SPRFMO
South Pacific Regional Fisheries Management Organisation

Report of the Jack Mackerel Data Workshop SCW11

9-11/10-12 August 2021

1 Opening of the meeting

The Jack Mackerel Working Group Chairperson (Martin Pastoors) welcomed all participants. The 9-hour web meeting (3 sessions of 3 hours) was attended by 28 delegates. A list of participants is provided in Annex 1.

The Agenda (Annex 2) and topics were agreed as below, with age determination topics (agenda item 3) covered first. Jan Arge Jacobsen, Niels Hintzen, Jim Ianelli, Aquiles Sepulveda, Maite Pons, Lee Qi, and Marianne Vignaux agreed to assist with rapporteuring.

2 Overview of sample sizes in length/age sampling data

2.1 Data reporting and inventory

Martin Pastoors made a presentation (SCW11-02[1]) which showed the results of his analysis looking at the age-length keys (ALK) templates (back to 2015, but mainly 2018 and 2019). This highlighted that the files needed to be made available in one accessible place. This was accomplished in the intervening periods between the workshop sessions.

Shortcomings in the final reporting based on the ALK templates were noted, especially with respect to historical data sets. A standardised method for importing the template data into a SPRFMO database and storing this database (on a SPRFMO server) would be valuable and was highly recommended. Also, there was a suggestion to update some of the data in the ALK templates (particularly for offshore and Peru).

The workshop agreed that the SC should keep using the templates on an annual basis and look at ways to help Members complete the templates. This included providing training and translation of the explanatory text into other languages. A list of term definitions used in the template was also suggested. Finally, the group asked if Niels Hintzen could record a presentation on what the different tabs and fields mean to help translate the terms into different languages as needed.

2.2 Data processing and application

The workshop discussed how members process the ALK data from the templates and provide input to the assessment. Niels Hintzen noted that many templates as reported have gaps and only a few have been 100% completed. Validating and crosschecking the ALK templates with Members is time consuming. The group suggested developing a process that involved submitting the data earlier in the year so that Secretariat support might be more feasible.

Martin Pastoors' presentation showed that there can be large differences in the cumulative length distribution for different fleets (within Fleet 4) depending on where the fleet was fishing, or which trips had

[1] Presentations available on Teams, or on request from the Secretariat

observers on board.

The group noted that there is only one ALK for Peru (and it was repeated in the available templates). This ALK is not used in the data preparation for input into the assessment model (see Paragraph 14 of the SC8-Report Jack Mackerel Technical Annex) as only Peruvian length frequencies are used.

Martin Pastoors showed some standard sampling effort relative to 1,000 t of catch that is commonly reported for ICES stocks. A target in some areas is to have about 125 age-determinations per 1,000 t. Ignacio Paya noted that for Chile, the sample sizes are based on a sampling design analysis. For a narrow range of sizes and ages the target per tonne of catch may differ. The group agreed that identifying on a target metric for Jack mackerel sampling coverage needs more study.

Niels Hintzen made a presentation (SCW11-03) which covered the approach used to raise the offshore fleet data. Via application of the ALK template, Member data on catch, sampling effort, lengths, and ALKs (if available) are used to compute catch at age. Most countries provide length frequency distributions raised to the total catch (by quarter). The relevant catch-at-age (c@a), weight-at-age, are catch-weighted and summed over quarters and fleets to annual levels for use in the assessment. This process is summarised in Figure 1. A question arose regarding the annual sample sizes used to create the ALK for the offshore fleets. This could not be shown at the workshop due to technical issues, but this will be done in preparation for the benchmark.

In cases where age data are unavailable (as is the case in some offshore fleets), ALKs from other Members have been used to convert the length data to ages for the assessment. Usually the EU ALK is used, but in some cases the EU fish length and/or seasonal range appears to be too limited to extrapolate to other fleets. When this happens, the Chilean ALK (Fleet 2 data) is used. However, similar problems can arise. Niels Hintzen used a decision tree (see Figure 1 below) to decide what ALK should be used for a particular length dataset. This approach is done by hand and on a case-by-case basis, and therefore lacks reproducibility. **The workshop agreed that an approach to automate or standardise application of ALKs should be developed so that the process is completely reproducible.**

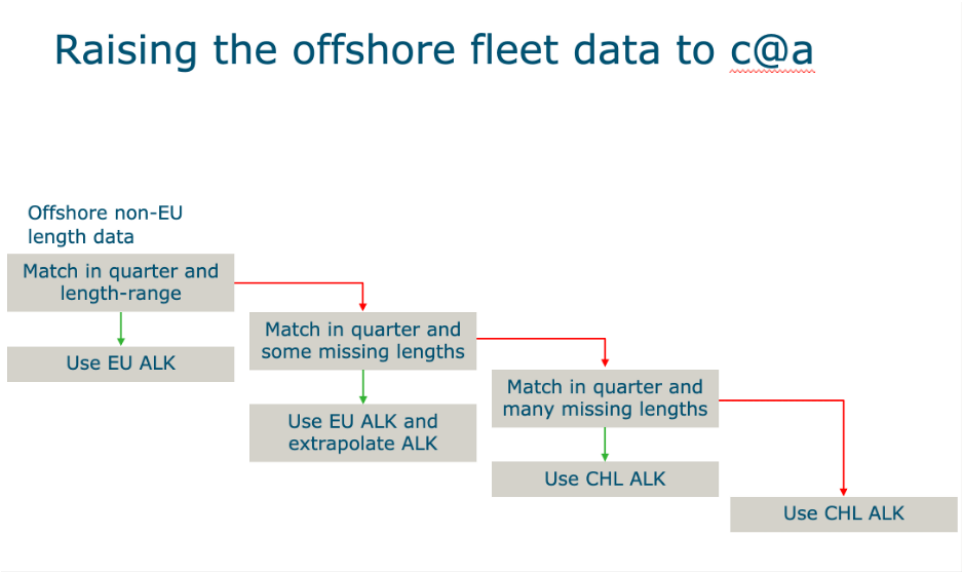

Figure 1. Flowchart showing the hierarchy of data application for cases when ALKs are unavailable for a specific fleet.

There was discussion about whether it will be necessary to develop a script that could produce completed templates for the years prior to this meeting, providing ALKs based on the new ageing criterion presented this year. This would retrospectively complete the templates (or the read-in database) with the new data. Ideally the data would not be put into excel format, but would be fed directly into a common database. It was suggested that perhaps this could be based on the Chilean database structure or in combination with the template reader code that has been developed.

The Far North area (Fleet 3) is currently reflected with only one ALK, even though there might have been changes in growth over the whole period. It was clarified that the Peruvian fleet provides only length frequency data and a growth model (not an ALK). As such, the Peru ALK is not used in the assessment (see Paragraph 14 of the SC8-Report Jack Mackerel Technical Annex). However, there are checks carried out within Peru on the relationship between length and age. It would be relevant to the SC if such checks would be reported in the annual report.

It was agreed that an otolith exchange is still needed to check that ageing is consistent from different Members. For example, EU may be using a different ageing technique than Chile.

It was suggested to look at how environmental conditions impact age structure and how growth variability (spatially and temporally) can impact assessment results. Growth could vary quite a lot along the coast, in a way that it is not easy to predict. The Benchmark workshop may need to look at how this could be included in the model.

2.3 Age determination methods used for the EU (and other) data

The EU age-determination from samples is carried out at a Polish lab. The workgroup inquired if this matches well with the new developments presented by Chile (see agenda Item 3 below). The group noted that a means for comparing the ALKs between these two sources is needed. Ultimately, this should be developed prior to the 2022 planned Benchmark workshop so that the issue can be addressed then.

2.4 Review of methods

Chile presented the methods used to re-estimate ages of Jack mackerel samples. The main results indicated that the 1st and 3rd "ring" had been incorrectly interpreted as annuli. Their study showed that this was persistent over time. As such, past age-determination data could be recalculated using the new criteria without re-reading the otolith samples. This was supported by daily increment analysis for younger individuals. A summary of the new data processing workflow is shown in Figure 2. Code for this analysis can also be found at this link.

Jorge Csirke inquired about the impact on age-determination of older individuals and if they could also be overestimated. It was also noted that catch in numbers is provided but it is not clear how this is obtained and where it happens in the diagram presented. It was suggested that the last box of the diagram (bottom left of Figure 1 of SCW11-01; Figure 2 below) also include total catch in number (as opposed to catch in tonnes by age).

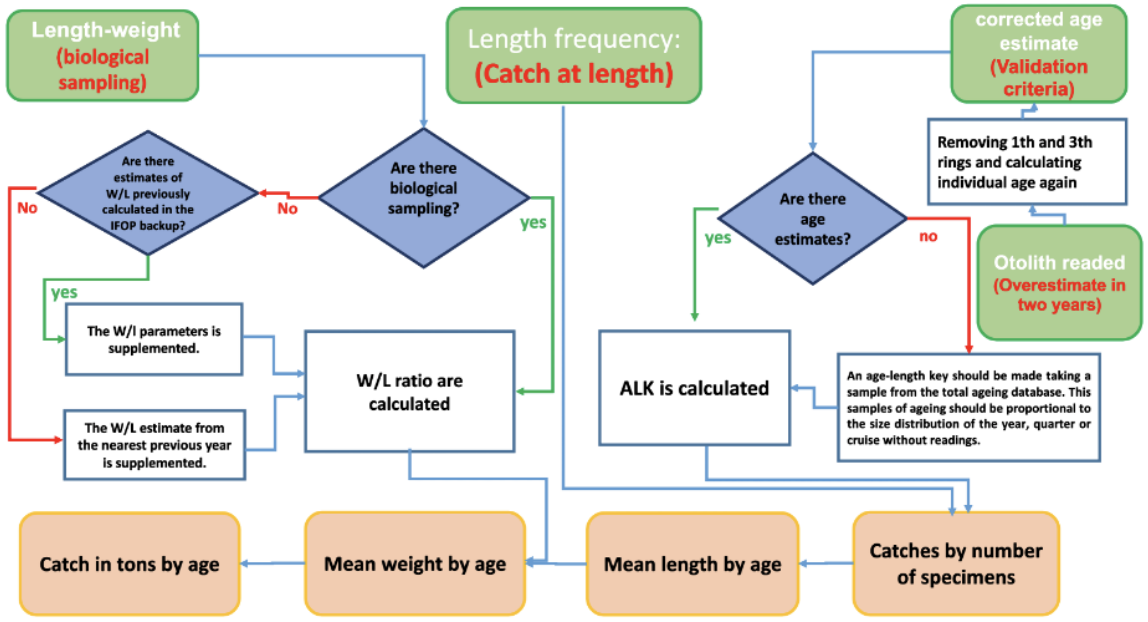

Figure 2. Flowchart submitted by Chile documenting the data processing that results in catch at age data for use in the stock assessment. *The workshop noted that a final box giving catch in numbers at age was missing.*

After discussion, papers showing that older fish ages had been validated with bomb-radio carbon dating were presented. This study comprised older individuals. Some concern remained that researchers ageing older fish may still be counting the seasonal ring as annuli and hence result in over-estimates. Further, concerns were raised about the use of bomb radiocarbon methods to validate the new ageing method, given the uncertainty of ±2 years in bomb radiocarbon dating.

Maite Pons inquired whether marginal increment analyses had been done as an alternative way to validate seasonality. Francisco Cerna presented results of border and marginal increment analysis (SCW11-04) that had been completed. This showed that the proportion of borders showing translucent rings is highest in October/November. This analysis showed an annual periodicity for all ages combined. On the other hand, the marginal increment analysis for younger fish (<5 yr) showed a 2-ring formation per year, validating the ageing technique used by Chile consistent with the conclusions of the new age-determination protocols.

Spatial differences in population age structure between Peru and Chile were made apparent. The group discussed whether those differences affected the comparability of ageing methods between Peru and Chile. Additionally, the group inquired about variable environmental impacts on growth in the Peruvian zone (e.g., due to El Niño). Peru has historically conducted several otolith cross-validation methods, including an analysis that was published in 2013, but those analyses have not been presented in SC meetings in recent years. To date, the growth in the Peruvian zone is taken to be consistent from year to year such that the growth curve used to fit the length frequency data in the assessment model is appropriate. The comparability of ageing methods between Peru and Chile could be addressed at the planned otolith exchange. Further to the recommendation in the previous section, **the workshop recommended that the otolith exchanges take place as soon as possible and that work to confirm age determination protocols be completed**.

The Workshop agreed that the new criteria described improvements to the age determination techniques,

and it was agreed to move on to discussing how the information should be used in data processing.

2.4.1 Dealing with missing observations

The group noted two situations where missing ALK data occurs. One is when there are incomplete observations for the ranges of lengths available in the length frequency data. The second is when an entire survey is missing an ALK.

2.4.1.1 Missing ALK in catch data

For the Chilean fisheries, an ALK is generally available for every year and quarter for each fleet. When there are gaps within the actual fishery ALK (e.g. for lengths that were unsampled from the catch) they are interpolated by using an average age for that length from historical data. This happens rarely and the Workshop agreed it seems negligible.

Martin Pastoors presented a comparison of an ALK using the new Chilean data with ALK from other Members, to see whether the Chilean ALK could be used to fill in ALK for EU data when an ALK is not available. He was expecting to see a shift to smaller individuals. The new ageing method from Chile resulted in the age composition of the catch shifting to older fish, which seemed unusual. This is for all years combined. Ignacio Paya suggested that it might be better to compare the data only for 2020 for Chile. Because there is an effect of the length frequency, it is better to compare new-2020 with old-2020. This requires the 2020 for other members to be available for analysis. It is not clear how to compare ALKs and be sure that they are sufficiently similar. Niels Hintzen noted that the comparison showed the new Chilean ALK as it currently stands may not be appropriate for application to the offshore data. It was clarified that there had been a mistake filling in the ALK template, and a new version of the template was submitted.

The workshop recommended that the ALKs and methods used to derive all of the age composition data be made available prior to the benchmark. This will ensure transparency that is presently lacking between the observed measurements (i.e., length frequencies and ALKs) and the final compiled data used in the assessment.

As mentioned in Section 2.2, Chilean ALKs have historically been applied to offshore fleets for which ALKs were unavailable. Given the new Chilean ageing methods, **the workshop recommended that the offshore trawl data be evaluated closely and re-processed if possible**.

2.4.1.2 Missing ALK in survey data

When ALKs are missing for an entire survey, the approach has been to pool data from the other years. This large dataset is then randomly resampled for ALK observations proportional to the length frequency data within a survey year. This is only done for the Chilean acoustic survey. In response to a question about the sensitivity of the results to the number of individuals sampled from the pooled data, Christian Valero showed a sensitivity analysis for replicate drawn samples of different magnitudes. For years when acoustic survey ALK data were missing (2001-2007) samples sizes of 200, 300 or 400 individuals showed that even with only 200 individuals the mean lengths at age were similar. The samples were drawn proportionally by length frequency within each stratum, so the differences were minor. From this, the workshop noted that it was unclear if the consistency shown by length at age would hold if one examined proportions-at-age (which is much more critical for stock assessment purposes). **In general, ALK data should only be used from the year that it is being applied.** By definition (unless there's minimal year-class variability), proportions at age conditioned on length (a main feature of ALK application) will vary over time unless there is very little overlap in lengths at different ages. That is, since the ALKs are apportioning ages conditional on lengths, it is possible that fish in one length category could be distributed to different ages depending on the relative year-class strengths. **The Workshop agreed that due to these concerns, the age composition data for**

surveys with missing ALKs should have lower weight in (or excluded from) the model.

2.4.2 Implications for the benchmark

One task for the workshop was to evaluate the implications of the new ageing criteria on the assessment for both the benchmark and in the short term for the SC-9 assessment. For the benchmark, the workshop identified key changes:

- Alternative natural mortality parameters consistent with revised growth data
- Revisions in size at age
- Impacts on maturity-at-age
- Revisions of ALKs to apply to available off-shore length frequency data

Ignacio Paya presented some preliminary estimates of natural mortality and maturity at age, given the new ageing method and data. He showed a growth curve including corrected age data and bomb radiocarbon ages as well. Mean length at age for 1975-2018 data before and after the age corrections indicated a shift towards younger fish. Consequently, alternative values of natural mortality were proposed based on different methods. Current values of 0.23 were shifted to 0.35 with the new growth based on application of a tool developed by Jason Cope and others (link here). The tool uses different estimation methods based on life history parameters, and other data for example on temperature. Ignacio Paya also presented alternative maturity-at-age curves with the new data indicating spawning at earlier ages.

The group noted that a natural mortality value of 0.33 is used for the Far North stock in the two-stock model. The natural mortality values used in the current stock assessment are derived from Pauly's method, using the 1995 Gili growth function from Chile and the Dioses (2013) growth function for Peru (see Paragraph 32 of the SC8-Report Jack Mackerel Technical Annex).

Rationale for alternative values of natural mortality will be required going forward. This should include diagnostics to provide support for the values selected. The workshop participants **recommended that a small group be convened (Francisco Cerna, Ignacio Paya, Jim Ianelli, Aquiles Sepulveda) prior to the benchmark to come up with proposed values**. In the past natural mortality had been estimated within the stock assessment model and generally resulted in higher values.

Jim Ianelli presented some Exploratory analysis on the implications of the new ageing criterion, comparing the data in the assessment with newly provided data using "new" and "old" criteria for the South-Central Chilean fleet. It appears that the newly provided (but old) data doesn't line up exactly with what is in the assessment (for average weight; Figure 3). For the benchmark the group agreed that there needs to be consistency between data submissions (e.g., via templates) and the compiled assessment data, including any intermediate databases. Also, for average annual body mass-at-age, it should be appropriately weighted by quarter. Similarly, quality checks will be required for the catch-at-age composition data. There were some slight differences between the revised data set provided by Chile prior to this workshop and that which is currently included in the assessment for age compositions as well (Figure 4).

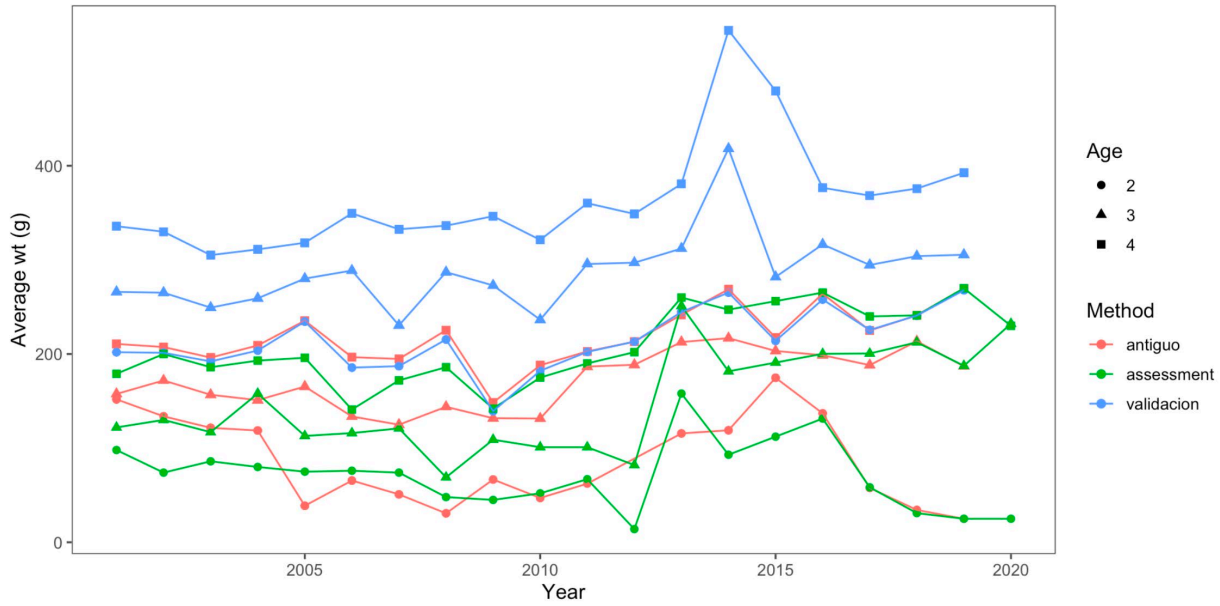

Figure 3. Mean weight-at-age in the assessment (green) compared to the new ("validacion") and old ("antiguo") age determination criterion for ages 2-4 Jack mackerel.

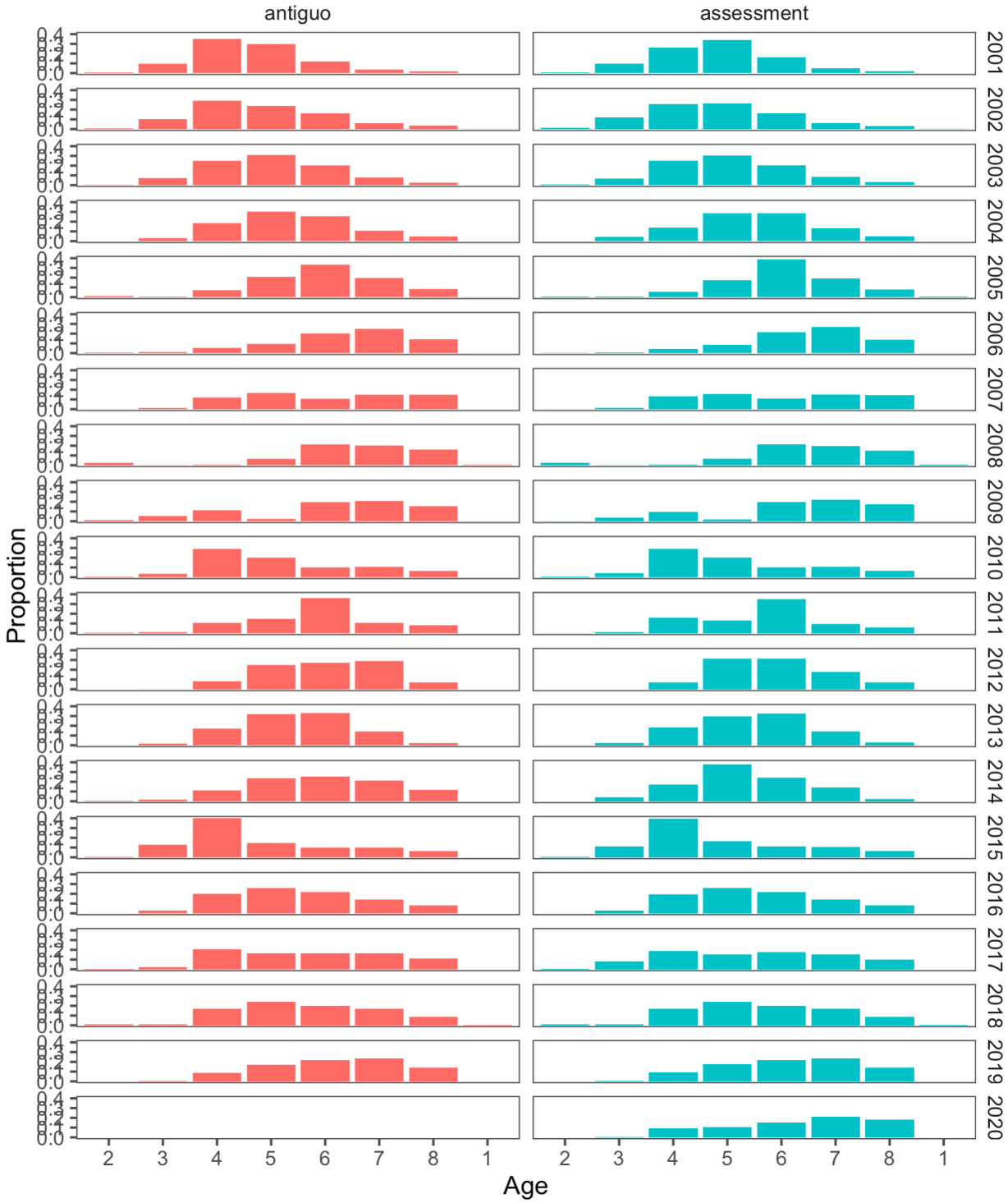

Figure 4. Comparison of proportions-at-age in one fishery as seen presently from the assessment model (right side) and from the updated data using the old ("antiguo") age determination method.

2.4.3 Implications for the 2021 assessment

Noting Figure 4 and the slight differences between the revised data and the data presently used in the assessment, the group agreed that using the revised set was the best available now. This was appropriate for fleets 1 and 2; however, fleet 4 will require more work because of the use of different ALKs. The group **recommended that fleet 4 ALKs and age compositions be updated to be consistent with fleets 1 and 2. Given the amount of work involved, this will most likely only be achievable prior to the benchmark meeting of 2022 and not for SC9.** Given the lack of full evaluation and the benchmark review the group discussed the best plan for the 2021 assessment advice. It was clear that the existing model would be the basis of advice (for one- and two-stock hypotheses) with updated 2020/2021 data. In order to have some idea of how things might change given the data revisions, a limited number of sensitivity runs were developed:

a) 2020 assessment data as is (updated through 2021 as available)
b) As in a) but use revised data series "antiguo"
c) Incorporate revised (validated) age data for surveys and fleets with M and maturity updated (M=0.35)
d) as c) but M=0.45

The group agreed that the new runs may require a change in the wording around the advice to the Commission. Specifically, due to the lack of progress from a benchmark review, it was agreed that model runs would be limited to those detailed above and that the advice would be tempered with greater than usual uncertainty.

3 Evaluation of the Chilean set-based CPUE index

Chile presented an alternative set-based CPUE index at SC8. This index was intended to be reviewed at this Data Workshop. Due to a variety of circumstances, the workgroup agreed to defer further consideration until the forthcoming benchmark. The new CPUE series will be unavailable for evaluation within the assessment for SC9. **However, the workgroup requested that Chile update the currently used trip-based CPUE series in time for the 28 August SC papers deadline** (or better, as soon as possible).

4 Industry derived samples ("self-sampled")

Martin Pastoors made a presentation (based on his paper SC8-JM04) reminding the workshop participants about a comparison of industry derived samples (the self-sampling data) and those from observers. There is generally good alignment in the length frequency between self-sampling and observer data. There may be differences in the data, because the self-sampling may cover more trips. He proposed using the self-sampling data for the length frequency data, to be raised using the ALK to supplement observer data, as there were not observers on all trips.

Niels Hintzen explained that he has sometimes used a combination of the length frequency data from self-sampling data in order to fill obvious gaps (within quarter) from the observer data. This raises the question of creating more complexity if we use the length frequency data from quarters when no EU observer data existed (i.e. there are no corresponding age data). There would be advantages in improving coverage of the length frequency distribution, but disadvantages in introducing more uncertainty to the age composition data (e.g. by using an inappropriate ALK). Fish further out at sea, targeted by the EU, may grow differently than the fish targeted by the Chilean fleet. If the ALKs for fish caught offshore were very similar to those for fish caught closer to shore, the Chilean ALK could be used to convert the additional lengths to ages. If the ALKs are different errors or biases to age compositions could be introduced.

It was noted that the alternative data stream would be in addition to data collected by on-board observers and cover areas when observer data was missing. It was suggested that collecting age/otolith data from

self-samples would also be helpful. In principle it is possible to do this, but there are some administrative or logistical issues. It would be necessary to work out how many otoliths would need to be collected, for example, and who would read them.

It was explained that the samples for the self-sampling data are taken by the fish technician responsible for monitoring the fish quality. In this role measures such as fat content are collected for marketing purposes. Collecting the length data would be in addition to their normal activities. Jan Arge (Faroe Islands) noted that, as a general principle, when there is a high variability in length distributions in different areas it is likely better to sample fewer fish from more tows rather than many samples from a few tows. Such a self-sampling program would facilitate this superior sampling framework.

As far as developing a protocol for when self-sampling data could be used for assessment purposes, the workshop noted that when such data coincided with observers would be required. An accreditation programme for scientific observers is in place but such a system is impractical for a self-sampling program. The workshop noted that there would be some verification of the data as the observers and the self-sampling efforts will sometimes overlap. If they were in sufficient agreement, then the group agreed that the full self-sampling dataset could be reasonably used. Additional scrutiny for potential issues within strata (e.g., area-quarter) might be required. As such, the workshop noted the following guidance for future self-sampling activities:

- Compare the variability in ALKs between quarters, seasons, and areas (this was brought up in the first section, but suggested again in this one)
- Investigate the practicality of otolith collections by non-observers
- Compare length frequency distributions between observer and self-sampled data in order to make a decision about how to combine or not the data for use in the assessment
- Check that this approach would be consistent with CMM 16 (Observer Programme)
- Develop a protocol on how the self-sampling data could be integrated with the observer data for consideration at the next benchmark

5 Updated species profiles for CJM and MAS

Marianne Vignaux explained that there were old species profiles on the SPRFMO website that probably should be updated, and that she had prepared a draft in which material which could not practically be kept up to date, or which would be hard to get agreement on, had been removed (with track changes turned on). There was general agreement that the outdated species profiles should be dealt with, and that providing some sort of accurate species profile was something that the Scientific Committee should be involved in.

Jorge Csirke asked for clarification on the specific format of the species profiles—whether it's a long form or a short form. He noted that the detailed documents have a lot of information that could be very useful, and should not be lost. Marianne suggested that the profiles on the website should be something that would not change much over time, and should also be consistent across working groups.

Things to be updated included specifically the age and growth section for Jack mackerel, and also the profile for chub mackerel. There is a section on the different stock hypotheses for Jack mackerel that could prove to be quite controversial to work on, but Marianne suggested removing this to reduce the probability of disagreement. A proposed short version of these profiles is in the Species Profiles folder on the Teams drive under the General channel for SPRFMO SC9.

Jorge Csirke and Ignacio Paya suggested that it would be ideal to have Species Profiles that were updated (when necessary) every year, but it was agreed that there would not be time within the SC for this to be

worked on and also agreed to. Jorge Csirke and Niels Hintzen both expressed a desire to keep the controversial topics within the profiles for full transparency, but to ensure that politics remained outside of those profiles. Marianne Vignaux explained that the Secretariat is unable to take on this task and it was recommended that Members step up to take this on.

Jorge Csirke proposed having two separate documents:

1. A species profile for the website with biological information that is unlikely to change every year (based on what Marianne Vignaux has already drafted)
2. A short document (synopsis) for the general public with a summary of current scientific knowledge which will likely need to be regularly updated

It was agreed that a small group of Members would work on both of these tasks, including Francisco Cerna (Chile), Ana Alegre (Peru), Antonio Aranis (with particular expertise on chub mackerel), as well as someone from the EU. The short profiles should be dealt with prior to SC09, while the synopses have a target date of the benchmark meeting.

6 Recommendations

The workshop compiled a set of **recommendations** to be considered by the SC and Commission:

- Improve management of completed ALK template data storage
- Standardise processing of ALK templates and the process for raising the length/age frequency data to catch
- Continue use of the ALK template as is, but give better guidance to improve how they are completed
- Work on the data structure for storing age/length data, possibly based on the Chilean database and/or the template reader code
- Conduct an otolith exchange to improve consistency of age-reading methods among Members.
- Make ALKs and methods used to derive all of the age composition data available prior to the benchmark.
- Evaluate and revise the offshore trawl age composition data, preferably in time for the SC9
- Convene a small group prior to the benchmark to come up with proposed demographic values for the assessment

7 Next steps

At the conclusion of the workshop, the following items were highlighted for completion.

Action	By
Improve management completed ALK template data storage	Marianne Vignaux
Provide training/documentation/translations to assist Members in accurate completion of ALK templates	Niels Hintzen (Marianne Vignaux can assist)
Standardise and automate process for raising the length/age frequency data to catch	Niels Hintzen
Work on the data structure for storing age/length data, possibly based on the Chilean database and/or the template reader code	TBD
Compare variability in ALKs between quarters, seasons, and areas	TBD
Otolith exchange is still needed to check that ageing is consistent from different Members	TBD
Prior to the Benchmark, make sure that there are reliable estimates of age composition for all years/fleets	TBD
A small group led by Chile to meet prior to the Benchmark to come up with some candidate estimates of natural mortality and maturity	Ignacio, Aquiles, Jim, others
The Benchmark workshop will consider the implications on the model of new value of natural mortality, new growth, new maturity and new ALKs for all years and all quarters.	Benchmark workshop
For the SC9 stock assessment: a) 2020 assessment data as is (updated through 2021 as available) b) As in a) but use revised data series "antiguo" c) Incorporate revised (validated) age data for surveys and fleets with M and maturity updated (M=0.35) d) as c) but M=0.45	Jim, Lee Qi
New set based CPUE index to be discussed at a meeting between SC9 and the Benchmark workshop so that it can be used as a sensitivity analysis for the benchmark model	Chile
Old trip based CPUE index to be updated as normal and used in the SC9 stock assessment	Chile
Develop a protocol on how the self-sampling data could be integrated with the Observer data, to be in a paper to the SC for approval, to be integrated into the assessment after discussion during the benchmark.	Martin Pastoors
A small group of Members including Francisco Cerna (Chile), Ana Alegre (Peru), Antonio Aranis (with particular expertise on chub mackerel), as well as someone from the EU to review and update short profiles (biological information that is unlikely to change every year) prior to SC09	Identified group
A small group of Members including Francisco Cerna (Chile), Ana Alegre (Peru), Antonio Aranis (with particular expertise on chub mackerel), as well as someone from the EU to produce synopsis with a summary of current scientific knowledge (likely to be regularly updated) prior to the Benchmark.	Identified group

ANNEX 1. List of Participants

JMWG CHAIRPERSON
Martin Pastoors

SC CHAIRPERSON
Jim Ianelli

INVITED EXTERNAL EXPERTS
Lee Qi
Maite Pons

CHILE
Ignacio Payá
Katherine Bernal
Víctor Espejo
Silvia Hernandez
Gabriela Bohm
Christian Valero
Aquiles Sepulveda
Antonio Aranis
Francisco Cerna

CHINA
Gang Li
Luoliang Xu

ECUADOR
Manuel Peralta
Rebeca Espinoza
Viviana Jurado

EUROPEAN UNION
Niels Hintzen

FAROE ISLANDS
Jan Arge Jacobsen

KOREA
Eunjung Kim

NEW ZEALAND
Marco Milardi

PERU
Jorge Csirke
Ana Alegre
Erich Diaz
Enrique Ramos
Pablo Marin

SPRFMO SECRETARIAT
Marianne Vignaux

ANNEX 2. Agenda for the Jack mackerel Data Workshop

1. OPENING OF THE MEETING
   a. Identification of Participants
   b. Confirmation of discussion topics
2. OVERVIEW OF SAMPLE SIZES IN LENGTH/AGE SAMPLING DATA
3. NEW AGEING METHOD DEVELOPED BY CHILE
4. DIAGNOSTICS AND MODEL STRUCTURE OF THE NEW CHILEAN SET BASED CPUE INDEX
5. SELF-SAMPLED LENGTH DISTRIBUTIONS
6. UPDATE SPECIES PROFILES FOR CJM AND MAS