External Independent Peer Review by the Center for Independent Experts (CIE)

Central Subpopulation of Northern Anchovy Assessment

Online meeting

December 7-10, 2021

National Oceanic and Atmospheric Administration (NOAA)

National Marine Fisheries Service (NMFS)

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Executive Summary

The Stock Assessment and Review (STAR) Panel met online from December 7-10, 2021, to review a draft assessment by the Stock Assessment Team (STAT) for the central subpopulation of Northern Anchovy (CSNA). Introductions were made and the agenda was adopted. A draft assessment document and background materials were provided to the Panel about 2 weeks in advance of the meeting on a Google Drive website. The online meeting was at times very well attended with up to 53 participants. On average there were about 30 participants.

Peter Kuriyama presented the assessment and provided information about the alternative indices of abundance, Juan Zwolinski overviewed the Acoustic Trawl (AT) Method survey, and Emmanis Dorval and Brad Erisman summarized how the age-reading error matrices and maturity ogives were estimated. Kirk Lynn (CDFW) summarized the results of recent aerial surveys for CSNA.

The proposed base model in the draft assessment provided to the Panel was based on the Stock Synthesis Assessment Tool v3.30.17. It aimed to estimate current 1+ biomass using the data source the STAT considered most reliable, the acoustic trawl (AT) survey. Consequently, the assessment started in 2015, the first year for which estimates of biomass for the CSNA are available from the AT survey (earlier surveys took place but no estimates of anchovy biomass as it was targeted towards hake and sardine). In addition to fitting to a biomass index data from the survey, the assessment also fitted age-composition data from two fisheries MexCal S1 and MexCal S2, and the AT survey. Compared to the huge increase in stock size in recent years the fishery is very small (only about 1% of the stock is caught per year). The assessment pre-specified weight-at-age rather than estimating from a parametric growth curve and allowed for time-variation. The assessment also allowed for time variation in selectivity of the fishing fleets and for the age-0 in the AT survey.

There are also two other fishery independent surveys that provide relevant information about the stock. The Rockfish Recruitment and Ecosystem Assessment Survey (RREAS) in late spring gives relative abundance indices of all anchovy biomass, adult (age 1+) anchovy biomass and young-of-the-year (age 0) abundance from 2004 through 2021. The California Cooperative Oceanic and Fisheries Investigations (CalCOFI) has each annual cycle four seasonal surveys and provide indices of egg and larvae abundance from 2000 to 2019. All four indices where quite consistent with the AT survey in signaling a low stock until 2015 and a steep increase since then. Thus, these are potentially useful time series which in the future should not be overlooked, but further developed and improved in relation to the CSNA assessment.

It was noted that Council has adopted a new assessment framework, which requires an average estimate of 1+ biomass for the most recent ten years and an estimate of the exploitation rate on 1+ biomass corresponding to MSY (e.g., EMSY). Because the stock was very small between 2010 and 2015 a ten-year mean is by far most dependent on the recent years which are the years considered in the assessment, 2015-2021. We calculated a 10-year mean of age-1+ biomass using all available years (2015-2021) from the new tentative base assessment model and each of three options for setting age-1+ biomass for years before 2015: (a) zero, the estimate of age-1+ biomass for 2015, and 1.5x the estimate of age-1+ biomass for 2015. The three mean biomasses are: 567554 t, 574997 t, and 578719 t, respectively.

Panel discussion focused on specification of the AT survey catchability (Q), selectivity-at-age (which varied considerably from one year to the next), whether the very high fishing mortality rates for some fisheries and seasons were plausible, ageing quality and specification of age-reading matrices, and whether the results of 2015 AT survey (which appear to be much lower for ages 1 and older than expected given the subsequent

surveys) should be included in the assessment. Also, the stock definition and its scientific basis was discussed and well as other future research needs. The Panel made a quite large number of requests for alternative assessments runs to the Assessment Team (see below).

Ecosystem and multispecies models to inform about natural mortality seems to be lacking from the California Pacific ecosystem. For the future an unbiased and verified age determination seems to be the most important issue for a robust estimation of natural mortality.

Density dependent growth, maturity and natural mortality might be difficult to get at when age determination is uncertain. However, there were indications that maturity at age was substantially lower in 2021 than in 2017 for ages 0 and 1. The stock was an order of magnitude larger in 2021 than in 2017. There were no maturity data from other years. It is of course a question of how much information one can extract from only two years of data. But maybe the 0-hypothesis should be that density dependence always exists and it is better to include it in the modelling than ignore it. This is especially relevant in this case when the magnitude of change in stock size is so large that it seems likely judged from what is seen in other fish stocks, that density dependence could be measurable. However, more data years would be good to have for such an endeavor.

The Panel concluded that a model slightly modified from the STAT Teams suggestion does reflect the current stock dynamics relatively well. The modifications were: Q changed to take account of the area not sampled by the core AT survey, age reader 15 removed, use of an age 3 + group instead of age 4+, selection pattern option changed to one less variable by year, and a preliminary AT summer 2021 survey index included. The resultant current stock size (1 June 2021) was around 2.0 million t of age1+, increasing steadily from a stock size on 1 June 2015 of less than 0.1 million t. This was due to very high recruitment in recent years.

The strength of the assessment was the fisheries independent information from the acoustic survey and supported by that from independent egg and larvae surveys and an independent trawl survey. All sources agreed that the stock was low from 2000 to about 2015 and that it increased very substantially after that.

A weakness was that age-determinations are quite uncertain, but improvements are well under way with good quality control systems, training samples, and ideas for new ways of determining ages not so dependent on subjective judgments by human otolith readers. The assumption of Q=1 for the area covered by the AT survey, is also a weakness as there are many possible reasons why this could be different from 1, as highlighted by the review carried out in 2018 of the AT survey.

The assessment lived up to the demand for being based on best available science and was risk neutral.

The STAT teams are commended for their hard work and willingness to respond to the Panel's many requests. My fellow Panel members and the public are commended for very open-minded, constructive, risk neutral, and highly competent discussions.

Background

The National Marine Fisheries Service (NMFS) is mandated to conserve, protect, and manage USA's marine living resources based upon the best scientific information available (BSIA). Assessments for this stock will provide the basis for the management of the groundfish fisheries off the U.S. west coast, providing scientific basis for setting Overfishing Limits (OFLs) and Acceptable Biological Catches (ABCs) as mandated by the Magnuson-Stevens Act.

NMFS science products, including scientific advice often require scientific peer reviews that are strictly independent of all outside influences. The present meeting was such a review process. It took place during a formal, public, multiple-day virtual meetings of fishery stock assessment experts.

As a CIE reviewer I participated in the review of the Central Sub-Stock of Northern Anchovy (CSNA) assessment. The CSNA has not been assessed recently. The commercial landings have been low since a reduction fishery in the 1980s and 1990s was shut down. The CSNA stock is currently monitored by SWFSC scientists, and the Pacific Fishery Management Council (PFMC). The stock assessment data and model were formally reviewed by the STAR Panel with a coastal pelagic species subcommittee of the SSC. The resulting biomass estimate will be used to compare the efficacy of the current harvest guideline and other potential management recommendations.

The STAR Panel reviewed draft stock assessment documents and any other pertinent information for CSNA, worked with the stock assessment teams to make necessary revisions, and produced a STAR Panel report for use by the PFMC and other interested persons for developing management recommendations for the fishery.

All relevant documentation was made available on a cloud drive two weeks before the meeting. The first two days were spent on presentations and a first discussion of the assessment. The panel recognized the tremendous amount of effort by scientist staff in preparing the assessment and by fishers, observers, managers, and scientists regarding data collection and filtering. Both the documentation and the presentations were of a very high quality. The additional analysis requested by the panel during the meeting were done very effectively and in a very competent way.

Plenary virtual meetings were held all days between 08:30 and 17:00 San Diego time (equal to 17:30 - 02:00 Central European time). Participants worked solo outside this time window. The assessment team participated all time at the plenary and worked with the requests put forward by the Panel inside and outside this time window. All answers were presented during the meeting except a few ones which was made after the end of the online meeting.

The Panel discussed the assessment materials in the context of the terms of reference provided for this review.

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

I read the material posted before the meeting and prepared my key questions to the assessments. I participated in all the plenary meetings from Tuesday morning 08:30 to Friday afternoon 15:00 when the meeting ended (San Diego time). There were good opportunities to discuss the questions as well as the

questions from the other panel members. I put forward a few requests to the assessors like done also by the other panel members and we agreed a final list of requests each day. The same or next day we got the answers back from the stock assessment staff, and these were then discussed and concluded upon. After the meeting I prepared the present report. I also participated in drafting the Panel report of the meeting until the deadline of the present report, 24 December 2021.

Summary of Findings for each ToR for Central Subpopulation of Northern Anchovy Assessment.

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

The terms of reference were:

Ad 1. Along with the entire STAR Panel, I reviewed the draft stock assessment report, a previous assessment in 1995, reports of the AT survey and its review in 2011 and 2018, reports of the Rockfish Recruitment and

Ecosystem Assessment Survey (RREAS), and reports of the California Cooperative Oceanic and Fisheries Investigations (CalCOFI).

Ad 2-5. Along with the entire STAR Panel, I worked with the STAT teams to ensure that assessments are reviewed as needed, we documented the meeting discussions (see extracts below of requests from the Panel to the STAR Teams and the STAR teams answers), and recommended alternative methods and modifications of proposed methods, as appropriate during the STAR Panel meeting.

Ad 6. We were focused on technical aspects of stock assessment work. We strived for a risk neutral approach and my judgement is that we were very successful in this. Not a single time during our discussions did I hear an argument like that "…we should do this or that because it is more precautionary…." or the other way around.

It is the first time in 25 years this stock is assessed. The assessment presented was an impressive collaboration between assessment modelers and data providers from acoustic surveys, egg and larvae surveys, bottom trawl surveys, new aerial surveys to monitor anchovy very coastal, and fisheries data. The assessment report documented very well what was done. It is clear that because of the enormous increase in stock size and the very limited catch in recent years, the estimate of the present stock situation in highly dependent on the acoustic survey.

The proposed base model in the draft assessment provided to the Panel was based on the Stock Synthesis Assessment Tool v3.30.17. It aimed to estimate current 1+ biomass using the data source the STAT considered most reliable, the acoustic trawl (AT) survey. Consequently, the assessment started in 2015, the first year for which estimates of biomass for the CSNA are available from the AT survey (earlier surveys took place but no estimates of anchovy biomass as it was targeted towards hake and sardine). In addition to fitting to a biomass index data from the survey, the assessment also fitted age-composition data from two fisheries MexCal S1 and MexCal S2, and the AT survey. Compared to the huge increase in stock size in recent years the fishery is very small (only about 1% of the stock is caught per year). The assessment pre-specified weight-at-age rather than estimating from a parametric growth curve and allowed for time-variation. The assessment also allowed for time variation in selectivity of the fishing fleets and for the age-0 in the AT survey.

The Panel discussed every bit of the assessment and found that it generally lived up to the demand for being based on the best available science. We requested many points to be investigated at the meeting and formulated in writing 32 requests to the STAT team. They answered these very well during the meeting and a few ones after the meeting. When writing this CIE report, one issue was not yet completely answered, and it concerned the overlap in time and space between the AT core area survey, the AT coastal survey, and the arial survey and how best to accommodate this in the assessment. All requests and answers will be published in the Panel's final report.

I find that all points were dealt with in a very balanced, scientific, risk neutral, and constructive way. I don't think that I ever have been so much in line with all that were decided by the Panel, as in this review.

Below, I go through the most important issues at the meeting.

The age determination of anchovy is difficult and there is no long tradition or experience to build on, or at least, there have been a long period where age determinations were not done on a major scale. There is little biological difference (e.g., expected length) between age-3 and age-4 fish, aging errors are greater at the older ages, and age-4 fish appear to be rare. Therefore, a sensitivity analysis, showing the results of starting the plus group at age-3 rather than age-4 were done. The time series comparing age-0+ and age-1+ biomass, selectivity and fishing mortality for the two models is shown in Figure 1.

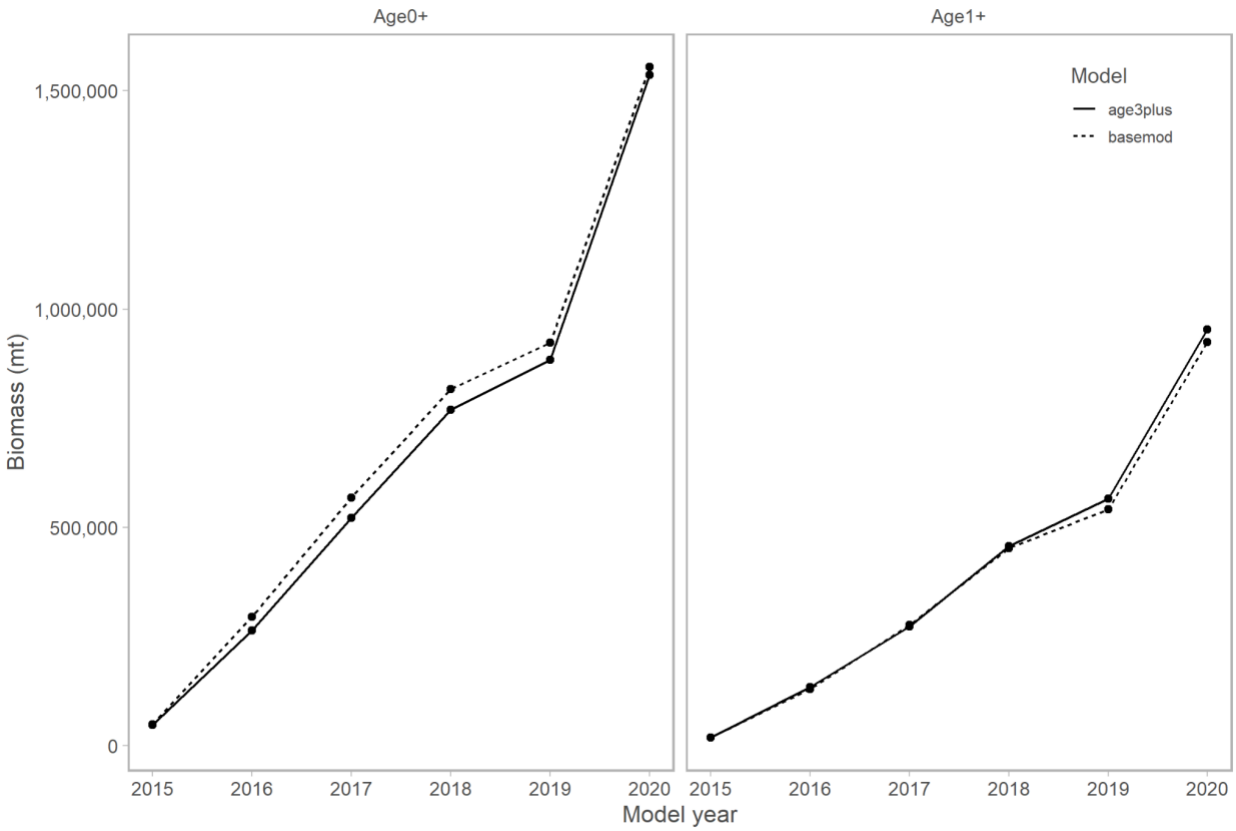

Figure 1: Time series comparing age-0+ and age-1+ biomass, selectivity and fishing mortality

It was agreed to move to a model based on a plus-group at age 3+.

It furthermore seemed that one age reader where especially out of synchrony with the two other readers. The STAT updated the age-reading matrices excluding the data for "reader 15", which led to much smaller (and more realistic) estimates of age-reading standard deviation. A model run based on the updated age-reading error matrices shows little effect of changing the age-reading error matrices on the time-trajectory of age-1+ biomass (see Figure 2 where "ageingerror" is the run without age "reader 15"). Fits to survey and fishery age data were also similar.

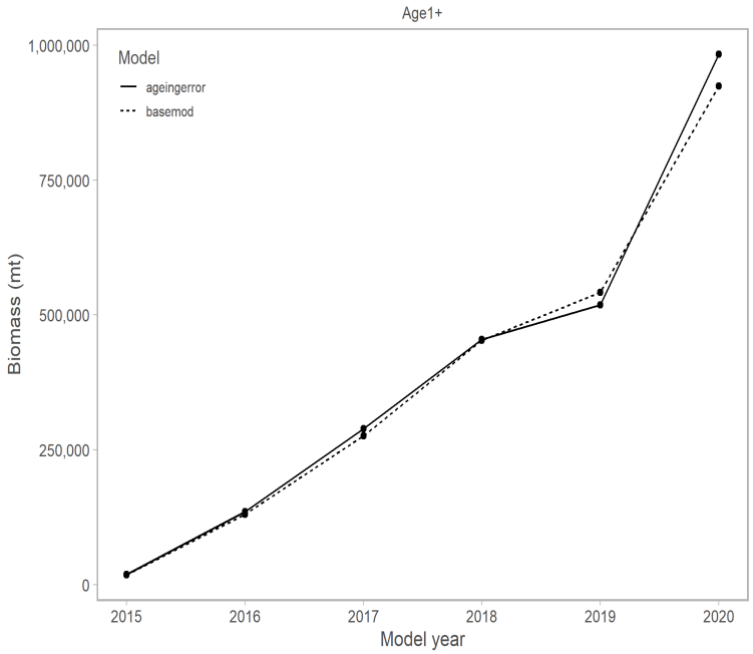

Figure 2: Model with ageinerror run

It was noted that there was substantial anchovy biomass in the northern area in spring 2021 but spawning primarily appeared to have occurred in the south. This could confound calculations of maturity at age/length if age/length compositions vary across space, to an unknown extent.

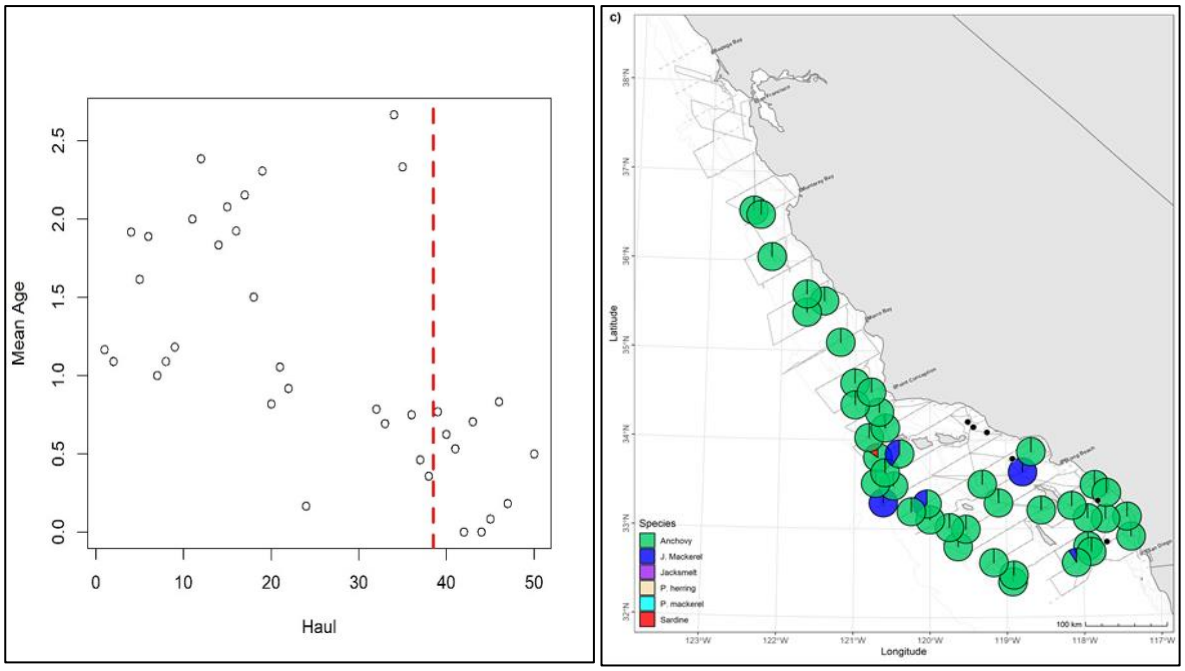

Figure 3: Mean age per haul based on 2021 AT survey

Figure 3 shows the mean age per haul from south to north (the higher haul number the more towards the north) during the spring 2021 AT survey. The points to the left of the vertical line correspond to the trawls south of Point Conception. The plot to the right is haul location.

The Panel agreed that the information provided did not necessitate a change to the assessment model but that continued work on understanding maturity was important. A sensitivity analysis to assess how much age-1+ biomass changes if the maturation ogive is based on 2017 data alone or 2021 data alone were done. The fitted maturation ogives for 2017 and 2021 are different (possibly reflecting density dependence as the stock was much larger in 2021 than in 2017, but with only two years of data this is necessarily speculative) so it is important to determine how sensitive the relevant assessment outputs are to the uncertain maturation rate of age-0 fish. The plot below shows the maturity curves for only 2017 and only 2021 data compared to that used in the base model.

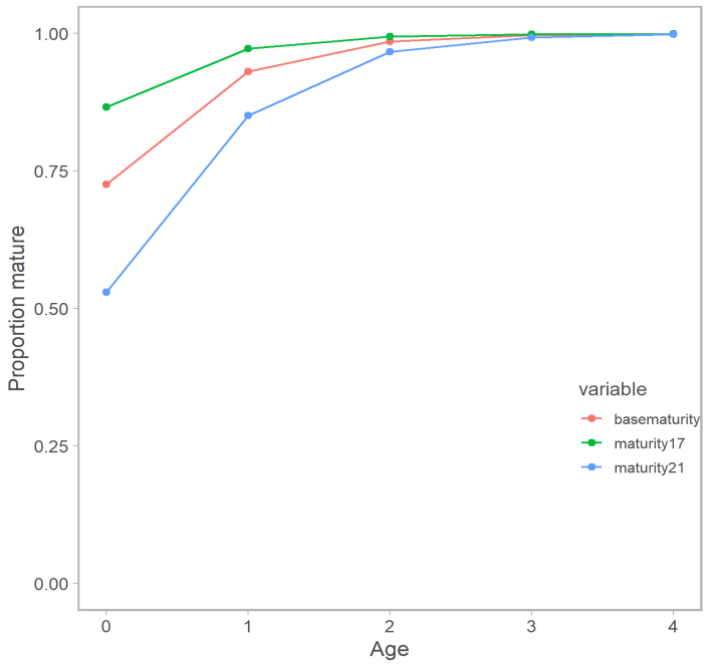

Figure 4: Maturity curves

The Panel agreed that specifications for maturity had little impact on final model outputs used for management. The estimate of E_{MSY} will depend to some extent on the assumed maturation ogive and the short-term research recommendations include the need to assess the sensitivity of E_{MSY} to the assumed maturation ogive. This could include its density dependence which in recent years have got a renaissance in science (see e.g., ICES 2008, Lorenzen 2016, and Morgan *et al.* 2016) probably due to the recent success in the northern hemisphere of combating overfishing and rebuilding of stocks (which make density dependence relevant).

Density dependent growth, maturity and naturel mortality might be difficult to get at when age determination is uncertain. However, there were indications that maturity at age was substantially lower in 2021 than in 2017 for ages 0 and 1. The stock was an order of magnitude larger in 2021 than in 2017. There were no maturity data from other years. It is of course a question of how much information one can extract from only two years of data. But maybe the 0-hypothesis should be that density dependence always exists and it is better to include it in the modelling than ignore it. This is especially the case when the magnitude of

change in stock size is so large that it seems likely, judged from what is seen in other fish stocks, that density dependence could be measurable. However, more data years would be good to have for such an endeavor.

In 2021, the summer AT survey extended well into Mexico and presumably encompassed the entire range of CSNA. It estimated a biomass of 2.357 million t (out of which 0.169 million t or 7% was in Mexico). The spring 2021 AT survey stopped at the US-Mexico border and estimated a biomass of 1.359 million t. Assuming no change in total biomass between spring and summer, this suggests that only a fraction (1.359/2.537 - 0.58) was in US waters in the spring (rounded to 0.6 for the initial request). In the summer 2021 AT survey, 93% of the estimated biomass was in the US. As a sensitivity analysis, the base model was re-run except with catchability Q=0.93 for summer AT surveys (except the summer 2021 AT) and 0.6 for spring AT surveys. The summer 2021 AT survey extended into Mexico, implying complete latitudinal coverage and thus had a Q=1. The base model forecasts for June 2021 to be 1.59 million t for age-1+ (see Figure 5). The preliminary biomass estimate from summer 2021 AT cruise was 2.357 million t (including age 0), CV=0.15 (and no age compositions yet). Thus, the stock seems to further increase substantially in size.

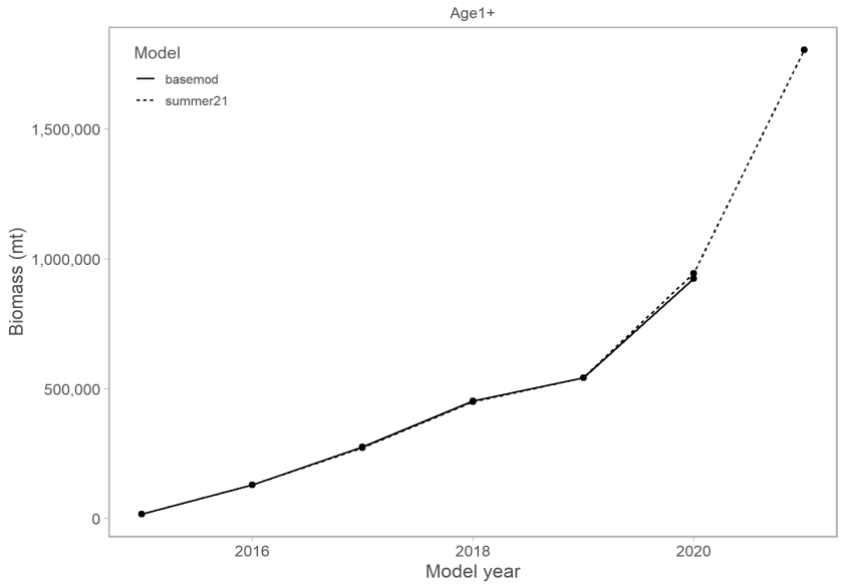

Figure 5: Base model and summer 21 model forecasts

In most if not all models considered, there were some “unreasonably high” F values in certain semesters. These may reflect very low modelled selectivity on the age classes predominantly available to the fishery in a particular semester. It might be more appropriate to plots exploitation rate. This is shown in Figure

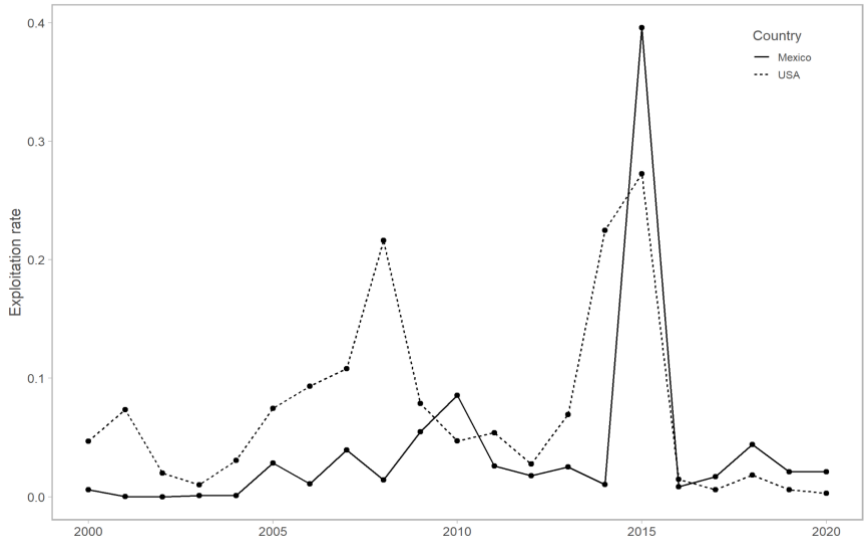

Figure 6: Exploitation rates, US and Mexico

The exploitation rates were generally low (< 5% for most years and fleets) with the notable exception of 2015. This year is problematic in terms of a very low AT survey of age 1+ and this issue is further explored below.

In a public comment by Richard H. Parrish, it was noticed that the 2015 AT summer survey had a very low estimate of age 1 and older anchovy which were inconsistent with later years AT summer survey estimates of the same cohorts (see Table 1).

Table 1

Age	2015-1	2016-1	2017-1	2018-1	2019-1
0.00	6,382,846,725	3,747,020,227	2,691,781,345	15,592,332,064	55,363,648,561
1.00	35,971,945	5,244,311,678	3,864,460,391	17,133,921,069	13,356,511,132
2.00	23,218,653	1,832,204,375	361,449,845	7,489,967,728	11,265,252,029
3.00	5,212,058	703,471,103	1,717,587,093	4,749,526,624	2,289,677,487
4.00	869,555	190,315,556	394,352,262	1,126,676,589	1,905,120,589
5.00	829,173	72,456,282	976	470,723,406	653,680,483
6.00	30	41,144,521	947	65,718,720	161,511,252

The Panel discussed this extensively but could not find any external reason for discarding this survey. It just happened to be that the survey found very few 10+ cm anchovy. One could of course speculate that these anchovies have been away from the surveyed areas and came back in 2016 and onwards, but there were no data to support such a notion. A sensitivity analysis was run, excluding the 2015 AT survey. Figure 7 show the results.

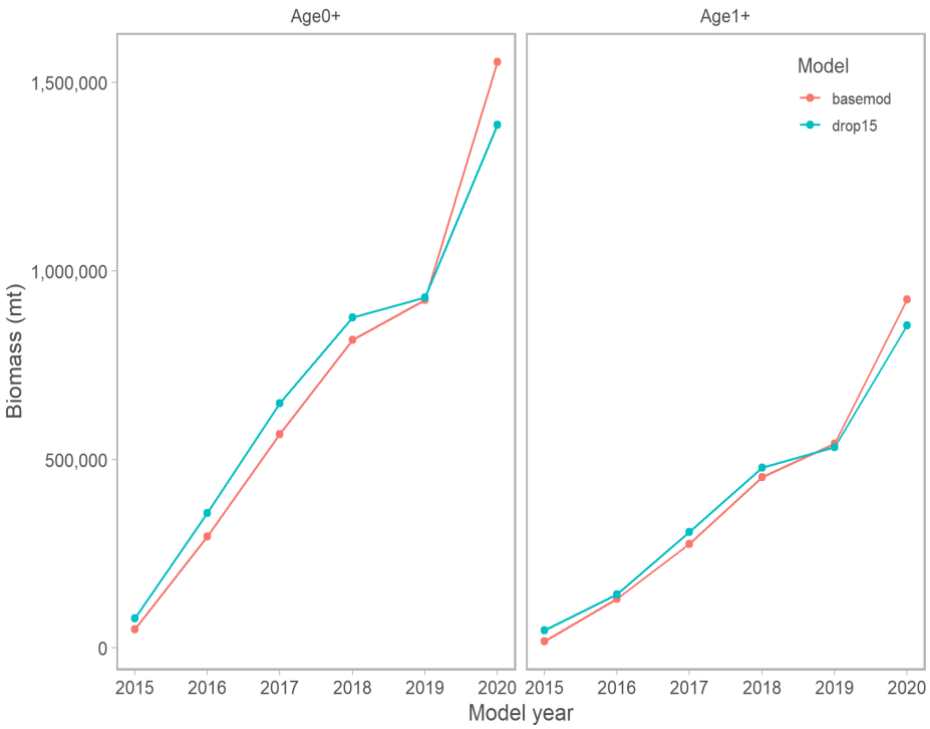

Figure 7: Sensitivity analysis, excluding the 2015 AT survey

The results of the run with no 2015 survey (index or age-composition) were qualitatively nearly identical to those for the original base model.

It was noted that the timing was incorrect in previous versions of the model with the RREAS index. The 2020 RREAS index value should be dropped because of Covid-19 pandemic the spatial coverage was very small in 2020. The survey occurs in May, generally after the spring AT survey and before the summer AT survey. Consequently, for example, the May 2015 RREAS should be input as a recruitment index input to the model at June 1 during model year 2016. The RREAS base model is "realigned_rreas_no2020" in Figure 8.

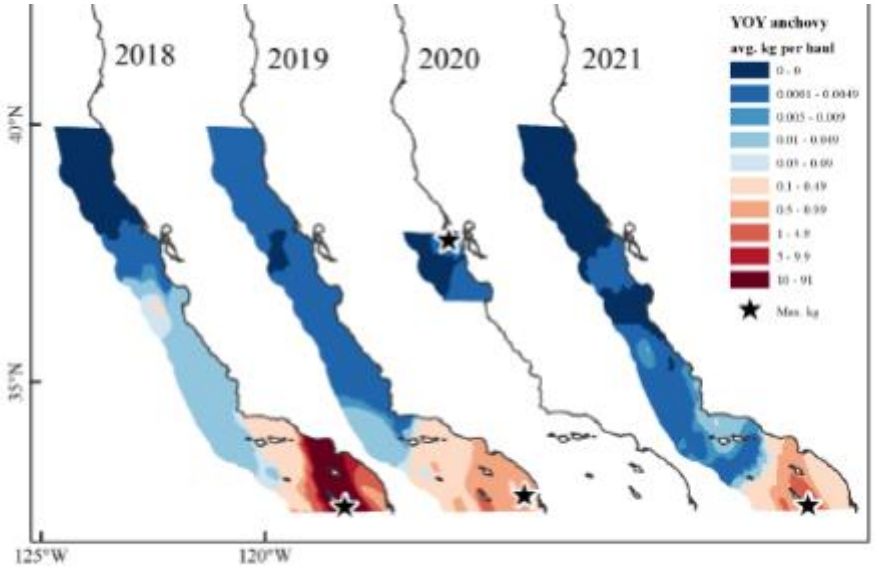

Figure 5: Spatial distribution of young-of-the-year (YOY) anchovy catches, 2004-2021

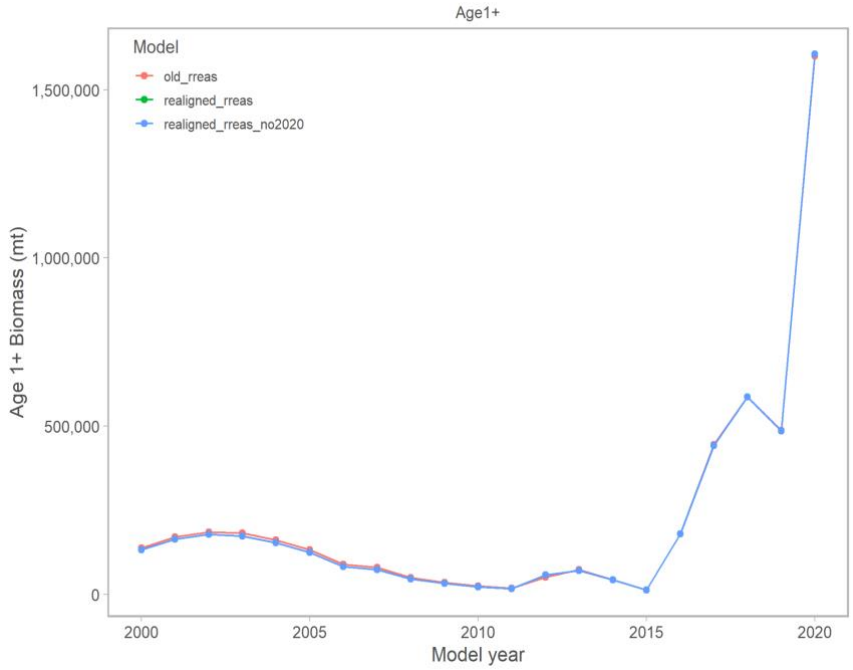

Figure 8: RREAS base model

This changed only very little in the assessment of the stock but was judged sensible, as it has a better logic.

The 2015 AT survey may be less reliable than later AT surveys for the purpose of estimating CSNA biomass as mentioned above. To provide a sensitivity of the extended model including the RREAS, a run excluding the 2015 AT survey was done (Figure 9).

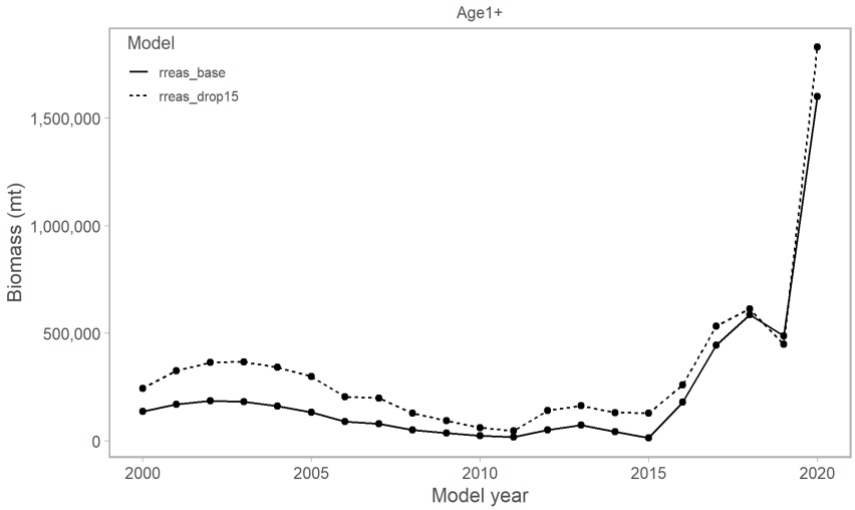

Figure 9: Sensitivity analysis of the extended model including the RREAS and excluding the 2015 AT survey

The revised model showed that excluding the 2015 AT survey increased biomass in general (as expected) and especially for the years prior to 2018.

Age-0 fish make a large contribution to total biomass in the assessment. The weight-at-age for age-0 fish from the AT summer survey were applied to the modelled population as a whole, which represent 1 June each year. The selectivity of AT survey makes it likely that the survey mainly captures the larger individuals of age-0 and thus overestimate the weight-at-age of the stock. Furthermore, the AT survey is conducted 1 to 3 months later than 1 June, the date when the stock biomass from the SS model is estimated. Generally, 0-age anchovy grow very fast during summer and the AT data for weight-at-age is therefore likely an overestimate of the weight-at-age 1 June. The Panel recommended to focus the outcome of the assessment on age-1+ stock biomass estimates instead of age-0+ stock biomass estimates.

The selectivity of the fishing fleets varied wildly. An alternative analysis suggests that a penalized variation in selectivity pattern (an auto regression SS software option) leads to more realistic selectivity patterns. The plot below shows that it helped significantly. The effect of the overall biomass trajectories was small, but it gave a slightly improved fits to data (Figure 10).

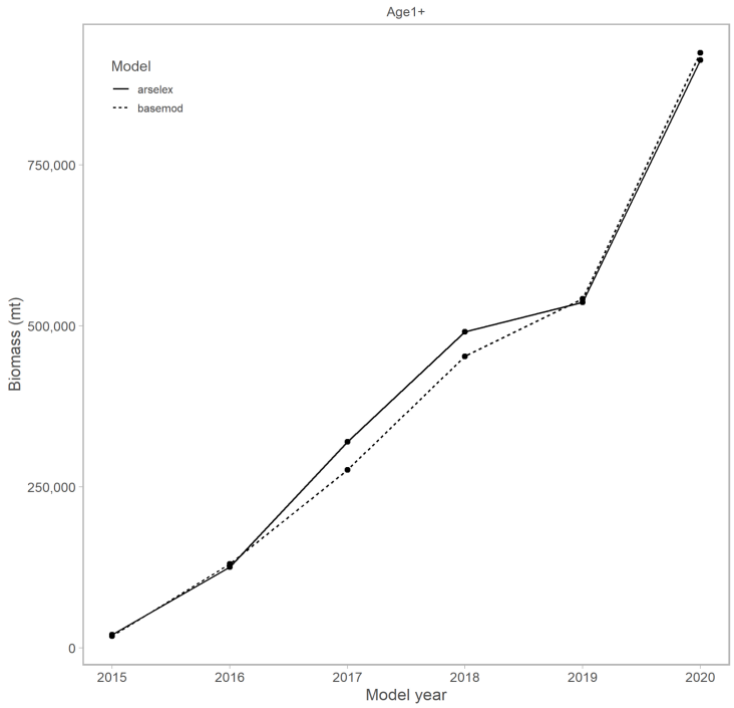

Figure 10: Base model vs. arselex

Anchovy likely have high natural mortality and some past estimates of *M* have exceeded 1.0 yr-1. Therefore, it was agreed to raise the upper bound of 1.0 per year on *M* for future model runs. An upper bound of at least 1.5 per year seems plausible. The revised model run estimated *M* as 1.06 year in one case but in most cases, *M* did not seem to approach the initial 1.0 per year boundary.

The final assessment used the AT survey from 2015 and onwards. There are also two other independent surveys that provide relevant information about the stock. The Rockfish Recruitment and Ecosystem Assessment Survey (RREAS) in late spring gives relative abundance indices of all anchovy biomass, adult (age 1+) anchovy biomass and young-of-the-year (age 0) abundance from 2004 through 2021. The California Cooperative Oceanic and Fisheries Investigations (CalCOFI) has each annual cycle four seasonal surveys and provide indices of egg and larvae abundance from 2000 to 2019. All four indices where quite consistent with the AT survey in signaling a low stock until 2015 and a steep increase since then. Thus, these are potentially useful time series which in the future and should not be forgotten, but further developed and improved in relation to the CSNA assessment. This will likely improve the robustness of future assessments.

The Panel requested a set of model runs as described below, implementing the changes listed below in all runs:

- Plus-group age3+.
- Catch series: extend the model so that the first projection year is part of the historical period
- Estimate R_0, R_0 offset and initial F
- Split AT formulation into a spring AT and a summer AT (will be inconsequential if Q is the same for all AT surveys)
- Include new age-reading error matrices
- Long model

- RREAS: Exclude 2011 & 2020; include 2021
- Start in 2004.
- Correct timing of survey.
- Use weight-at-age provided by John Field for the RREAS.

For each row/model number (see Table 2), both a short and a long variant was requested. Model length "S" means a model starting in 2015 and using the AT survey but not the RREAS. Model length "L" means a model starting in 2004 and using both the AT survey and the RREAS.

Table 2

	Model Length	Selex*	Q (summ/spr)	Q (nearshore adjustment?)	2015 AT Survey
Model 1	S/L	Option 17	1/1	N	Y
Model 2	S/L	2dAR (σ=1)	1/1	N	Y
Model 3	S/L	2dAR (σ=1)	0.93/0.57	Y	Y
Model 4	S/L	2dAR (σ=0.5)	1/1	N	Y
Model 5	S/L	2dAR (σ=2)	1/1	N	Y
Model 6	S/L	2dAR (σ=1)	1/1	N	N

*For all instances of selectivity 2dAR, implement time blocking of age-0 selectivity.

The main result is shown in Figures 11 – 13.

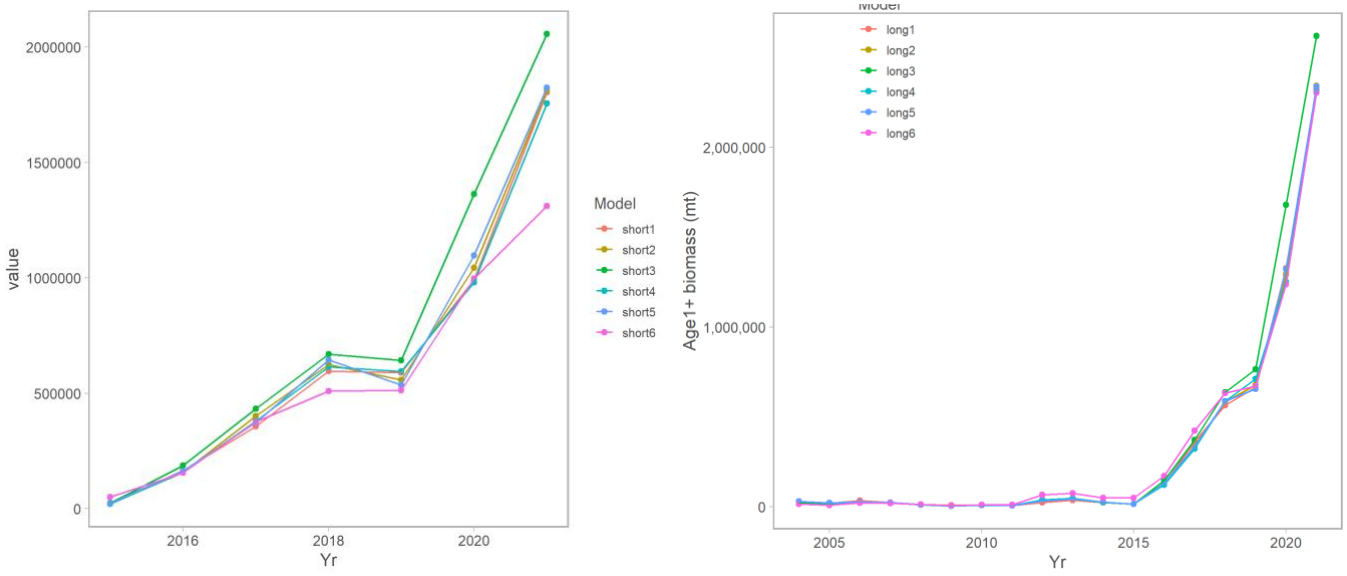

Figure 11: Model run results

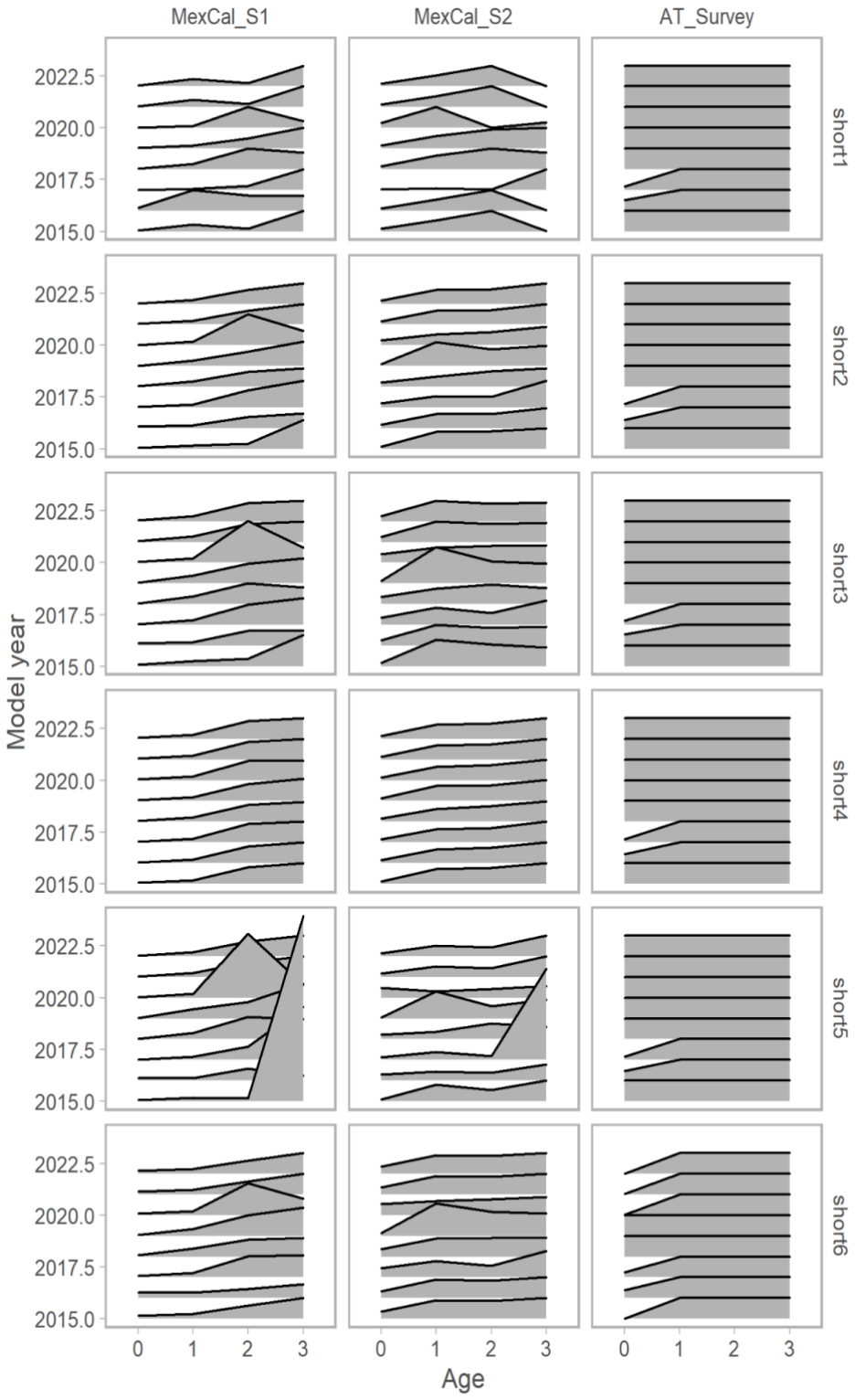

Figure 12: Short model selectivities

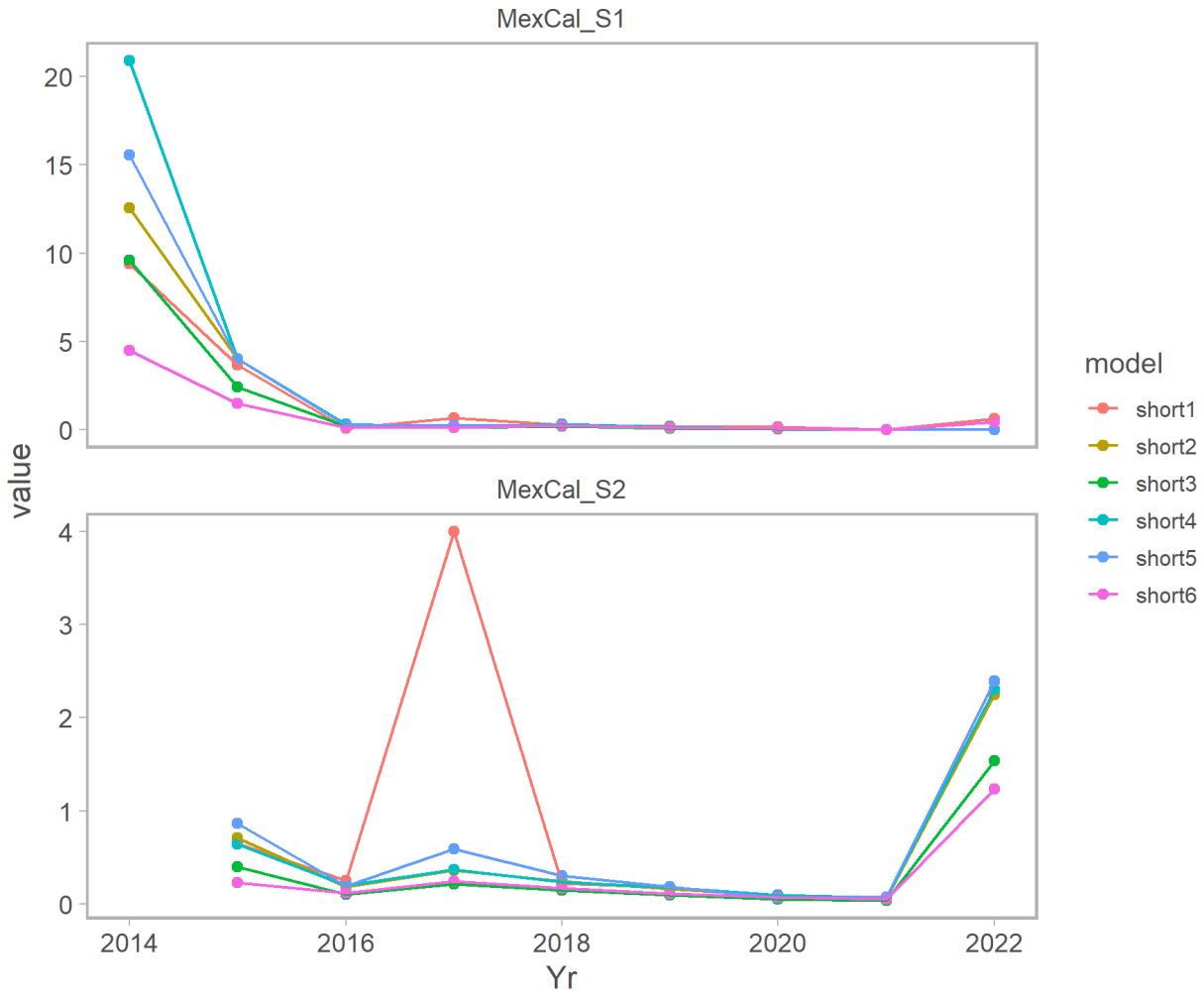

Figure 13: Short model Fs

Based on these runs and the analysis further above a tentative base model was proposed:

- Use the shorter model time period, excluding the RREAS because of model instability in the longer formulation, and because estimation of *M* was especially challenging for the long model.
- Keep 2015 AT data because after extensive discussion, it was decided that the data for this survey should not be discarded simply because 2015 seemed biologically anomalous since there was nothing unusual about the execution of the 2015 AT survey compared to later years, and it is expected that some data points will have large residuals.
- Use 2dAR selectivity with σ=1 for the two fisheries, with 2d selectivity estimation starting in the second year of available age composition data (the first age composition defines the reference curve), because the 2dAR selectivity with σ=1 led to the best performance.
- Account for biomass shoreward of the AT core survey area: Add nearshore AT biomass (preferably from surveys, otherwise from extrapolation and do not adjust Q to account for inshore coverage when these additions are made) or apply Q ratio calculations based on aerial surveys. This was based on STAT preference to add observed or extrapolated biomass to the core AT survey rather than adjust Q when possible.

- Adjust AT Q in all years to account for geographic coverage (spring Q=0.58, summer Q=0.93) based on the estimated proportion of biomass in Mexico (spring Q is 0.58 rather than 0.6 due to performing the final calculation to a higher precision).

Sensitivity and diagnostic analysis were done and extracts of these in terms of various plots are shown in Figure 14.

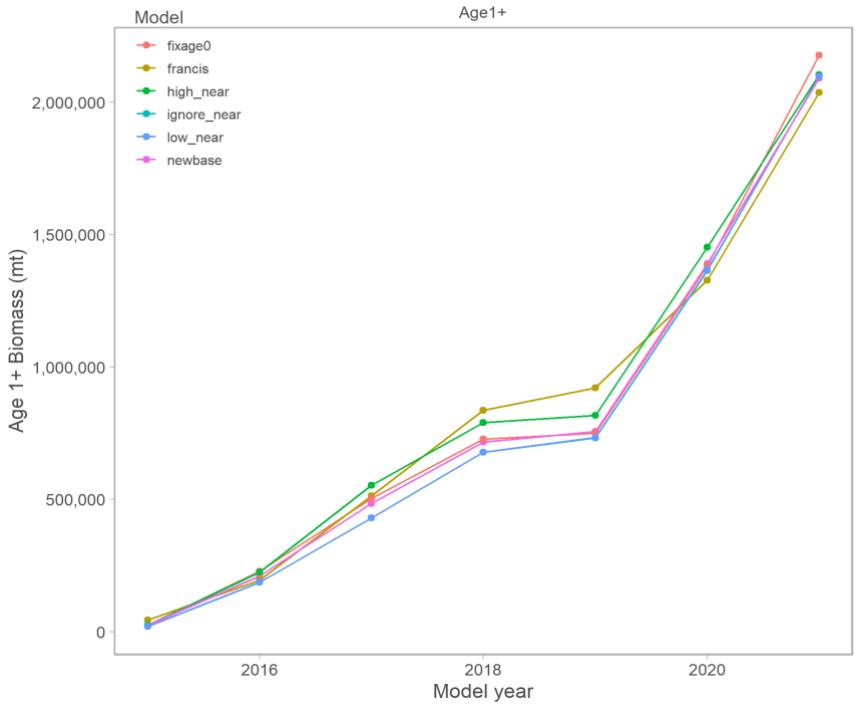

Figure 14: Selectivity and diagnostic analyses

Figure 14 shows the age-1+ biomass trajectories for the model period of 2015-2021. The models shown are the base model ("newbase"; pink), a model that ignores nearshore biomass estimates ("ignore_near"; light blue), a model with Francis reweighted age composition for all fleets ("francis"; yellow), a model that assumed the highest nearshore biomass values ("high_near"; green) and a model that assumed the lowest nearshore biomass values ("low_near"; purple).

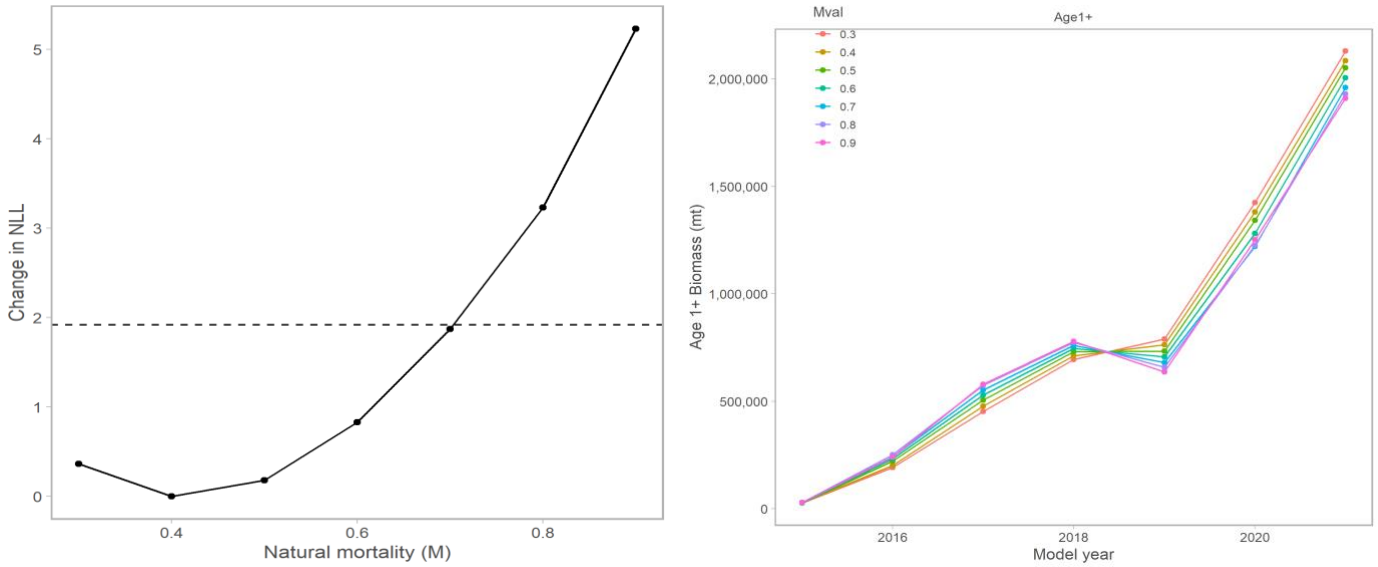

Figure 15: M profile

Figure 15 shows the *M* profile (age-1+ biomass trajectories) with steepness fixed at steep 0.6 (left) and the biomass trajectories for the alternative values of *M* (right).

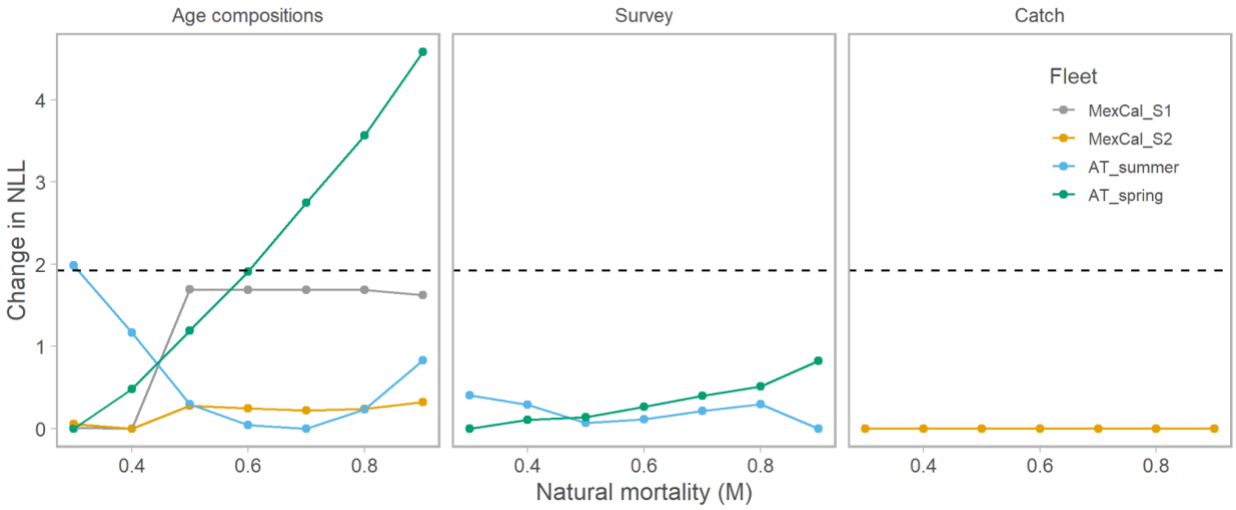

Figure 16: Likelihood profiles for M

Figure 16 shows likelihood profiles for *M* by component. Note the conflicting profiles for *M* for the spring vs summer AT surveys. Not many sources favour high *M* from a likelihood perspective and the profiles for the indices are quite flat.

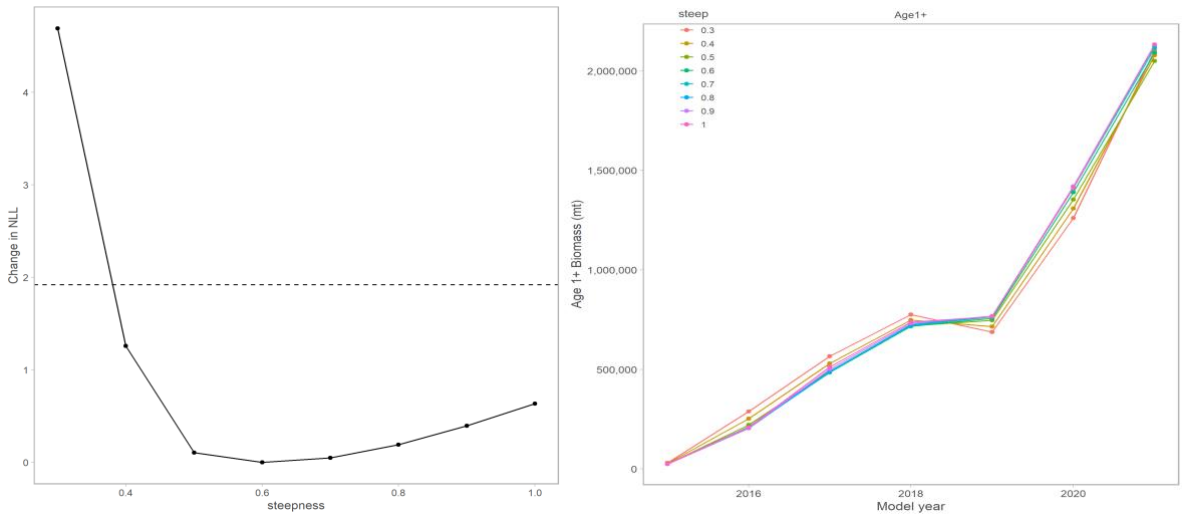

Figure 17: Steepness profiles and biomass trajectories

Figure 17 steepness profile (left) and the biomass trajectories for the alternative values of steepness (right).

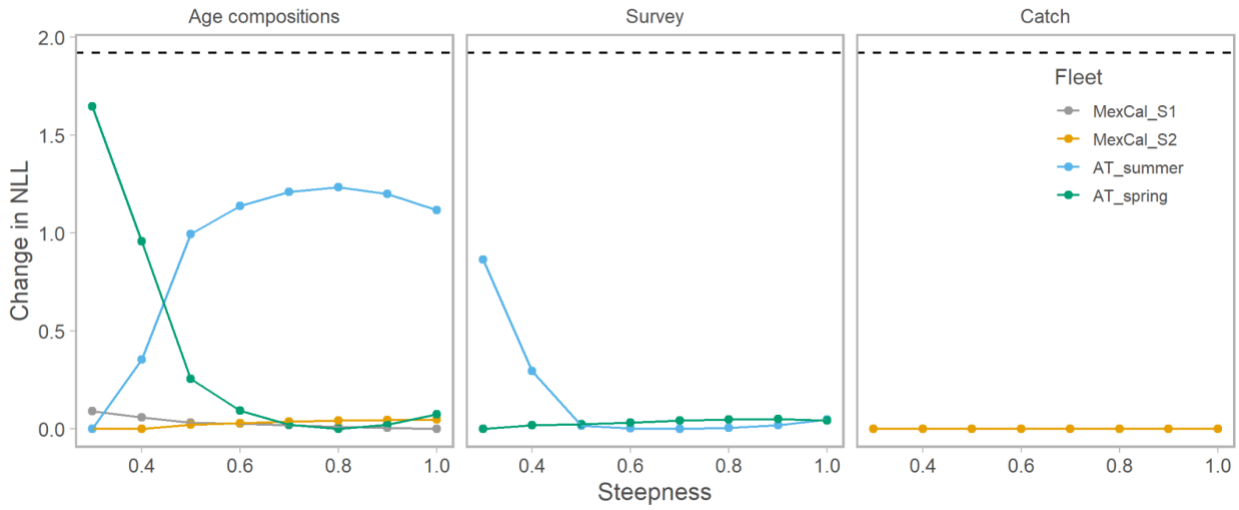

Figure 18: Changes in likelihood as a function of steepness

Figure 18 changes in likelihood as a function of steepness. There is little information on steepness beyond ruling out very low values. As steepness goes up, M goes down; but M is less than 0.65 yr-1 over the range explored.

A preliminary jittering confirmed the results of the tentative base model.

It was noted that the Council has adopted a new assessment framework, which requires an average estimate of 1+ biomass for the most recent ten years and an estimate of the exploitation rate on 1+ biomass corresponding to MSY (e.g., EMSY). Because the stock was very small between 2010 and 2015 a ten-year mean is by far most dependent on the recent years 2015-2021. These are the years included in the assessment. We calculated a 10-year mean of age-1+ biomass using all available years (2015-2021) from the new tentative base assessment model and each of three options for setting age-1+ biomass for years before

2015: (a) zero, the estimate of age-1+ biomass for 2015, and 1.5x the estimate of age-1+ biomass for 2015. The three mean biomasses are: 0.568 million t, 0.575 million t, and 0.579 million t respectively.

CPSMT issues

The most important issues raised by CPSMT (The Coastal Pelagic Species Management Team) were the following, as far as I see it.

The estimated value for natural mortality *M* seems quite problematic in this assessment as it is particularly low given previous work on this issue.

While it is certainly easier to model the stock in discrete time periods, the biology of anchovy does not fit that method very well given that CSNA can spawn throughout the year.

The combination of the three very distinct fishing fleets widely geographically separated, and their differing targeting strategies, timing, and degree of effort fishing for this stock of anchovy in Monterey, southern California, and Mexico also seems problematic.

Also, the work on how best to adjust AT survey results to deal with the nearshore correction factor is still a work in progress for the stock assessments. The CPSMT representative notes that the methods utilized in this assessment differ from those used in the 2020 benchmark assessment for sardine and that there may be benefits in developing consistent methods.

All these points are very relevant but not possible to do much about with the current data and knowledge. The issues seem worthy for future research.

CPSAS issues

The CPSAS (Coastal Pelagic Species Advisory Subpanel) raised several issues which were thoroughly discussed during the meeting, and among the most important pending ones are the following two, as far as I judge it.

The Panel did not go into discussing estimation of E_{MSY} (due to the SS software not yet capable of dealing with age 1+ as the stock biomass metric), but it seems appropriate for when doing that, to consider uncertainty around *M*, steepness, varying weight at age etc. and I would add its density dependent aspects.

Future assessments should consider and incorporate multiple indices, including RREAS, CalCOFI and nearshore aerial surveys. These of course then need to be up to date for the use in the present anchovy assessment.

Conclusion of the assessment

The strength of the assessment was the fisheries independent information from the acoustic surveys and supported by that from independent egg and larvae surveys and an independent trawl survey. All sources agreed in the big picture that the stock was low from 2000 to about 2015 and that it increased very substantially after that.

A weakness was that age-determinations are quite uncertain, but improvements are well under way with good quality control systems, training samples, and ideas for new ways of determining ages not so dependent on subjective judgments by human otolith readers. The assumption of Q=1 for the area covered by the AT core area survey, is also a weakness as there are many possible reasons why this could be different from 1, as highlighted by the review carried out in 2018 of the AT survey.

The assessment lived up to the demand for being based on best available science and was risk neutral.

The STAT teams are commended for their hard work and willingness to respond to the Panel's many requests. My fellow Panel members and the public are commended for very open-minded, constructive, risk neutral, and highly competent discussions.

Research recommendations

The Panel agreed on the following research recommendations (priorities high = H, medium = M, low = L) and I am in full agreement with them, except for the point about exploring whether other data sources, with longer time series than the AT surveys (CalCOFI egg and larval data, RREAS) might inform on YOY and age-1+ biomass, which I tend to think should have a high priority instead of a low priority. Given the uncertainty in the Q values for the AT survey and the potential problem at small stock sizes with the near coastal coverage, it could be important for the robustness and precision of the assessment that other data sources are incorporated into the assessment. It seems to me to be a low hanging fruit to extract the relevant indices from these surveys, which are taken place anyway because they are also aimed at other species. This means that it is only a question of working up the data sampled, so that it can be used in the anchovy assessment. However, it of course depends on the importance of the precision of the assessment management needs whether this small extra effort is worthwhile.

Natural Mortality

- (M) Estimate a time-varying natural mortality rate given changes in predator numbers relative to prey abundance over time. The STAT indicated that there is a proposal within SWFSC to investigate this issue.
- (M) Assess whether predator abundance, absolute or relative, and their anchovy consumption can provide a lower bound for anchovy biomass and/or inform *M*.
- (H) Develop a prior for *M*.

Ageing

Assessing age presented a challenge for the assessment given the diversity of sources of data and methods.

- (H) Obtain length/age composition for the Mexican anchovy catch and include it in future assessment.
- (H) Improve the accuracy of ageing determination and increase age validation efforts.
- (H) Continue efforts to standardize the ageing process among laboratories, including Mexican laboratories.

Stock structure

- (M) Consider genetic and non-genetic methods to determine stock structure.

Modelling

- (M) Develop ways to better account for the continuous nature of spawning and growth versus the discrete time steps used in current modelling.
- (H) Examine the sensitivity of estimates of E_{MSY} to assumptions regarding *M*, maturity, and growth.

- (L was the priority of the Panel, but I think it should be a priority H) The current available input data for the model covers a period in which the CSNA stock is increasing. However, CSNA is characterized by rapid increases and declines. Examine the performance, stability, or accuracy of the assessment framework under different circumstances such as different trends in CSNA recruitment and biomass. Explore whether other data sources, longer than the AT surveys (CalCOFI egg and larval data, RREAS) might inform on YOY and age-1+ biomass.
- (M) Conduct research to understand the reasons behind the (interannual) variability in selectivity, including variability in market demand.

Data - Aerial Surveys and Small Vessel Inshore Acoustic Surveys

- (M) Uncertainty prevails in how to use/include the aerial surveys and/or small vessel inshore acoustic surveys as the coverage changes, and the aerial and the acoustic-trawl surveys have not always overlapped in the past. Continue to conduct research to estimate corrections to AT survey Q or adjustments to the AT survey estimates of abundance to account for the components of the stock south and inshore of the core sampling area.
- (M) Aerial survey biomass estimates have only been validated for a limited number of anchovy schools, and only for small schools (typically 100 mt or less) because of challenges in vessel capture of larger schools for sampling, but larger schools contribute most of the estimated inshore biomass in high biomass years. Use of packing densities, aerial photos of school area combined with vessel estimates of school depth is one approach to validating large school estimates from spotter pilots. Validation of biomass estimates for larger schools remains an ongoing challenge but important to increasing confidence in use of aerial survey estimates in high biomass years.
- (M) Compare the proportion of volume of waters shoreward of the AT sampled by the aerial survey vs. the inshore acoustics to better understand how much shoreward habitat each covers. While the nearshore AT penetrates deeper into the water column than the 10 meters typically observed by the aerial survey, the narrow swath of water sampled by the limited cone width AT in shallow waters and water not observed between the transducer at the keel and the waterline limit the volume of habitat sampled in the nearshore. Using track lines and the geometry of the coverage of each survey, the total volume of surveyed waters shoreward of the AT survey can be estimated and compared to account for differences in spatial coverage in considering which survey is preferable. This becomes important given the patchy distribution of the species and a minimum target of 30% from basic sampling design considerations, which have implications for the precision of the estimates.
- (M) Age-0 fish make a large contribution to total biomass in the assessment and there was considerable annual variation in the estimated weight for fish of age-0 from the surveys and a likely overestimation due to using the data from the AT summer survey as representing the stock at 1 June each year. Provide information relevant to the reliability of estimates of weight-at-age for age-0 fish from the AT survey (conducted in July and August) when applied to the modelled population as a whole at 1 June each year.

Improvements to Stock Synthesis

- (H) Add an option to output estimates of uncertainty in age-1+ biomass.

The NMFS review process

The review process was influenced by the Covid-19 pandemic, so a physical meeting could not take place. Instead, a virtual meeting was conducted with individual participants working from home via their PC. This worked quite well. It was important that almost all presentations were produced 2 weeks before the start of the meeting so that it was possible to prepare well for the meeting. However, most of the normal one-to-one informal interactions between participants were lacking, which under normal circumstances are important for a comprehensive exchange of views, ideas, and opinions. Daily sessions from 08:30 to 17:00 San Diego time were a bit long when you come from Central Europe (Denmark) because it means staying up until 02:00 each night.

The guidelines to the reviewers from the CIE secretariat were clear and to the point. I was especially happy to see that the Terms of Reference strongly highlighted the importance of being risk neutral in the assessment of the stock. The precautionary approach is only prudent when managers use the assessment to provide advice to the fisheries. The science should be risk neutral and not have any precautionary elements.

The documentation and presentation were of a high quality. Documentation was sent out two weeks before the meeting using a cloud drive. The meeting was conducted in an efficient, engaged, and positive atmosphere.

The exchange of knowledge and communication between the participants was exceptionally efficient, constructive, risk neutral and competent.

The Panel put forward many requests to the assessors. These were very efficiently answered, although the assessors had to work hard and had long days during the meeting.

The presentations of all the important aspects relevant for the review were very much appreciated by me and the rest of the Panel.

The NMFS review process have evolved over time and seems now to have reached at very high standard in my opinion.

All in all, it was a very good process seen from my perspective as a reviewer, for doing a comprehensive and in-depth review the assessment, given the Covid-19 circumstances and the necessity to have the meeting online.

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Morgan, M. J., Shelton, P. A., Gonzalez-Costas, F., and Gonzalez-Troncoso, D. 2016. Compensation potential in six depleted groundfish stocks from the Northwest Atlantic. Canadian Journal of Fisheries and Aquatic Sciences, 73: 257–269.

Appendix 1. Bibliography list of material provided

Primary Document

Kuriyama, P.T., Zwolinski J.P., Teo, S.L.H. and K.T. Hill. Assessment of the Northern anchovy (*Engrualis mordax*) central subpopulation in 2021 for U.S. management in 2021-2022.

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Background documents

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Zwolinski J.P., Stierhoff, K.L. and D.A. Demer. 2019. Distribution biomass, and demography of coastal pelagic fishes in the California Current Ecosystem during summer 2017 based on acoustic-trawl sampling. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-610.

Other Documents

PFMC. 2020. Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review Process for 2021-2022. https://www.pcouncil.org/documents/2021/01/terms-of-reference-for-the-coastal-pelagic-species-stock-assessment-review-process-for-2021-2022-december-2020.pdf/

Appendix 2. Performance work statement

Performance Work Statement

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

Virtual STAR Panel Review of the 2021 Central Stock of Northern Anchovy Stock Assessment

December 7-10, 2021

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.

(http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf).

Further information on the CIE program may be obtained from www.ciereviews.org.

Scope
The CIE reviewers will serve on a Stock Assessment Review (STAR) Panel and will be expected to participate in the review of Central Stock of Northern Anchovy (CSNA) stock assessment. The Central Stock of Northern Anchovy has not been assessed recently since commercial landings have been low since a reduction fishery in the 1980's and 1990's was shut down. The CSNA stock is currently monitored by SWFSC scientists, and the Pacific Fishery Management Council (PFMC). The stock assessment data and model will be formally reviewed by the STAR Panel with a coastal pelagic species subcommittee of the SSC. The resulting biomass estimate will be used to compare the efficacy of the current harvest guideline and other potential management recommendations.

This 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 CSNA, work with the stock assessment teams 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 the STAR Panel review are attached in **Appendix 2**. The tentative agenda of the Panel review meeting is attached in **Appendix 3**. Finally, a Panel summary report template is attached as **Appendix 4**.

Requirements
Two CIE reviewers shall participate during a virtual panel review meeting in La Jolla, California during December 7-10, 2021, and shall conduct an impartial and independent peer review accordance with the Performance Work

Statement (PWS) and ToRs herein. The CIE reviewers shall have the expertise as listed in the following descending order of importance:

- The CIE reviewer shall have expertise in the design and execution of fishery-independent surveys for use in stock assessments, preferably with coastal pelagic fishes.
- The CIE reviewer shall have expertise in the application of fish stock assessment methods, particularly, length/age-structured modeling approaches, e.g., 'forward-simulation' models (such as Stock Synthesis, SS) and it is desirable to have familiarity in 'backward-simulation' models (such as Virtual Population Analysis, VPA).
- The CIE reviewer shall have expertise in the life history strategies and population dynamics of coastal pelagic fishes.
- It is desirable for the CIE reviewer to be familiar with the design and application of fisheries underwater acoustic technology to estimate fish abundance for stock assessment.
- It is desirable for the CIE reviewer to be familiar with the design and application of aerial surveys to estimate fish abundance for stock assessment.

The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review process.

Tasks for reviewers

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

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

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

- Stock assessment documents;
- 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 ToRs, logistical considerations.

Test: Additionally, two weeks prior to the peer review, the CIE reviewers will participate in a test to confirm that they have the necessary technical specifications provided in advance of the panel review meeting.

Virtual Panel Review Meeting: The CIE reviewers shall conduct the independent peer review in accordance with the PWS and ToRs, and shall not serve in any other role unless specified herein. **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 COR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the review panel's virtual meeting, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements

(e.g., video or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

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

- Attend and participate in the virtual panel review meeting
  - The meeting will consist of presentations by NOAA and other scientists, stock assessment authors and others to facilitate the review, to provide any additional information required by the reviewers, and to answer any questions from reviewers
- After the virtual review meeting, reviewers 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 may assist the Chair of the meeting with contributions to the summary report.
- Deliver their reports to the Government according to the specified milestone dates

Foreign National Security Clearance
When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. Since the meeting will be virtual due to the COVID-19 pandemic, there will be no Foreign National Security Clearance required.

Place of Performance:
The CIE reviewers shall conduct an independent peer review during the panel review meeting scheduled for the dates of December 7-10, 2021. Due to current uncertainties in the state of the COVID-19 pandemic at this time, this meeting will be conducted as a virtual meeting.

Period of Performance
The period of performance shall be from the time of award through January 2022. Each 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.

Within two weeks of the award	CIE sends reviewers contact information to the COR, who then sends this to the NMFS Project Contact
Approximately two weeks later	NMFS Project Contact sends the CIE Reviewers the pre-review documents
December 7-10, 2021	The reviewers participate and conduct an independent peer review during the panel review meeting
Approximately two weeks later	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final CIE independent peer review reports to the COR

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

Travel
No travel expenses shall be incurred since the meeting will be held virtually.

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

NMFS Project Contacts
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Appendix 1: 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 should 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 should 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 Performance Work Statement
   Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Appendix 2: Terms of Reference for the Peer Review of the Central Stock of Northern Anchovy stock assessment

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

Appendix 3: DRAFT AGENDA: 202 CSNA STAR PANEL

	Tuesday, 7 December	
08h30	Call to Order and Administrative Matters, Introductions	Punt
	WebEX troubleshooting	TBD
	Work plan and Terms of Reference	Griffin
	Report Outline and Appointment of Rapporteurs	Punt
09h00	CSNA survey-based assessment presentation	Kuriyama/Hill
10h00	Break	
10h30	CSNA model-based assessment presentation	Kuriyama/Hill
11h30	Acoustic trawl survey	Zwolinski, ATM group
12h00	Lunch	
13h00	Acoustic Trawl Survey, continued	Zwolinski, ATM group
14h00	CalCOFI Survey, Rockfish Recruitment Ecosystem Assessment Survey	Kuriyama/Hill
15h00	Break	
15h30	Aerial Survey, other surveys	TBD
16h00	Panel discussion and analysis requests	Panel
16h30	Public comments and general issues	
17h00	Adjourn	

Wednesday, 8 December		
08h30	Assessment Team Responses	Kuriyama/Hill
10h30	Break	
11h00.	Discussion and STAR Panel requests	Panel
12h30	Lunch	
13h30	Report drafting	Panel
15h00	Break	
15h30	Assessment Team Responses	Kuriyama/Hill
16h00	Discussion and STAR Panel requests	
16h30	Public comments and general issues	
17h00	Adjourn	

Thursday, 9 December		
08h30.	Assessment Team Responses	Kuriyama/Hill
10h30	Break	
11h00.	Discussion and STAR Panel requests	Panel
12h30	Lunch	
13h30	Report drafting	Panel
15h00	Break	
15h30	Assessment Team Responses	Kuriyama/Hill
16h30	Discussion and STAR Panel requests	
17h00	Adjourn	

Friday, 10 December		
08h30.	Assessment Team Responses	Kuriyama/Hill
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 4: 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. List of participants

Name	Affiliation
Stock Assessment Review Panel	
André Punt	SSC/University of Washington, Chair
John Budrick	SSC/CDFW
Marisol García-Reyes	SSC/Farallon Institute
Will Satterthwaite	SSC/SWFSC
Gary Melvin	Canada Department of Fisheries and Oceans
Henrik Sparholt	Denmark, Independent Scientist
Advisers	
Diane Pleschner-Steele	CPSAS
Greg Krutzikowsky	CPSMT
Stock Assessment Team	
Peter Kuriyama	SWFSC
Juan Zwolinski	UC Santa Cruz / SWFSC
Kevin Hill	SWFSC
Steve Teo	SWFSC
Other attendees	
Dale Sweetman	SWFSC
Kirk Lynn	CPSMT/CDFW
Juan Zwolinksi	SWFSC
Alan Sarich	CPSMT
Angela Forristall	NMFS
Brad Erisman	SWFSC
Briana Brady	CDFW
Brittany Schwartzkopf	SWFSC
Chelsea Protasio	CDFW
Emmanis Dorval	SWFSC
Heather Fitch	Alaska Department of Fish and Game
John Field	SWFSC
Josh Lindsey	NMFS
Julie Thayer	Farallon Institute
Kelsey James	SWFSC
Lorna Wargo	CPSMT/WDFW
Owyn Snodgrass	SWFSC
Richard Parrish	Independent
Steve Crooke	CPSAS
Kevin Piner	SWFSC
Taylor Debevec	NMFS
Trung Nguyen	CPSMT/CDFW
Alex Jense	U Washington
Anne Frieire de Carvalho	SWFSC
Barb Muhling	SWFSC

Ben Enticknap	Oceana
Bill Sydeman	Farallon Institute
Brian Wells	SWFSC
Conception Enciso	INAPESCA
Corey Niles	PFMC/WDFW
Dana Myers	CDFW
Desiree Tommasi	SWFSC
Dianna Porzio	CDFW
Ed Weber	SWFSC
Erin Satterthwaite	SWFSC
Geoff Shester	Oceana
Jarrod Santora	SWFSC
Jon Walker	SWFSC
Josiah Renfree	SWFSC
Josh Lindsay	NMFS
Julia Coates	CDFW
Katie Grady	CDFW
Kelly Kloos	CDFW
Martin Hernandez Rivas	Instituto Politécnico Nacional, Mexico
Megan Human	SWFSC
Michelle Horecxko	CDFW
Mike Cornman	CPSAS/Ocean Gold
Mike Okoniewski	CPSAS/Pacific Seafood
Noelle Bowlin	SWFSC
PY Hernvann	UC Santa Cruz
Rebecca Miller	NWFSC
Robert Wildermuth	UC Santa Cruz
Sherri Charter	SWFSC
Tara Brock	Oceana
Theresa Tsou	SSC/WDFW
Will Fennie	Moss Landing Marine Labs
William Watson	SWFSC

CDFW = California Department of Fish and Wildlife
CIE = Center of Independent Experts
CPSAS = Coastal Pelagic Species Advisory Subpanel
CPSMT = Coastal Pelagic Species Management Team
NMFS = National Marine Fisheries Service
NWFSC = Northwest Fisheries Science Center
PFMC = Pacific Fishery Management Council
SSC = Scientific and Statistical Committee
SWFSC = Southwest Fisheries Science Center