South Pacific Regional Fisheries Management Organisation

Annex SWG-04

Report of the Jack Mackerel Subgroup

Viña del Mar, Chile: 21-26 October 2010

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1. Opening of the Meeting

The meeting of the Jack Mackerel Sub-group (JMSG) of the Science Working Group (SWG) was opened by the chair of the SWG, Mr Andrew Penney (New Zealand), who welcomed all participants. On behalf of all participants, he thanked Chile for hosting the meeting.

Participants introduced the members of their scientific delegations. A list of SWG participants is attached as Annex SWG-2.

2. Adoption of Agenda

The draft agenda (SWG-09-01) was adopted without amendment (Annex SWG-1).

3. Administrative Arrangements

3.1 Meeting Arrangements

The Executive Secretary, Dr Robin Allen, explained the proposed schedule of meetings (SWG-09-03) and other administrative arrangements.

3.2 Meeting Documents

A list of documents from the meeting was provided as SWG-09-02.

4. Nomination of Rapporteurs

Dr. Alexandr Glubokov (Russian Federation) and Dr Ilona Stobutzki (Australia) offered to act as rapporteurs for the meeting. Dr Ianelli offered to coordinate the preparation of technical annexes summarising the stock assessment methods used and the results obtained.

5. Chairmanship of the Jack Mackerel Sub-Group

No inter-sessional nominations were received for a Chair of the Jack Mackerel Sub-Group. The Sub-Group agreed that this meeting would be Chaired by the Chair of the SWG.

Participants asked Dr James Ianelli (independent assessment advisor to the meeting, NOAA) whether he was available for nomination to the position of Chair of the Jack Mackerel Sub-Group. Dr Ianelli noted that this would need to be approved by NOAA.

6. Report on the Assessment Simulation Task Team Technical Workshops

The Chair presented key points from his presentation to the 1st SPRFMO Preparatory Conference (Auckland, July 2010) on the first workshop held by the Assessment Simulation Task Team (ASTT) in Lima, Peru, from 6 – 9 April 2010. The report of the workshop (SWG-09-JM-01) is available on the SPRFMO website. The first ASTT workshop explored a number of alternative candidate stock assessment models for use in SPRFMO jack mackerel assessments using simulated data, and made recommendations on preferred assessment methodologies and approaches for jack mackerel assessments to be conducted in 2010 using real data.

Dr Ianelli presented key points from the report of the first week of the 2nd ASTT workshop held in Seattle from 16 – 20 August 2010 (SWG-09-JM-02A). The primary purposes of that workshop were to specify the framework of the joint assessment model to be used for the 2010 JM assessment, to propose projection methods and reference points and to specify provisional input data for the 2010 assessment. The workshop explored reasons for differences found between the reference and Chilean SCA models evaluated during the first workshop, and developed a Joint Jack Mackerel (JJM) SCA assessment model for use in the 2010 assessments. This model was generalised to facilitate addition of fleets and survey indices, to allow sharing of selectivities over different fisheries, to provide projection capabilities, and to add the possibility of using length data and ageing errors for catch-at-age data. Details of the JMM model specifications, fisheries, indices, proposed projections, reference points and input data are described in SWG-09-JM-02A.

Dr Ianelli then presented key points from the report of the second week (23 – 27 August 2010) of the Seattle ASTT workshop (SWG-09-JM-02B), during which participants were trained in the use of the JJM. The week focussed on implementing refinements to the JJM assessment model and developing routines for producing diagnostics and outputs for the assessment. Modifications include allowing any index to share selectivities between different gear types, and allowing for power coefficients to relate an abundance index (such as CPUE data) to population biomass. Details of the revised model specifications are described in SGW-09-JM-2B. A range of alternate model specifications (sensitivity analyses) and projection specifications (recruitment scenarios and future harvest strategies) were used for initial exploratory analysis of the data available at the workshop. Figures showing resulting model fits to the input data, model outputs, estimated selectivities and projections of estimated biomass and fishing mortality are included in the workshop report.

7. Jack Mackerel Stock Assessments

7.1 Selection and specification of base-case and sensitivity stock assessment runs to be conducted

The Sub-Group reviewed the results of the alternate model assessment runs conducted during the 2nd week of the Seattle ASTT workshop (SWG-09-JM-02B). After consideration of the likelihoods resulting from alternate sensitivity analyses, the group agreed to drop the power fits to CPUE. It was agreed to retain the three growth models used to cohort-slice the Peruvian length-composition data (Peruvian, Kochkin and Gili growth functions). The Gili growth function provided improved model fits in the analyses conducted in Seattle, and it was agreed to use this as the growth function for derivation of Peruvian age-composition in the initial base case assessment model, and to use the other growth formulae in sensitivity runs. It was agreed to add a vessel-type-weighted Russian CPUE index, and to retain all the other indices used in Seattle. It was proposed that one additional sensitivity be run to investigate the effect of the assumption on natural mortality used in the Seattle ASTT workshop.

Other model specifications remained unchanged from those developed by the ASTT during the Seattle workshop. The resulting model base case and sensitivity and projection specifications are summarised below:

Assessment models used: Chile and the EU prepared assessments using the JJM model developed during the ASTT Seattle workshop, in cooperation with Dr Ianelli. The Russian Federation prepared assessments using triple independently separable VPA (TISVPA).

Model specifications:

Model	Description
Basecase Model 1	• All indices assumed proportional to biomass • Soviet age compositions from Russia • Include all index data • Gili growth
Sensitivities	
Model 2	Peruvian growth
Model 3	Kochkin growth
Model 4	Soviet age compositions from Chile
Model 5	Downweight acoustic indices (Double CV)
Model 6	Downweight CPUE data (Double CV)
Model 7	Natural mortality alternative (0.33 instead of 0.23)

Projection specifications:

The initial projection specifications (future recruitment scenarios and alternative harvest strategies) used during the Seattle workshop (SWG-09-JM-02B) were retained unchanged.

Further technical details of the specifications of the seven initial assessment model runs are provided in Annex JM-1, together with results for model fits, residuals for key data inputs and example outputs

7.2 Preparation of data sets required for the agreed stock assessment runs

The Russian Federation provided updated data on historical catches by region (SWG-09-INF-06), data on length and age composition of catches for the historical trawl fishery over the period 1979 – 1991 (SWG-09-JM-INF08) and nominal CPUE by vessel type (SWG-09-JM-04).

Fleet Definitions: It was agreed to use four fleet definitions:

- Fleet 1: Chilean northern area within EEZ purse-seine fishery. Specifications for selectivity of this fleet remain the same as used by the ASTT – Peruvian catch-at-age and growth rates.
- Fleet 2: Chilean southern area within EEZ and high seas purse seine fishery.
- Fleet 3: Far northern area fishery, inside and outside the Peruvian EEZ.
- Fleet 4: International fleet high seas trawl fishery off the Chilean EEZ.

Catch by Fleet: The catch-by-fleet data table developed at the Seattle ASTT workshop was revised and updated in accordance with the above fleet definitions.

- The updated catch data provided by the Russian Federation were used to replace the USSR/Russian Federation catch data used at the ASTT workshop. These were provided in three regions: Inside Peruvian EEZ, off Peru high seas and off Chile high seas.
- USSR historical catches inside the Peruvian EEZ were already included in the reported Peruvian catch, and so were not added again. USSR catches off Peru were included in catches for Fleet 3.
- Ukrainian historical catches, which were separately specified in the Seattle workshop catch table, are included in the historical USSR catch, so were deleted from the table.
- All historical and recent high-seas trawl catches were removed from the previous definition of fleets 1 and 2 and moved to the definition of Fleet 4.

- Cuban high seas catches were apportioned between Fleet 3 (far north) and Fleet 4 (off Chile) in proportion to the distribution of USSR catches between these regions.
- Remaining Chilean purse-seine catches in the Chilean northern EEZ area then constituted the definition of Fleet 1.
- Remaining Chilean purse-seine catches in the southern Chilean EEZ and adjacent high-seas area then constituted the definition of Fleet 2.
- As far as possible, reported catches for 2010 were updated by participants up to the end of September, to provide catch estimates for the most recent year. After updates, the total catch for 2010 used in the assessments was 711,783t.

The final catch-by-fleet catch table used in the assessments is included in Annex JM-1. The updates in catch data resulted in slight decreases in total catch in years prior to about 1990 (as a result of removal of double-counted Ukrainian catch), but no change to total catches since 1990.

USSR / Russian Federation Catch-at-Age: There was substantial discussion of the differences in Russian catch-at-age data provided in SWG-09-JM-INF08 (which consist primarily of ages 2 – 5), and the high-seas catch-at-age used in previous Chilean assessments, which was calculated by applying Chilean age-length keys to historical high seas catches (which consist primarily of ages 5 – 9). There is close similarity in the length-composition of the Russian and Chilean catches, but substantial differences between the historical age-length keys. The differences in age-composition therefore results from substantial differences between the Chilean and Russian age-length keys used to raise length-composition to age composition (Figure X in Annex JM-1).

Given the close similarity between length-composition data, and the indications in recent catches of annual cyclical migration of jack mackerel from the Chilean zone out to the extent of the current fishery (to 120°W, see report of the 8th SWG meeting and SWG-09-04), participants considered it unlikely that there would be such substantial differences in age-composition between the Chilean Zone and high seas catches of Chile.

Within the available time, and without additional work on otolith interpretation and growth analysis, the sub-group was not able to reach agreement on which age-length keys are considered to be more correct for the high-seas catches by Fleet 4. It was therefore agreed to use the Russian age-composition data in the initial JJM assessment model base case specifications, and to run an alternate sensitivity analysis using Fleet 4 age composition derived by applying the historical Chilean age-length keys to the Russian length composition data.

USSR / Russian CPUE: All CPUE indices used by the ASTT workshop were retained. It was agreed to include the historical Russian nominal CPUE (1989 – 1997) as an additional abundance index for Fleet 4, after simple standardisation to produce a weighted average CPUE index across the vessel types in the data provided (SWG-09-JM-INF 04).

Survey Indices: All survey indices (acoustic and daily egg production) used by the ASTT workshop were retained.

7.3 Conducting of agreed stock assessment runs

The two assessments teams (JMM: Dr Ianelli/Chile/EU and TISVPA: Russian Federation) conducted assessments using the agreed model run specifications and input data, and provided results to Dr Ianelli for compilation and presentation to the sub-group.

7.4 Review and discussion of the results of stock assessment runs, and specification of further runs

Dr Ianelli presented a summary of the main results, model fits and residual patterns from the JMM and TISVPA assessment runs conducted (see Annex JM-1). Key observations by the sub-group included:

- Models 1, 2 and 3 (using the Russian historical age composition data for Fleet 4) produce unrealistically high and highly uncertain estimates of recruitment in 2010. This appears to result from substantial model over-estimation of the proportion of small fish in Fleet 4 catches in the past two years (see fits to Fleet 4 age-composition data for 2009 and 2010). This would affect projections if the final estimate of recruitment is included in the periods used in future recruitment scenarios.
- Model 4 provides better fits to age-composition and fleet selectivity data, partially as a result of applying a consistent age-length key across all of the fleets in the southern area (Fleets 2 and 4).
- There was considered to be little biological justification for the alternative *M* value of 0.33 used in Model 7.
- Results of the sensitivity analyses, particularly Models 5 (down-weighted survey indices) and 6 (down-weighted CPUE) show that there is some degree of tension or contradiction between the biomass trend signals provided by the catch-at-age data, and those provided by the indices.
- There is close correspondence between the trends in estimated biomass in the TISVPA and JMM models over the period of decline between 1990 and 1997, and close agreement in estimates of current biomass. The TIS VPA model departs from the JMM models (predicting lower biomass) over the period 2000 – 2005, and prior to 1985.

For the reasons identified above, the sub-group agreed to discard Models 1, 2, 3 and 7 from further JMM assessment runs. Models 5 and 6 were considered to be useful in exploring and demonstrating tensions between the alternative indices of abundance.

It was agreed to go forward with assessment Models 4, 5 and 6 as the basis for providing jack mackerel stock status advice in 2010. Assessment model 4 was designated as the final base case assessment, with Models 5 and 6 providing sensitivity analyses, down-weighting of the acoustic and CPUE indices respectively. The specifications of these three models remained unchanged for the final runs.

For the final model runs, the sub-group requested the following additional outputs:

- Historical trends in fishing mortality (F) for each of the model runs.
- Deterministic ten year projections (to 2020) of trends in predicted total biomass (*B*) and fishing mortality (*F*) under the recent 5-year (2005 – 2009) and ten year (2000 – 2009) average recruitment (excluding the 2010 recruitment estimate), under alternative constant proportions (0, 0.25, 0.75 and 1) of the 2010 catch (711,783t).
- Rations of current and predicted future biomass to current and future unfished biomass ($B_{2010}/B_{2010\ \mathrm{Unfished}}$ and B_{2020} / $B_{2020\ \mathrm{Unfished}}$) for each of the model runs.

7.5 Synthesis and summary of key results from final stock assessment runs conducted

Dr Ianelli coordinated final JMM model runs using the three agreed models, and prepared a technical annex containing the main outputs, model fit results, projection results for the final JMM assessment model runs and main results of the TISVPA analysis (Annex JM- 2).

Participants requested that the final JMM modelling software, control files, output software, projection software, data inputs and indices be made available on the SPRFMO website, for future reference. The SPRFMO Secretariat undertook to prepare an archive containing these files, and to consult with participants regarding potential confidentiality concerns before making the file available on the website.

7.6 Recommendations for Improving Future Assessments

There was substantial discussion regarding the tensions and trade-offs between biomass trend signals provided by catch-at-age data, survey indices and CPUE indices. The sub-group recognised that there are uncertainties and concerns regarding all of these data sources, and that future assessments would be improved by improving each of these data indices. The sub-group recommended that attention be given to the following work prior to the next assessment:

- Cooperative work between participants to develop consistent otolith ageing protocols and to resolve apparent differences in growth-rate analyses for the various regions.
- Further work to improve acoustic indices and to evaluate to what extent they provide indices of abundance for particular areas or stock components.
- If CPUE data are to be used to provide indices of abundance, efforts must be made to develop standardised CPUE indices adjusted for factors such as historical changes in vessels, fishing areas and seasonal fishing patterns.

8. Advice to the Scientific Working Group on Jack Mackerel Stock Status

9. Jack Mackerel Stock Structure Research Programme

9.1 Inter-Sessional Progress with the Jack Mackerel Research Programme

9.2 Application of Hydro-Acoustic Methods to Pelagic Research

10. Revisions to the Jack Mackerel Species Profile

11. Future Jack Mackerel Sub-Group Work Programme

12. Other Matters

13. Adoption of Jack-Mackerel Sub-Group Report and Summary