in the Pacific northwest);
   - define spawning biomass in terms of the numbers at the end of the year;

- explicitly include a zero age-class;
- include a log-normal bias-correction factor in the component of the objective function related to deviations about the stock-recruitment relationship; and
- quantify parameter uncertainty using the MCMC algorithm.

Figure 1. X-Y Plots of indices used in Mackerel assessment.





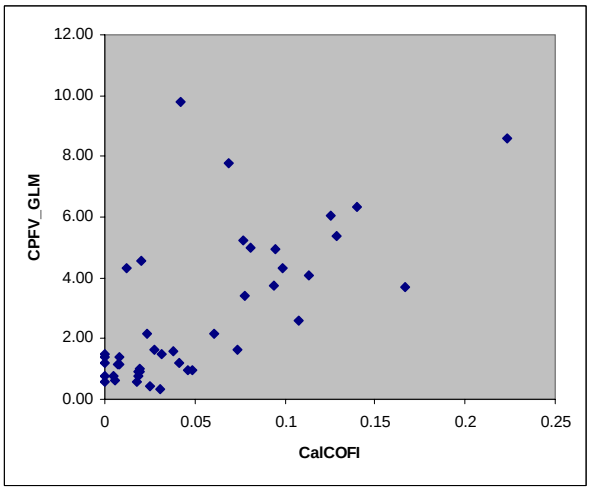


Figure 2. Bubble plots of residuals

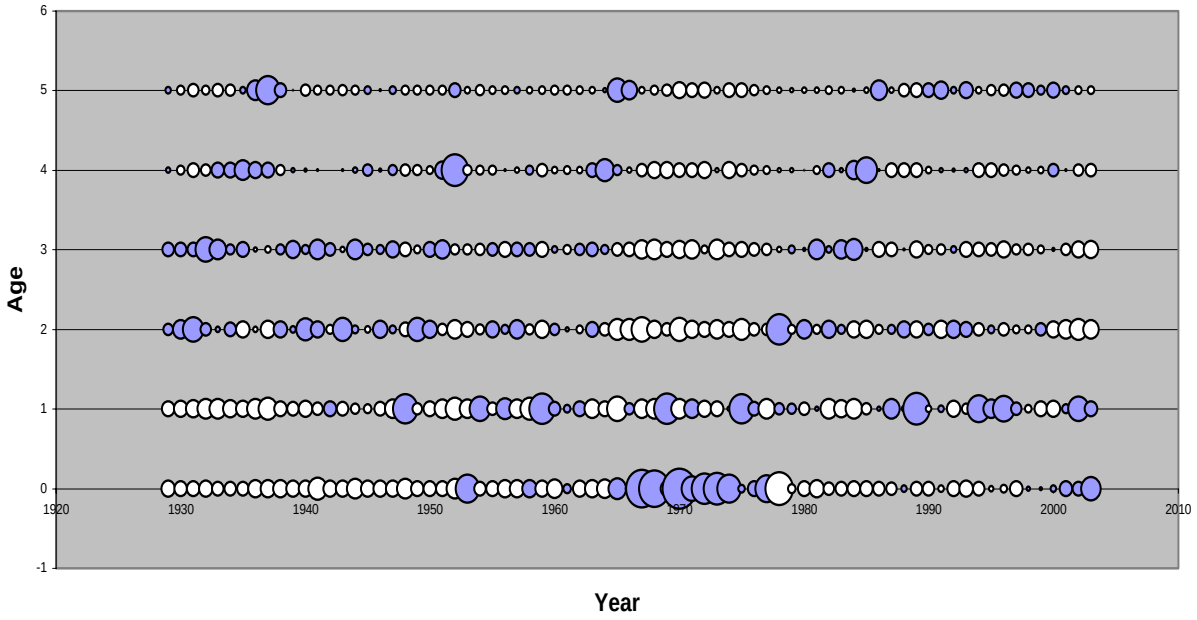


Table 1. New baseline results with increasing lambda catch.

G_2h Summary			
		1998 catch	
Lambda Catch	obj_fun	(obs-pred)	Biomass (Age 1+, Jan 2003)
100	1194.93	-8059.1	85,183
300	1197.07	-2673.2	87,138
1000	1197.84	-798.5	87,912