Independent Peer Review of the STAR Panel Review of the 2023-24 Pacific Mackerel Stock Assessment
April 11-13, 2023 La Jolla, CA

Submitted to the
Center for Independent Experts

by

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Executive Summary

A draft assessment report on Pacific mackerel was presented to the STAR Panel of the Pacific Fishery Management Council. The basic assessment data includes total catch from the combined commercial-recreational fishery including Mexico, an acoustic trawl (AT) survey that indexes biomass (expanded into Mexico in 2021), and size compositions for the fishery and survey. The assessment covered the years 2008-2021. The primary goal of the assessment was to estimate biomass in 2021 with adequate accuracy and precision which will be directly implemented into the Harvest Control Rule that has previously been specified by management. Thus, the Panel and STAT knowingly made modeling compromises that improved the estimate of current biomass at the expense of estimates of prior year biomass and the biological relationships of the stock-recruitment (SR) function and natural mortality. The model structure was designed to estimate time-varying catchabilities associated with the AT survey, a time-invariant Lorenzen M at age vector, virgin equilibrium recruitment, initial (2008) recruitment, fishery and survey selectivities and stock recruitment deviants based on a fixed Sigma R and steepness. Since the control rule was fixed there was no need to attempt to define Fmsy and Bmsy and thus, debates about the SR function were limited. However, it is recommended that the decades-old control rule be revisited in the future which implies that the SR function would have to be re-evaluated as well.

A number of analyses were conducted at the meeting to develop an appropriate model structure for time-varying catchabilities for the AT survey recognizing the overall objective of a 2021 biomass estimate. The initial model structure from the draft assessment document was modified somewhat based upon those analyses. The final model structure estimated catchability 2016-2021 with a prior with mean 0.308 and CV 0.28 and time-varying (deviations) with a standard error of 0.25 for 2008-2015. This resulted in 2021 biomass being somewhat higher than in the original draft assessment.

The STAR Panel made a number of suggestions to be included in the final assessment report to strengthen justifications, to simplify explanations and clarify some modeling issues. Additionally, research recommendations were presented, most notably to improve collaboration with Mexico, improvements and expansion of the AT survey and improved size sampling.

The results of the STAR Review including the modifications to the base model structure, suggestions for additions, improvements and justifications in the final assessment report and research recommendations were made. The joint effort of the STAR Panel Report and the final assessment report which will ensue from the STAR Panel represents the best scientific information available in going forward to providing management advice.

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions. This report constitutes a portion of the expert review of the Pacific Mackerel stock assessment.

The Pacific mackerel stock is assessed regularly (currently, every 3 years) by Southwest Fisheries Science Center (SWFSC) scientists and the Pacific Fishery Management Council (PFMC) uses the resulting biomass estimate to establish an annual harvest guideline (quota). The stock assessment data and model are formally reviewed by a Stock Assessment Review (STAR) Panel once every three years, with a coastal pelagic species subcommittee of the SSC reviewing updates in interim years. Independent peer review is required by the PFMC review process. The STAR Panel reviews draft stock assessment documents and any other pertinent information for Pacific mackerel, works with the stock assessment team (STAT) to make necessary revisions, and produce a STAR Panel report for use by the PFMC and other interested persons for developing management recommendations for the fishery. The current STAR review took place at a public meeting (including virtual access) at the Southwest Fisheries Science Center, La Jolla, CA on April 11-13, 2023.

Description of the Individual Reviewers' Roles in the Review Activities

The STAR Panel consisted of three members of the SSC (André Punt who chaired this STAR Panel meeting, Tien-Shui Tsou and Christopher Free) and myself as the reviewer designated by the Center for Independent Experts (CIE) (Appendix 3 of this Report). The role of the CIE Reviewer was to be an equal member of the STAR Panel and, as such, provide the functions as defined in the terms of reference given in the Performance Work Statement (Appendix 2 of this Report). In addition, the CIE Reviewer is to provide guidance, elaboration and recommendations as required in the Performance Work Statement. Most notably, the CIE Reviewer is to provide a Report on these tasks. This document is my Report as the CIE Reviewer for the Pacific mackerel STAR Panel stock assessment review.

Summary of Findings for each Term of Reference

This section is organized into discussions of key features of the assessment that I have made comments on. This is followed by the direct responses to the Terms of Reference (TORs) which draw on these discussions.

Harvest Control Rule, Stock-Recruitment and Status Criteria

The Harvest Control Rule (HCR) established by the Pacific Fishery Management Council (PFMC) for Pacific Mackerel (PMack) is:

Harvest Guideline= (Biomass- 18,200 mt)*0.3*0.7

where 18,200 mt is the minimum biomass (CutOff) at which a harvest guideline is provided, 0.3 is the Fraction of the excess biomass (Biomass-Cutoff) that is to be exploited and 0.7 is the Proportion of the harvest assigned to the US fishery. The Cutoff, Fraction and Proportion have been fixed by previous management action and are not modified by the stock assessment. Thus, the goal of the stock assessment is to provide an estimate of the current biomass of PMack from which the harvest guidelines are computed from the above formula. In PFMC usage, Fraction is also labeled as Emsy. However, both the Cutoff and the Fraction were based on analyses and stock conditions from many years (decades?) ago. One could express this HCR in terms of Fmsy by:

Yield =Biomass * Fmsy * [1- Cutoff/Biomass]*(Emsy/Fmsy)

giving some guidance on the relationship between Fmsy and Emsy in this HCR. Essentially, the harvest rule is implementing an Fmsy as adjusted by buffers Emsy/Fmsy and (1-Cutoff/Biomass). However, it is unlikely that Fraction relates directly to current Fmsy, as will be noted below.

The stock-recruitment (SR) function that was implemented in the PMack assessment was a Beverton-Holt (BH) function parameterized by steepness (h) fixed at 0.75, recruitment deviations fixed at σ_R = 0.75 and equilibrium recruitment with no fishing Ro was estimated, as was equilibrium recruitment "offset" (the equilibrium recruitment at the beginning of the assessment time series 2007).

Recall that SR functions are inherently mortality functions of the number of surviving eggs (E) during the recruitment process and in the BH case it is: $dE_t/dt= (- A - BE_t) E_t$ where A is the density-independent mortality rate and B is the density-dependent mortality rate, both acting throughout the recruitment time interval, leading to the SR function (Brooks and Powers. ICES. 2007)

$$E_t = \frac{E_0 exp(-At)}{1 + E_0 \frac{B}{A}\left(1 - exp(-At)\right)} = \frac{\alpha\, SSB exp(-At)}{1 + B\, \frac{\alpha\, SSB}{A}\left(1 - exp(-At)\right)}$$
$$E_t = \frac{E_0 exp(-At)}{1 + E_0 \frac{B}{A}\left(1 - exp(-At)\right)} = \frac{\alpha\, SSB exp(-At)}{1 + B\, \frac{\alpha\, SSB}{A}\left(1 - exp(-At)\right)}$$

Typical implementations of SR functions use SSB as the independent variable, as was done in this assessment. The implicit assumption when doing this is that egg production is proportional to SSB by a constant (α). Thus, the above collapses into the standard BH parameterization: R = a SSB/(1+ b SSB) which is converted into steepness, Ro and the ratio So/Ro (calculated from life-history data). A feature of the BH process (noted by Beverton-Holt, themselves) is that a series of BH recruitment intervals that include different density-dependent mortality, density-independent mortality or both collapses into a "combined" BH function with the parameterization R = a SSB/(1+ b SSB). If fishing occurs during a recruitment interval, then that F would be included in the density-independent component (A). However, this would have important ramifications in that the timing of F within a year's recruitment process, the changes in F between years and the appropriate catch equation becomes relevant. [C= F N(1-exp(-F-M)/(F+M) is no longer correct (Powers ICES 2014)].

The current assessment using the BH SR function generates a "recruitment" estimate for an unspecified time in the age 0 year, then adds a density-independent M (from the Lorenzen relationship) for the remaining portion of age 0. The estimate of M age zero in the draft assessment document (their Fig 23) was Mo=~1.1. However, there is a substantial catch of age 0's (their Fig 16) and it is often the dominant age of the catch. Based on this, the implicit SR assumption that the assessment is making is that there is a very short (instantaneous?) period of density-dependence followed by a period of density-independent M and a significant F completing age 0. Additionally, the Lorenzen M is based on an annual M relationship between ages. It is unclear to me how that is affected by partial years (such as is possible for Mo=1.1). The timing and nature of the recruitment process was not discussed in the document.

The choice of steepness of h = 0.75 was carried over from the previous assessment without discussion. The ramifications of this for a BH function are: 1) the equilibrium SPR at the origin of the SR function is (1-h)/(4h)= 0.083 (smallest theoretical sustainable SPR), and 2) equilibrium SPR at Maximum Excess

Recruitment (MER, where the slope of the SR function is equal to the ratio Ro/So) = $\sqrt{[(1-h)/(4h)]}=0.29$. Barring selectivity effects, F at SPRMER might be used as a surrogate for Fmsy. In any case, the point to be made is that status criteria that might be derived have essentially been specified, not estimated, by the choice of steepness. Additionally, if Fmsy equal to FSPRMER were used, then Fmsy would be less that Emsy in the current control rule indicating that the current control rule may be out of date in terms of status determination criteria.

The draft assessment document and background documents and presentations indicated the assumption of fecundity being proportional to SSB was being used (the alpha in the above SR equation). Ideally, it would be appropriate to move research in that direction, but apparently PMack reproduction is very diffuse occurring throughout the year. It is being modeled as occurring in July at the beginning of the July-June fishing year, coupled with a large $\sigma_R = 0.75$ which likely adjusts somewhat for continuous reproduction. The assessment team was asked to use the literature to develop a supporting argument for using SSB, which they did for the STAR Panel Report, and it will presumably be in the final assessment document, as well. It is noted that fecundity research on this stock will be difficult.

The choice of $\sigma_R = 0.75$ was carried over from a previous assessment without discussion. I have no basis to disagree with that choice. However, my evolving thinking is that there must be some relationship between σ_R, M and the perceived curvature in a stock recruitment relationship. I believe there is a need to do analytical/computational work to explore that relationship and to establish best practices for specifying σ_R. Other alternatives for recruitment deviations might be explored, e.g., instead of lognormal σ_R, perhaps, random beta pdf survival models. My thoughts are that many assessments appropriately model dynamics with a null (h=0.999) SR function; thus, the relevant issue becomes σ_R, rather than steepness. In any case, this hypothesis is beyond the scope of this assessment or any individual assessment.

This long discourse on SR relationships is in many ways irrelevant to the current assessment. The STAR Panel and the SSC have been given an HCR by management (presented above) and the goal of the assessment is to get the best estimate of current biomass to plug into that HCR. While I have some trepidations about the timing of density-dependence and the choice of steepness, they are largely unimportant in this assessment. Given the catch history and a $\sigma_R = 0.75$, I suspect that a h=0.999 result would not be very different from the current=0.75 result as indicated in the following figure (Figure 1).
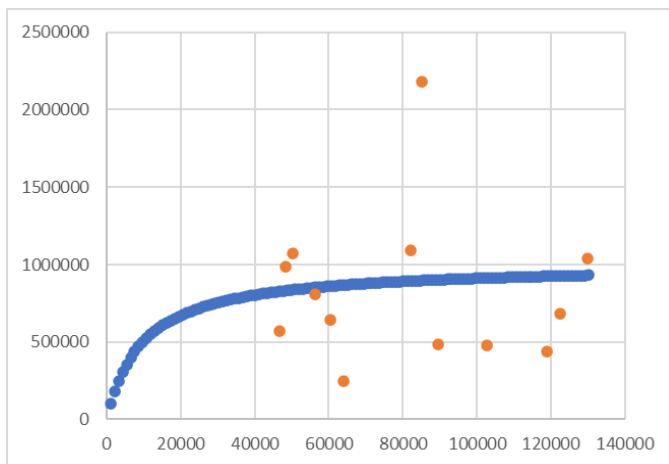

Figure 1: Day 3 base case SR results from Report.sso

Issues of density-dependence relate to status criteria. In this assessment, status criteria are not evaluated since the HCR is fixed and unchangeable at this time. Thus, the SR mortality function becomes unimportant because whatever the underlying density-dependence is, it is adequately approximated by the statistical versions of mortality imposed during age 0 in order to get the biomass estimate. However, if I or the STAR Panel were asked to determine overfishing/overfished criteria based on Fmsy and Bmsy and status, then we would be unable to do so using the current assessment.

Natural Mortality

Natural mortality M at age was based on a Lorenzen curve that relates age-specific M's in a declining function at age where the average M was limited with a diffuse prior with median M=0.675 yr^{-1} and standard deviation 0.31 (Hamel-Hope). Apparently, the estimate of M for Pacific mackerel is larger than the estimate of M for anchovy or sardine.
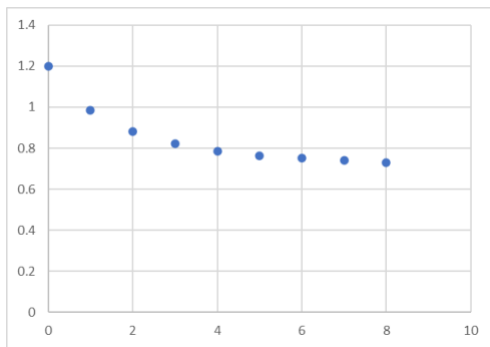

Figure 2: Day 3 base case M at age results from Report.sso

This is perhaps unexpected even though the value for M in this assessment is clearly supported by the few 2+ Pacific mackerel found in the AT survey, which is assumed to have asymptotic selectivity, and the estimate is within the Hamel-Cope prior. I am not convinced that there isn't confounding of the Lorenzen relationship and M in age 0 with the SR function and how that might affect the M of subsequent ages through the Lorenzen model. This may have something to do with the higher perceived M relative to their coastal pelagic species. In any case, future work should explore what is known about M for the similar Coastal Pelagic Species (CPS) and the effect of the SR timing with a view of reflecting this information in future assessments.

Long Term Perceptions of Stock Dynamics

The STAT in this and the previous PMack assessment and subsequently we (the STAR Panel) made the pragmatic decision to focus on the recent era (post 2007) for the assessment, since the goal is the best estimate of current biomass. This was done with the knowledge that assessments have periodically been done since 1990. Issues with missing data and new and evolving data streams led to our (collective) decision. However, there is a downside. Perceptions of the stock-recruitment relationship, the ecological relationship with other species (notably anchovies and sardines) and the natural mortality rate are all limited by focusing on the recent time period. If status criteria are to be revisited or if a control rule has an ecological component to it, then the previous era will probably have to be re-investigated. In the meantime, as a reminder to the SSC and Council, it was suggested that the final reports include the long-term catch history as an indicator of long-term deviations in the dynamics.

Ageing and age-length keys

PMack are routinely aged for samples from the commercial fishery and the AT survey and semi-annual age length keys are constructed (draft assessment document Fig 11). Aging is done by two scientific groups with ageing error vectors estimated based on double read methods. The age-reading error standard deviations differed markedly between the fishery and survey, even for young ages. The Panel was provided with information on the distribution of ages among agers for the survey data, but not for the fishery data. The STAT provided several new figures examining age-reading errors for the fishery data. These figures were provided. Possible reasons for the discrepancy were noted (Table 1).

Table 1: Differences in aging methods between samples collected from the fishery and the survey

Component	Fishery Ageing Data	Survey Ageing Data
Ageing criteria	Same as survey	Same as fishery
Sample selection for Double readings	Every third- fourth Sample	Every trawl
Ageing precision	Up to 75% agreement	Up to 100% agreement
Data used to compute agieng errors	Double readings before 75% agreement	At 100% agreement
Rationale	Not possible to adjust/drop assessment ages after double reading readings	Possible to adjust/drop age after double reading
	Data are not submitted by reader to the assessment	Data are submitted by reader
	Avoid bias in CV	Improved/better precision

However, at present this remains an unresolved issue contributing to the uncertainty.

Selectivity

Age selectivities were estimated for the combined commercial-recreational fishery and for the AT survey. Fishery selectivity was allowed to vary in order to better depict variation in the size frequency data which was a weakness in the previous assessment. A "random walk" was used to establish a selectivity parameter at each age, and then deviations were modeled as autoregressions through time. Alternatives to the reference period at which selectivity was fixed with autoregressive estimates deviating from that period were explored at the meeting by dropping parameters one at a time. The results suggested that the last fishery selectivity be fixed and the Panel supported the change.

AT survey selectivity was age-based and assumed asymptotic and time-invariant with selectivity for age 0 estimated. It was noted that estimating time-variant AT selectivities resulted in biologically unreasonable M estimates. Thus, time-variants were not explored further.

Catchability and the Acoustic Trawl Survey

The primary data for fitting the assessment model was the Acoustic Trawl (AT) Survey and size data from the fishery and Survey. Since the AT provides the scale for estimating current biomass, it was the major focus of the Panel meeting.

The AT Survey has been conducted since 2008 with 2008 and 2012-2021 (excluding COVID year 2020) being used in this assessment. The AT is essentially a survey method that determines density (No./Area) of PMack for AT transects and these are expanded to the total area within a strata. As such, the underlying theory is that the AT is generating estimates of total biomass. However, there are various data and sampling issues (dearth of nearshore sampling, various missing strata, etc.) that has resulted in treating the AT as an index with associated catchabilities. But in this context, even though it is treated as an index, knowing the characteristics of the total biomass approach means that there is some basis for formulating priors on catchability: one would expect that catchability would not be too much less than 1.

However, it is recognized (and evidence presented) that catchability has varied from year to year. The STAT and the STAR Panel spent the majority of the meeting in specifying an estimated suite of catchabilities that appropriately balanced the AT data with the size data to provide a current biomass estimate with adequate precision. (Previous STAR Panels and STATs must have realized the importance of these catchabilities by assigning the notation Upper-case Q, whereas as the rest of us struggle with the lowly lower-case q for our surveys).

The draft assessment document denoted that Q's were estimated in three blocks: 2008-2012, 2013-2015 and 2016-2020 with Q(2021) fixed at 0.357 and used as a prior for the three other blocks. The choice to rely on the 2021 estimate relates to the fact that this year the AT was extended to Mexico. However, the choices, justifications and options for Q were not fully explained or explored prior to the meeting. Therefore, the STAR Panel made a number of requests for STAT to develop alternative approaches for specifying survey Q and allowing for time-variation in survey Q, conduct assessment model runs for each approach, and select the most appropriate parameterization. The STAT provided a detailed review of AT survey coverage as the evidence basis for identifying alternative approaches for specifying survey Q and conducted new assessment model runs for each of the identified approaches. The review revealed variability in the spatial extent of the survey and in the distribution of Pacific mackerel. The survey occurred coastwide in most years but stopped north of Morro Bay during 2012 and 2017 and extended into Baja during 2021. Pacific mackerel were consistently observed off northern California, Oregon, and southern Washington and were regularly observed off southern California. There were often no observations of Pacific mackerel off central California. Results showed that Q could vary over time because of low abundance in patchy distributions; logistical challenges result in implementing a variable survey grid; and/or movement/geographical shifts in distribution along the coast.

Three general methods for handling survey Q in the assessment were identified and evaluated: (1) make survey Q time-invariant; (2) modify the blocking for a time-varying survey Q; and (3) modeling survey Q as deviations. All approaches rely on a survey Q prior based on the 2021 survey, which the STAT rederived as having a mean of 0.309 by dividing the US core biomass by the total US biomass. The STAT arbitrarily assumed a standard deviation of 0.6, which resulted in an uninformative prior for ln Q. Subsequently, this SD was updated based on an associated Monte Carlo experiment leading to a revised standard deviation of the logarithm of survey Q of 0.28. Sensitivities/alternative model structures were explored leading to the proposal of a blocked approach for specifying Q: (1) Q for 2008-2015, the survey years with more uncertainty, is estimated as deviations using the updated Q prior and a SE for survey Q deviations of 0.25; (2) Q for 2016-2019 is estimated using the updated Q prior; and (3) Q for 2021 is fixed at the mean of the Q prior. The resulting model shows a similar trend but slightly higher biomass relative to the original base model. Survey data were well fit and Q estimates were at reasonable values. Thus, this rendition was proposed as the new base model and this was accepted by the Panel.

Final Base Model

The final base model fulfills the goal of a reliable estimate of terminal year biomass to be implemented into the HCR. However, this approach to stock assessment means that estimates of early (pre-2016) biomass are very uncertain and that the future applications of this approach to stock assessment relies on the continuation of the AT survey, and collection and reading of age structures for the fishery and survey. The final base model uses the following specifications:

>Time period from 2008-2021, with projections to 2025.
>Sexes combined and maximum modelled age of 8 years.
>Natural mortality estimated with a diffuse prior with median M=0.675 yr^{-1} and standard deviation 0.31 and a Lorenzen function of age.
>AT survey catchability estimated for 2016-2021 with a prior with mean 0.308 and CV 0.28 and time-varying (deviations) with a standard error is 0.25 for 2008-2015.
>Maturity pre-specified with fecundity based on average weight-at-age.
>Commercial and recreational fisheries combined.
>Empirical weight-at-age.
>Selectivity
    Fishery selectivity: age-based, time-varying, and modelled using a non-parametric base form with random annual and age-based deviates.
    AT survey selectivity: age-based and assumed asymptotic and time-invariant with selectivity for age 0 estimated.
>Virgin recruitment (R_0) estimated; underlying recruitment variability (σ_R) and steepness (h) both set to 0.75.
>Initial equilibrium ("SR regime" parameter) estimated.
>Recruitment deviations estimated from 2008-2021.

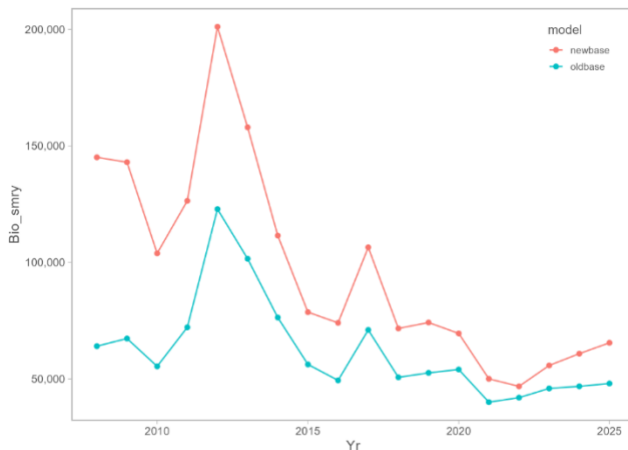The summary biomass of the new base compared to the old base (including projected biomass) is:

Figure 3: Day 3 base case summary biomass

Research Recommendations

Specifying priorities for research recommendations are always nebulous since they always depend on who is spending the money, the negotiation of perceived needs by management and the likelihood of achieving useful outcomes. Therefore, I defer to the Panel members who are more familiar with the PFMC management needs and research framework and, thus, include the prioritized list verbatim that was given in the STAR Panel Report. Several of these items were suggested by me with justifications indicated in the discussions above. Additionally, I have included a research goal in the paragraph beginning "The choice of σ_R = 0.75 was carried over from a previous assessment …" in the discussion section "Harvest Control Rule, Stock-Recruitment and Status Criteria". However, this recommendation is beyond the scope of this individual PMack assessment or of any individual assessment.

High priority research recommendations
    Improve collaboration with fishery researchers from Mexico. As noted in previous assessment reviews, a large fraction of the catch is taken off Mexico, and efforts should be made to obtain length, age, and related biological data from the Mexican fisheries. Inclusion of the AT surveys in the

assessment has increased the need for continued comparable surveys within Mexican waters. This research recommendation was made by the STAR Panel in 2019 and remains a high priority.

Continue to refine indices of abundance. The Panel agrees that the AT survey remains an appropriate method to index the abundance of Pacific mackerel. However, there are several issues that still need to be addressed *as per* the reviews of the AT survey in 2011 (PFMC 2011) and in 2018 (PFMC 2018). Some of the recommendations from those reviews have been implemented (e.g., Zwolinski and Demer, 2014). The following are a subset of tasks to better realize the potential of the AT survey for Pacific mackerel:

> Trawl sampling during the day to address the potential for differences in fish represented by the signal from the acoustic sampling during the day versus trawl sampling at night to capture the species, length, and age compositions of the sampled fish.

> Refine the target strength estimates for Pacific mackerel.
> Provide separate estimates of age-0 and age-1+ Pacific mackerel biomass from the AT survey. There appears to be more uncertainty in the enumeration of age-0 mackerel than of other age classes due to the spatial distribution and age-specific selectivity patterns.

> Investigate the spatial distribution, especially the range, of the Pacific mackerel population over time and whether this changes with population size and/or environmental conditions. In particular, an environmentally-based index of spatial distribution might prove useful for developing priors for AT survey catchability for use in future assessments.

Improve collection of age data, coordination of ageing laboratories, and cross validation efforts to standardize reads between laboratories and develop bias adjustments.

> Increase support for current port sampling and laboratory analysis programs for CPS, particularly in the Pacific Northwest. Biological (e.g., length, age, sex) data on mackerel caught in the Pacific Northwest should be collected. These data could further assist in understanding whether and to what extent selectivity for the commercial fishery is dome-shaped. The aging of Pacific sardine in the Pacific Northwest should be coordinated with laboratories conducting ageing in California. The next assessment should include a section on recent information regarding biological data for the Pacific northwest.

> Analysis of data from the multistage approach to age/length composition sampling has indicated that most of the variability occurs between commercial trips as opposed to replicate sampling of a landing within a landing. The number of trips sampled is relatively low due to the infrequent fishing, and need to coordinate sampling with industry to increase the effective sample size. Many samples from the Pacific Northwest have not been processed and should be aged with methods consistent with those currently employed by the CDFW from the commercial fishery.

Revisit the harvest control rules and reference points for Pacific mackerel. The basis for the current harvest cutoff is derived from analyses performed by MacCall et al. (1985) over 30 years ago using data, biological assumptions (e.g., about selectivity and natural mortality), and methods (virtual population analysis) that are not reflected in the current stock assessment. If the underlying data and assumptions used by MacCall et al. (1985) are no longer considered relevant to the current population, it is likely time to revise the scientific basis for these reference points.

Refine the approach to quantifying age-reading error for the next stock assessment so that estimates

of age-reading error are based on analysis of all available data on double-reads of otoliths. Consideration should be given to age-reading error matrices by the reader.

Medium priority

Apply the state-space approach developed by Jim Ianelli for computing weight-at-age and quantifying uncertainty.

Develop a fecundity-weight relationship and include it in future assessments.

Further explore reasons for variability in survey Q.

Further explore spatial variability as it relates to stock structure and management.

Explore what is known about M for the full suite of Coastal Pelagic Species (CPS) with a view of reflecting this information in future assessments.

Low priority

Explore the feasibility of modeling non-landed mortalities of sublegal-sized fish in the Mexican fishery.

TORs
TOR 1. The CIE reviewer is one of the four equal members of the STAR panel. The principal responsibilities of the STAR Panel are to review stock assessment data inputs, analytical models, and to provide complete STAR Panel reports.

As a participant and STAR Panel member, I reviewed the assessment and supporting documents presenting data inputs and analytical models and I contributed to the writing, review and consensus development of the STAR Panel Report which has since been passed on the PFMC staff. I'd like to believe I performed as an equal member of the STAR Panel, but that is for others to judge.

TOR2. Along with the entire STAR Panel, the CIE Reviewer's duties include: 1) reviewing draft stock assessment and other pertinent information (e.g.; previous assessments and STAR Panel reports); 2) working with STAT Teams to ensure assessments are reviewed as needed; 3) documenting meeting discussions; 4) reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the Stock Assessment and Fishery Evaluation (SAFE) document; 5) recommending alternative methods and/or modifications of proposed methods, as appropriate during the STAR Panel meeting, and 6) the STAR Panel's terms of reference concerning technical aspects of stock assessment work. The STAR Panel should strive for a risk neutral approach in its reports and deliberations.

As a participant and STAR Panel member, I: 1) reviewed the draft stock assessment and other pertinent information including previous assessments and STAR Panel Reports; 2) I worked with the STAT and other STAR Panel members to ensure the assessment was reviewed as needed; 3) the meeting discussions were documented in the completed STAR Panel Report to which I contributed; 4) I reviewing summaries of stock status analyses prepared by the STAT integration into the SAFE document; 5) I, and, collectively, the STAR Panel recommended alternative methods/model structures as appropriate during the STAR meeting and, as noted above, this led to base model modifications as well as suggestions to strengthen the final assessment report; and 6) I and the Star Panel addressed only technical aspects of the stock assessment work striving to risk-neutral in our approach.

TOR3. The STAR Panel, including the CIE Reviewer, is responsible for determining if a stock assessment or technical analysis is sufficiently complete. It is their responsibility to identify assessments that cannot be reviewed or completed for any reason. The decision that an assessment is complete or not shall be made by the reviewer. If agreement among the four review panel members cannot be reached, then the nature of the disagreement must be described in the Panels' and CIE Reviewer's reports.

As a participant and STAR Panel member, it is my scientific opinion that the PMack assessment as modified by us (STAR Panel and STAT) and the technical analyses supporting it are sufficiently complete for submission to the SSC for their mandate to provide harvest guidelines to the PFMC. As indicated in the Panel Report, there was no disagreement of the Panel on this issue.

TOR4. The review solely concerns technical aspects of stock assessment. It is therefore important that the Panel strive for a risk neutral perspective in its reports and deliberations. Assessment results based on model scenarios that have a flawed technical basis, or are questionable on other grounds, should be identified by the Panel and excluded from the set upon which management advice is to be developed. The STAR Panel should comment on the degree to which the accepted model scenarios describe and quantify the major sources of uncertainty 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.

I am sure that the review solely concerned technical aspects of this stock assessment and that the Panel strived for a risk-neutral perspective in its report and deliberations. Several model structures (scenarios) were identified that were not well justified and supported by the data and thus, alternative structures were suggested, analytically evaluated and then implemented into the final model and identified as the set of information upon which management advice is to be developed.

The accepted model scenarios describe and quantify the major sources of uncertainty and confidence intervals of indices and model outputs through the standard errors generated through SS3 and through the externally estimated input data. These were included in the draft assessment report and will be in the final assessment report, as well. These will be useful to the SSC when generating management advice. However, as noted extensively in the discussions above, certain parameters are fixed and others are allowed to be relatively imprecise in the attempt to reach the overall goal of an estimate of current biomass with appropriate accuracy and an appropriate estimate of precision.

TOR5. Recommendations and requests to the Stock Assessment Team (STAT) 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 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's and Panel's responsibility to carry out any follow-up review of work that is required.

The STAR Panel Report lists 15 requests for further explanations and further analyses explicitly providing the request, the rationale for the request and the response to that request that were provided over the course of the 3-day meeting. These analyses allowed the Panel and STAT to formulate a new base model for the final assessment report. The specifications of this base model are outlined in the section entitled *3) Technical Merits and/or Deficiencies of the Assessment* of

the Star Panel Report. Additionally, specifications that the Panel wishes to be included in the Final Assessment report were given, as was prioritized research recommendations. These aspects were noted in the discussions above. The STAR Panel report has been completed and has been passed to PFMC staff.

Conclusions and Recommendations

The NMFS review process relies on the cooperation of STAR Panel members and STAT analysts to be responsive to suggestions and capable of providing short term analyses. The STAR Panel and I thank the STAT for their hard work and willingness to respond to Panel requests, and the staff at the SWFSC La Jolla Laboratory for their usual exceptional support and provisioning during the STAR meeting. The STAR meeting structure worked well. I also would remind that with the resumption of in-person meetings, a lot more was accomplished in three days than would have been accomplished in a WEBEX meeting.

The Pmack assessment as modified through the STAR Panel Review represents the best scientific data and modeling approach for providing the necessary inputs to the PFMC control rule. However, this stock (as with most coastal pelagics) is characterized by high volatility, high M, high sigma R and large variability in catchability. Thus, the need for further data collection particularly for biomass surveys is paramount.

Given the current management regime the stock appears to have been maintained at appropriate levels. However, status criteria related to the HCR are decades old, and are in need of revisiting. This implies that a more wholistic view of the assessment process should be explored in the future including long-term changes in M, the stock-recruitment function and the long-term relationship with other coastal pelagics, rather than just focusing on the current biomass estimate. Nevertheless, the current assessment approach adequately addresses the immediate management needs.

Appendix 1: Bibliography of materials provided for review

Crone, P.R., Hill, K.T. Zwolinski, J.P., and Kinney, M.J. 2019. Pacific mackerel (*Scomber japonicu*s) stock assessment in the 2019-20 and 2020-21 fishing years. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR, 97220 OR.

Dickerson, T.L., Macewicz, B.J., and Hunter, J.R. 1992. Spawning frequency and batch fecundity of chub mackerel, *Scomber japonicus*, during 1985. *CalCOFI Reports* 33: 130–140.

Farrag, M.MS, Ismail, R.F., El-Haweet, A.A.K., Abdel Fattah, M., and Oman, A.G.M. 2022. Reproductive parameters of the chub mackerel, *Scomber japonicus* (Houttuyn, 1782) from the East Mediterranean Sea, Egypt. *Iranian Journal of Ichthyology* 9.2: 96-110.

Hamel, O.S., and Cope, J.M. 2022. Development and considerations for application of a longevity-based prior for the natural mortality rate. *Fisheries Research* 256: 106477

Hill, K.T. and J. P. Zwolinski. 2021. Pacific mackerel (Scomber japoicus) catch-only stock assessment for U.S. management in the 2020-21and 2022-23 fishing years. Pacific Fishery Management Council. 7700 NE Ambassador Place, Suite 101, Portland, OR, 97220 OR.

MacCall, A.D., Klingbeil, R.A. and Methot, R.D. 1985. Recent increased abundance and potential productivity of Pacific mackerel *Scomber japonicus*. *CalCOFI Reports* 18: 136–148Palance, D.G., Macewicz, B.J., Stierhoff, K., Demer, D.A., and Zwolinski, J.P. 2019. Length conversions and mass–length relationships of five forage-fish species in the California current ecosystem. *Journal of Fish Biology* 95(4): 1116–1124.

PFMC. 2011. Acoustic-Trawl Survey Method for Coastal Pelagic Species Report of Methodology Review Panel Meeting. Agenda Item C.3a Attachment 1, April 2011.

PFMC. 2018. Methodology review panel report: acoustic trawl methodology review for use in coastal pelagic species stock assessments. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR, 97220 OR. Agenda Item C.3, Attachment 2, April 2018. 75 p.

Yoneda, M., Kitano, H., Myuji, M., Nakamura, A., Matsyama, M., Shimizu, A., Tsuzaki, T., Togashi, H. and Kamimura, Y. 2022. Maternal spawning experience and thermal effects on offspring viability of chub mackerel and their influence on reproductive success. *Frontiers in Marine Science* 9: 2701.

Zwolinski, J., and Demer, D. 2014. Progress related to the recommendations from ATM survey review. Appendix 3 of the Pacific Sardine STAR Panel Meeting Report, Agenda Item H.1a Attachment 3, April 2014.

Appendix 2:   Performance Work Statement

<div align="center">

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

STAR Panel Review of the 2023-24 Pacific Mackerel Stock Assessment

April 11-13, 2023

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Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1].

Scope

The CIE reviewer will serve on a Stock Assessment Review (STAR) Panel and will be expected to participate in the review of Pacific mackerel stock assessment. The Pacific mackerel stock is assessed regularly (currently, every 3 years) by SWFSC scientists and the Pacific Fishery Management Council (PFMC) uses the resulting biomass estimate to establish an annual harvest guideline (quota). The stock assessment data and model are formally reviewed by a Stock Assessment Review (STAR) Panel once every three years, with a coastal pelagic species subcommittee of the SSC reviewing updates in interim years. Independent peer review is required by the PFMC review process. The STAR Panel will review draft stock assessment documents and any other pertinent information for Pacific mackerel, work with the stock assessment teams (STAT) to make necessary revisions, and produce a STAR Panel report for use by the PFMC and other interested persons for developing management recommendations for the fishery.

The PFMC's Terms of Reference (ToRs) for this STAR Panel review are attached in Appendix 1. The tentative agenda of the Panel review meeting is attached in Appendix 2. Finally, a Panel summary report template is attached as Appendix 3.

Requirements

One CIE reviewer shall participate during a panel review meeting in La Jolla, California during 11-13 April, and shall conduct an impartial and independent peer review accordance with this Performance Work Statement (PWS) and ToRs herein. The CIE reviewer shall have the expertise as listed in the following descending order of importance:

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[1] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

- The CIE reviewer shall have expertise in the design and application of fishery-independent surveys for use in stock assessments, particularly, hydro-acoustic surveys for coastal pelagic fishes, such as mackerel spp., sardine spp., and anchovy spp;
- The CIE reviewer shall have expertise in the application of fish stock (population) assessment methods, particularly, age-structured population modeling approaches, e.g., 'forward-simulation' models (such as Stock Synthesis, SS) and to a lesser extent, familiarity in 'backward-simulation' models (such as Virtual Population Analysis, VPA);
- The CIE reviewer shall have expertise regarding life history strategies and population dynamics of coastal pelagic fishes; and
- It is desirable for the CIE reviewer to be familiar with stock assessment development/modeling for regularly advising resource management bodies, i.e., management vs. research models.

The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review process. Additionally, the Chair, who is in addition to the CIE reviewer, will also be participating in this review. However, the Chair's participation (e.g., labor and travel) is not covered in any way by this task order.

Tasks for Reviewer
- Review the following background materials and reports prior to the review meeting: *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 reviewer all 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 on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review, for example:*

  - *Recent stock assessment documents since 2019;*
  - *STAR Panel- and SSC-related documents pertaining to reviews of past assessments;*
  - *CIE-related summary reports pertaining to past assessments; and*
  - *Miscellaneous documents, such as ToR and logistical considerations.*

  Pre-review documents will be provided up to two weeks before the review, scheduled for April 11-13, 2022. Any delays in submission of pre-review documents for the CIE review will result in delays with the CIE peer review process, including a PWS modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewer is responsible only for the pre-review documents that are delivered to the reviewer in accordance to the PWS scheduled deadlines specified herein.
- Attend and participate in the panel review meeting.
  - The meeting will consist of presentations by the STAT and other collaborators (biologists, researchers, etc.) to facilitate the review, provide any additional information required by the reviewers, and answer any questions from reviewers.
- After the review meeting, reviewer shall conduct an independent peer review in accordance with the requirements specified in this PWS, OMB guidelines, and ToRs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.
- Each reviewer shall assist the Chair of the meeting with contributions to the summary report, if required by the ToRs.
- Deliver their reports to the Government according to the specified milestone dates.

Foreign National Security Clearance
When a given reviewer participates during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for the reviewer who is a non-US citizen. For this reason, the reviewer 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/ and
http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance
The place of performance shall be at the contractor's facilities, and at the Southwest Fisheries Science Center in La Jolla, California.

Period of Performance
The period of performance shall be from the time of award through June 30, 2023. The reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables
The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Schedule	**Milestones and Deliverables**
Within two weeks of award	Contractor selects and confirms the reviewer.
Two weeks prior to the panel review	Contractor provides the pre-review documents to the reviewer.
April 11-13, 2023	The reviewer participates and conducts an independent peer review during the panel review meeting.
Within two weeks after the panel review meeting	Contractor receives the draft report.
Within three weeks of receiving the draft reports	Contractor submits final reports to the Government.

Note: The Chair's Summary Report shall not be submitted to, reviewed, or approved by the Contractor.

Modifications to the Performance Work Statement
The reviewer shall write an individual review report in accordance with the PWS, OMB Guidelines, and the ToRs below. Modifications to the PWS and ToRs cannot be made during the peer review, and any PWS or ToRs modifications prior to the peer review shall be approved by the Contracting Officer's Representative (COR) and the CIE contractor. The PWS and ToRs shall not be changed once the peer review has begun.

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards:
(1) The report shall be completed in accordance with the required formatting and content (2) The report shall address each ToR as specified (3) The report shall be delivered as specified in the schedule of milestones and deliverables.

Travel

All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $3,000.00.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact

Kevin Hill
NOAA Fisheries, Southwest Fisheries Science Center
Fisheries Resources Division
8901 La Jolla Shores Drive, La Jolla, CA 92037-1509
kevin.hill@noaa.gov

Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether or not the science reviewed is the best scientific information available.

2. The report must contain a background section, description of the individual reviewers' roles 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 must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.

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

   c. Reviewers shall elaborate on any points raised in the summary report that they believe 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 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 report shall represent the peer review of each ToR, and shall not simply repeat the contents of the summary report.

3. The report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of this Statement of Work
   Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Appendix 1: Terms of Reference for the Peer Review of the Pacific Mackerel stock assessment

The CIE reviewer is one of the four equal members of the STAR panel. The principal responsibilities of the STAR Panel are to review stock assessment data inputs, analytical models, and to provide complete STAR Panel reports.

Along with the entire STAR Panel, the CIE Reviewer's duties include:

1. Reviewing draft stock assessment and other pertinent information (e.g.; previous assessments and STAR Panel reports);
2. Working with STAT Teams to ensure assessments are reviewed as needed;
3. Documenting meeting discussions;
4. Reviewing summaries of stock status (prepared by STAT Teams) for inclusion in the Stock Assessment and Fishery Evaluation (SAFE) document;
5. Recommending alternative methods and/or modifications of proposed methods, as appropriate during the STAR Panel meeting, and;
6. 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.

The STAR Panel, including the CIE Reviewer, is responsible for determining if a stock assessment or technical analysis is sufficiently complete. It is their responsibility to identify assessments that cannot be reviewed or completed for any reason. The decision that an assessment is complete or not shall be made by the reviewer. If agreement among the four review panel members cannot be reached, then the nature of the disagreement must be described in the Panels' and CIE Reviewer's reports.

The review solely concerns technical aspects of stock assessment. It is therefore important that the Panel strive for a risk neutral perspective in its reports and deliberations. Assessment results based on model scenarios that have a flawed technical basis, or are questionable on other grounds, should be identified by the Panel and excluded from the set upon which management advice is to be developed. The STAR Panel should comment on the degree to which the accepted model scenarios describe and quantify the major sources of uncertainty 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.

Recommendations and requests to the Stock Assessment Team (STAT) 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 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's and Panel's responsibility to carry out any follow-up review of work that is required.

Tuesday, 11 April

08h30	Call to Order and Administrative Matters	
	Introductions	Punt
	Facilities, e-mail, network, etc.	Yau
	Work plan and Terms of Reference	Doerpinghaus
	Report Outline and Appointment of Rapporteurs	Punt
09h00	Pacific mackerel survey-based assessment presentation	Kuriyama/Hill/Zwolinski
10h00	Break	
10h30	Pacific mackerel model-based assessment presentation	Kuriyama/Hill/Zwolinski
11h30	Acoustic-trawl survey operations and data	Zwolinski
12h00		
12h30	Lunch	
13h30	Pacific mackerel assessment presentation (continue)	Kuriyama/Hill/Zwolinski
14h30	Panel discussion and analysis requests	Panel
15h00	Break	
15h30	Public comments and general issues	
17h00	Adjourn	

Wednesday, 12 April

08h00.	Assessment Team Responses	Kuriyama/Hill/Zwolinski
10h30	Break	
11h00.	Discussion and STAR Panel requests	Panel
12h30	Lunch	
13h30	Report drafting	Panel
15h00	Break	
15h30	Assessment Team Responses	Kuriyama/Hill/Zwolinski
16h30	Discussion and STAR Panel requests	
17h00	Adjourn	

Thursday, 13 April

08h00.	Assessment Team Responses	Kuriyama/Hill/Zwolinski
10h30	Break	
11h00.	Discussion and STAR Panel requests	Panel
12h30	Lunch	
13h30	Finalize STAR Panel Report	Panel
15h00	Break	
15h30	Finalize STAR Panel Report	Panel
17h00	Adjourn	

Appendix 3: STAR Panel Summary Report (Template)

- Names and affiliations of STAR Panel members

- List of analyses requested by the STAR Panel, the rationale for each request, and a brief summary the STAT responses to each request

- 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 (including concerns raised by the CPSMT and CPSAS representatives)
  - 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, etc.

- Management, data or fishery issues raised by the public and CPSMT and CPSAS representatives during the STAR Panel

- Prioritized recommendations for future research and data collection

Appendix 3: Panel membership or other pertinent information from the panel review meeting Pacific Mackerel STAR Panel April 2023

Name	Affiliation
Stock Assessment Review Panel	
André Punt	SSC/University of Washington, Chair
Tien-Shui Tsou	SSC/WDFW
Christopher Free	SSC/University of California, Santa Barbara
Joseph Powers	CIE
Advisers	
Mark Fina	CWPA, CPSAS
Lisa Hillier	WDFW, CPSMT
Stock Assessment Team	
Peter Kuriyama	SWFSC
Juan Zwolinski	University of California Santa Cruz / SWFSC
Kevin Hill	SWFSC
Caitlin Allen Akselrud	SWFSC
Other attendees (in person)	
Jessi Doerpinghaus	PFMC
Chales Hinchliffe	SWFSC / University of California, Santa Cruz
Brad Erisman	SWFSC
Josh Lindsay	NMFS WCR
Emmanis Dorval	SWFSC, Lynker
Trung Nguyen	CDFW, CPSMT
Briana Brady	CDFW
Steve Crooke	CPSAS
Kelsey James	SWFSC
Huihua Lee	SWFSC
Annie Yau	SWFSC
Brittany Schwartzkopf	SWFSC, CPSMT
James Hilger	SWFSC
Steve Teo	SWFSC
Kelsey James	SWFSC
Owyn Snodgrass	SWFSC
Online	
Kirk Lynn	CPSMT/CDFW
Alan Byrne	IDFG, SSC
Alan Sarich	Quinault Indian Nation, CPSMT
Diana Porzio	CDFW
Fabio Caltabaellotta	FSUCML, WDFW
Jason Schaffler	SSC
Lynn Mattes	ODFW
Mike Okoniewski	CPSAS
Taylor Debevec	NMFS, CPSMT
Marlene Bellman	PFMC
Kirk Lynn	CDFW, CPSMT
Jon Walker	SWFSC, UC Santa Criz
Michelle Horeczko	CDFW
Will Satterthwaite	SWFSC, SSC

CDFW = California Department of Fish and Wildlife
CIE = Center of Independent Experts
CPSAS = Coastal Pelagic Species Advisory Subpanel
CPSMT = Coastal Pelagic Species Management Team
FSUCML = Florida State University
IDFG = Idaho Fish and Game
NMFS WCR = National Marine Fisheries Service West Coast Region
NWFSC = Northwest Fisheries Science Center
PFMC = Pacific Fishery Management Council
SSC = Scientific and Statistical Committee
SWFSC = Southwest Fisheries Science Center