2017 Scientific Committee

Report of the 5th Scientific Committee Meeting

Shanghai, China
23-28 September 2017

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1. Welcome and Introduction

1. The Scientific Committee Chairperson, Dr. James Ianelli, opened the meeting and introduced the dignitaries from Shanghai: Mr. Xin Zhong LIU, deputy director of Bureau of Fisheries, Ministry of Agriculture of China, Mrs. Li Lin ZHAO, head of the Division of Distant Waters Fisheries, Bureau of Fisheries, Mr. Hai Wen SUN, head of the Division of International Cooperation, Bureau of Fisheries and Prof. Jian Nong WU, the President of Shanghai Ocean University. Mr. LIU and President WU welcomed the group. The SPRFMO Executive Secretary Dr. Johanne Fischer thanked China for hosting the 2017 SC meeting and for the warm welcome that the hosts extended to all participants. Participants (**Annex 2**) then introduced themselves and their delegations.

2. Administrative Arrangements

2.1. Adoption of Agenda

2. The Scientific Committee (SC) adopted the agenda provided as **Annex 1**.

2.2. Meeting documents

3. The list of documents covered are provided in paper **SC5-Doc03_rev1**. There was extensive discussion among Members regarding late papers, however all late papers were ultimately accepted.
4. The SC reiterated its **recommendation** that papers be submitted on time following the SC protocol for submission of papers.
5. The SC **recommended** that an additional category for information papers be established so that it is easier to differentiate papers that have been submitted with the intention to inform substantive discussion from those papers provided as background information papers.

2.3. Nomination of Rapporteurs

6. Rapporteurs were appointed for each section. New Zealand, the USA and Peru for Jack mackerel. New Zealand, the USA and Australia for Deepwater. Chile and Peru for Squid. The EU and Australia for an Ecosystem approach. The USA, Chile and the Secretariat for an Observer while New Zealand and the EU covered the Research Programme.

3. Discussion of Annual Reports

7. Annual Reports were received from Australia, Chile, China, Cook Islands, Ecuador, European Union, Korea, New Zealand, Peru, Russian Federation, Chinese Taipei, USA and Vanuatu. Summaries for those reports are in **Annex 3**.
8. Paper **SC5-Doc07_rev2** was presented, which proposed Revised Guidelines for Annual reports to the SPRFMO Scientific Committee. This revision had previously been circulated to the SC intersessionally.
9. The USA provided some additional text relating to Members who were not currently fishing. Australia also provided minor edits to aid in clarity and **the SC adopted** paper **SC5-Doc07_rev3** as its new Guidelines for Annual reports.

4. Commission guidance and other Inter-Sessional activities

4.1. Commission SC Workplan

10. The Chairperson presented the SC Workplan elaborated in January 2017 by the Commission and stressed that these items needed to be addressed in the current meeting and reflected in the report. He invited participants to provide feedback, in particular, for items that they felt require attention in the future.

4.2. Secretariat SC related activities

11. The SPRFMO Data Manager introduced **SC5-Doc32** on the Secretariat's SC-related activities over the past 12 months. He highlighted the meeting of the ABNJ Deep Seas Project Steering Committee in February 2017, partially sponsored by FAO, where SPRFMO had been represented by Dr. Jianye Tang from China and Mr. Timothy Costelloe from the Cook Islands. The SPRFMO Data Manager attended the SPRFMO Deepwater Workshop in May in Australia and took the opportunity to stay another week liaising with the CCAMLR Secretariat on various matters of common interest. Finally, an FAO workshop on potential impacts of climate change on deep-sea ecosystems and the implications for the management of deep-sea fisheries, was attended on behalf of SPRFMO by Dr. Martin Cryer (from New Zealand, sponsored by FAO) and Mr. Luoliang Xu from China (sponsored by SPRFMO). A number of stakeholder workshops on deepwater fisheries in Wellington were also attended by the SPRFMO Data Manager.

12. The Executive Secretary introduced **SC5-Doc27** (Status of the SC Fund) and she explained that the fund was available for support of the work of the Scientific Committee and that in September 2017 it contained 46 000 NZD, close to its cap of 50 000 NZD. Some funds had been used in 2017 to support the participation of SPRFMO scientists at external meetings and for assistance of the Chairperson at the current meeting. It was agreed to fund the participation of modelling experts for Jack mackerel stock assessment and for squid experts at the next SC meeting in 2018. In addition, there were several proposals for funding, including work related to the aging of Jack mackerel and orange roughy using otoliths; support of the deep-water Zonation workshops organised by New Zealand; data recovery in squid; and participation of SPRFMO scientists at relevant meetings of other organisations, e.g. to workshops organised by FAO or PICES (North Pacific Marine Science Organization). It was also recommended to check the previous report for any activities that might require funding. The following indicative expense plan was suggested:

- Invited experts to the 2018 SC workshop/meeting (work time and travel expenses): 30 000 NZD
- Analytical support (2018): 3 000 NZD
- Support to deep-sea research (coordinated by NZ): 5 000 NZD
- Support to squid-related research (coordinated by China): 5 000 NZD
- Assistance for participation of SPRFMO scientists to external meetings (Secretariat in consultation with Chair): 13 000 NZD

13. Guillaume Carruel, who had completed an internship at the SPRFMO Secretariat during 2017, presented the summary fish profiles contained in **SC5-Doc06**. These were well received by the SC and participants considered how they could be improved. It was suggested to remove the section on research information, add stock status trends, ensure that the catch data were presented in a clear manner and include references. Several participants emphasised that the profiles will require an annual update for catch and stock status trends and for the relevant CMMs. It was advised to take advantage of modern tools for automatic updates and to use a hyperlink to the current CMMs. The SC **recommended** to remove the section containing research information, to investigate mechanisms for automatically updating catch and effort and other dynamic data, to continue the necessary work to finalise the species profiles intersessionally. When these are completed, the SC **recommends** posting the summaries on the web.

4.3. Deepwater workshop report

14. Simon Nicol presented the main outcomes for the workshop that was held in Hobart at the CCAMLR office earlier this year. The Hobart workshop was well attended and had 2 main themes both of which have been brought forward into this meeting. The Stock assessment theme covered a proposed tiered framework (further covered in **SC5-DW04**), assessment approaches for Orange roughy (**SC5-DW11 to DW15**) as well as data limited and non-target species (**SC5-DW09, SC5-DW10**). The Vulnerable Marine Ecosystems theme covered impact assessment (**SC5-DW06, SC5-DW07**) and spatial management (**SC5-DW05, SC5-DW08**).

15. The SC noted that the final Deepwater workshop report (**Annex 4)** provided a consolidation of information on Deepwater Stock assessment approaches and spatial management.

4.4. Pre-SC workshops

16. There were 3 activities conducted immediately prior to the main SC meeting. The first was data preparation activities for the Jack mackerel assessment coordinated by Niels Hintzen from the EU. Last year the SC approved 2 templates for provision of Length Frequency and survey/CPUE data and the SC noted with disappointment that much of the necessary information was provided very late and were often incomplete. The SC **requested Members fishing in the Jack mackerel fishery** to improve their internal processes including identification of "key persons" who would be directly responsible for submitting those templates.

17. A squid workshop was held on the 20th of September. The participants discussed papers **SC5-SQ01 through to SC5-SQ09** in detail covering the topics of basic biology, abundance, distribution, relations with the environment, stock structure, stock assessment and approaches to coordinating research. The Squid workshop report is in **Annex 6**.

18. A second Deepwater workshop was held on 21 September and covered deepwater shark risk assessments, spatial management options and deepwater stock assessment frameworks including orange roughy assessment (**Annex 5**). The SC **endorsed** the following key research priorities:

- Species identification and robust reporting remain issues in assessing the nature and extent of chondrichthyan species catches in SPRFMO bottom fisheries
- There remains a need to progress risk assessments for chondrichthyans to be more quantitative and allow for the estimation of absolute fishing mortality and potentially compare those to reference points
- The need for ongoing monitoring and/or refinement of the underlying data and habitat suitability models, including a focus on ongoing testing and updating of the habitat suitability models for the VME indicator taxa.
- Essential need for biological and age data and fishery independent abundance information for SPRFMO orange roughy stocks

19. The DW working group made the following recommendations to SC05:

- Research priorities as above
- All science presented to the workshop was considered acceptable and should be considered by the Scientific Committee when providing scientific advice to support the development of a new bottom fishing Conservation and Management Measure.

20. The report of both workshops was made available to the SC and was used when formulating the scientific advice contained in Sections 6 and 7 of this report.

4.5. Other SC Task Groups

21. The Coordinator of the Fishery-Dependent Acoustic Data Task Group presented an overview on Fishing Vessels as Scientific Platforms (SC4-26, SC4-Inf-01, **SC5-Doc09**). The Scientific Committee acknowledged the work of this group and considered that acoustic data from fishing vessels are usable for scientific research provided the ship is properly evaluated (SP-08-SWG-JM-11) and the digital echo sounder of the fishing vessel is calibrated following the procedure described by SNP (2015[1]). The SC **recommends** the use of provisional standard equations of Target Strength for CJM (**SC5-Doc10**):
    - For 38 kHz:TS38= 20 log L – 68.9
    - For 120 kHz: TS120 = 20 log L – 69.6 (where L = total length, in cm)
22. The SC **further recommends** that Members work toward a common database format including choice of metrics, indicators, and processing methods. Other future activities in fisheries acoustics will be undertaken according to specific needs inside a wider project on ecosystem monitoring.

5. Jack Mackerel Working Group

5.1. Inter-Sessional assessment/research

23. Chile presented paper **SC05-JM02** on a published study on age-validation of jack mackerel. Conventional ageing using whole otoliths were compared with modal progressions of length frequency distributions and through bomb-radiocarbon analysis. Results suggest that some of the conventional otolith ages appear to be older. Combined with daily ring analysis, results show high growth in juvenile and young-of-year jack mackerel and suggest age overestimation using conventional whole otolith ageing. New validation studies are necessary to increase the accuracy in the determination of absolute age in order to develop a definitive reading protocol for this species.
24. The SC was reminded of the long history of this issue and the amount of work that has been done by Members (especially Chile and Peru) to try to validate ages for *T. murphyi*. The SC discussed that jack mackerel life history is variable, and therefore differences in spawning season, selectivity, and movement may be able to explain differences in growth curves. The SC discussed that studies with different growth curves can define a range of possible patterns (e.g., from **SC5-JM02, SC5-INF04_rev1**). The SC noted that different growth curves can be used to help develop sensitivity analyses.
25. Various approaches for including revised age frequency information in the assessments were discussed and it was suggested that an ageing error matrix could be used within the assessment to map the differences in ageing results. It was also noted that if growth is changed in the model, age at maturity would need to be adjusted as well because it was based on length and converted to age following a growth curve.
26. The SC discussed that determination of a base case (for growth) could be explored intersessionally or at the next SC meeting (or jack mackerel assessment workshop). Members were encouraged to highlight where age structures are available in time and space so that variability can be evaluated.
27. On the issue of variability between age-determination methods, China and the EU stated they could exchange samples with Member scientists. Goals of such a program should be clearly laid out so that samples are representative and that exchange should also ensure that reading of the same otolith are comparable.
28. The Scientific Committee:
    - **Recommended** that there be an exchange of samples among countries to explore differences in growth curves and ageing techniques, with a goal ensure that samples exchanged would comprise a representative sample of the fisheries in terms of space and time. A plan should be developed to determine sampling design and coordinators should be identified.
    - **Recommended** that sensitivity analyses to growth curve scenarios continue to be explored in the stock assessment model, e.g., those from **SC5-JM02, SC5-INF04_rev1**.

[1] SNP, 2015. Calibration protocol for fishing vessels. SPRFMO Task Group on "Fishing vessels as Scientific Platforms". SNP Workshop, Lima, September 2015: 42 pages

5.2. Inter-Sessional Progress with the Jack Mackerel Stock Structure Research Programme

29. Peru presented **SC5-JM03** on life-history stages of jack mackerel in northern Humboldt Current System off Peru and Ecuador. The most distinctive traits of the northern jack mackerel stock that inhabits the northern Humboldt current system off Peru and Ecuador have already been described in earlier contributions and this paper collates the available data on the different life-history stages of jack mackerel observed through time off Peru and Ecuador. They argue that this demonstrates that, in addition to its distinctive traits, the northern jack mackerel stock reproduces and completes its full life-cycle entirely within the northern Humboldt Current System, off Peru and Ecuador.
30. The information analysed included larvae distribution and abundance since 1966, length frequency distributions from the commercial fishery since 1972 and from fishery independent research surveys since 1983, and of sexual maturity and spawning since 1967. They concluded that the information available confirms claims that there is a well-established jack mackerel spawning area off Peru and Ecuador, that there is continuity in the reproductive process within this area, that most if not all the juveniles found off Peru and Ecuador are generated within this area, that juveniles and mature adults of all sizes (and ages) are consistently present in Peruvian waters, and that jack mackerel spawns repeatedly every year off Peru. Thus, this provides clear indications that the northern jack mackerel stock reproduces and completes its full life-cycle entirely off Peru and Ecuador. This supports the first hypothesis considered by the SPRFMO since 2008, that "Jack mackerel caught off the coasts of Peru and Chile each constitute separate stocks which straddle the high seas", with a well-defined self-contained northern stock of jack mackerel off Peru and a separate much larger southern stock off Chile, both straddling albeit not equally, the high seas.
31. Some Members expressed concern with the conclusions that stocks are different based on the evidence of life history stage differences provided. A discussion followed about what data might be needed to more strongly conclude that there are different stocks. Also, they noted that patterns shown in this paper may be described by environmental variability.
32. It was noted that this analysis showed all life history stages within the area. A more definitive way to determine whether stocks (or populations) are different would be to look across entire boundaries and determine the extent of connectivity. The SC discussed that parasites, tagging, chemical analyses, or modern genome sequencing of spawning females; or looking at similar analyses within Chilean waters could help. Australia noted that in their experience, genetics and elemental chemistry is worthwhile, although all approaches have pros and cons and so looking across methods could be informative.
33. It was suggested that a Management Strategy Evaluation (MSE) could be revisited to assess the influence of having one area compared to two with varying degrees of movement, or more simply to use different assessment structures (which is what we currently do).
34. It was noted that changes in environment can influence spawning fish and larvae and thus the environment may affect patterns in abundance more so than site fidelity. Environmental variability would also be reflected in the Gonad Somatic Index (GSI). It was noted that surveys of the whole area might help show where separation exists which would provide a stronger argument for separate stocks noting that this may be complicated by changes over time.
35. The Scientific Committee:
    - **Agreed** to promote continued sampling of data across time and space to increase information to be able to determine stock structure.
    - **Recommended** that further research to better determine stock structure hypothesis should continue and be expanded. Potential methods identified include a comparable analysis over the entire jack mackerel range, assessing genetic differences or elemental differences in fish between areas; or a combination of methods.

5.3. Jack Mackerel Stock Assessments – Technical Session

36. The Commission advised the SC that a "full" assessment would be pursued in 2018 as one was completed at SC04 in 2016. For 2017 they requested an update assessment which meant simply adding in new information without extensive model re-specifications and evaluate whether the two-year TAC advice should be modified to be consistent with the Commission's rebuilding goals and noting the SC's 2016 advice that "should indicators of recruitment continue to be positive, increasing the TAC in 2018 may be appropriate".

37. The Secretariat briefly summarised **SC5-JM01** which is an annual paper providing information on catch histories and expected catches for the most recent year to be used as data inputs into the jack mackerel stock assessment model. Changes to previous versions for this data series were explained in the paper and generally limited to the 2016 final figures as advised by Members. The paper also shows that generally previous estimates for total current catches have been within 10% of the final figures with Fleets 1 (Northern Chile) and 4 (far North) showing the highest variance. The initial 2017 estimates were accepted for Chile (South-central), Peru and the EU. China, Chile (Northern) and the Russian Federation fleets have finished fishing for the year and they were able to provide final estimates. Korea adjusted its initial estimate upwards based upon the recent entry of its vessel into the fishery.

38. The standardized data templates developed over the past two years were again used to receive catch, age and length data from the fisheries and from the data used to derive indices. The templates are intended to facilitate consistent data reporting for stock assessment compilations. The chairs requested the Members to highlight concerns on these templates and whether they should continue to be used. The SC responded that they should continue and **recommended that Members adhere to the protocols for submitting stock assessment data through the use of these templates.**

39. Catch data were updated for all fleets including their age or length compositions. The Chinese CPUE index, offshore / EU combined index, Russian CPUE index, Chilean CPUE index, and echo-abundance index from Chile were all updated.

40. All datasets were added in an incremental way to the dataset used for the assessment to allow testing the impact on stock perception following from each data addition. A complete list of the model configurations and access to the data tables can be found online (https://goo.gl/Gdc2c7) or in **Annex 9** of this report.

41. A comparison was made between the 1-stock and 2-stocks model configuration and both models showed very similar trends for overall biomass. The 1-stock model suggests a more precautionary biomass estimate and hence is used for advice purposes.

42. CPUE estimates from all around the distribution area show diverging signals where Chinese and Russian CPUE show a small downward trend while the remaining offshore fleet and Chilean CPUE show increases.

43. Indications of a strong recruiting 2015 year-class showed up in the Northern Chile acoustic survey in 2016 and again in 2017. The strong year class also showed up in the catches of the EU fleet in the summer of 2017, just outside of the northern Chilean EEZ.

44. Model biomass estimates increased from 2016 to 2017 from nearly 4 million tonnes to over 5 million tonnes, estimated to be at or just above the interim B_{MSY} biomass reference point. Simultaneously, fishing mortality decreased further to a rate of 0.07 in 2017 being well below the F_{MSY} reference point.

45. Results of the 2017 assessment resemble the estimates provided by the 2016 assessment (**Figure 14 in Annex 9**), indicating a stable and mature assessment configuration.

46. Short term projections were carried out using the updated 2017 assessment outcomes, evaluating, among others a status-quo fishing mortality scenario for 2018. The confidence in the abundance of the 2015-year class estimates has increased. It was noted that the fishing mortality rate for this projection is based on the 2017 estimate (which is lower than the 2016 estimate).

5.4. Advice to the Commission on jack mackerel stock status

47. The SC is tasked to give advice on the status of jack mackerel. Advice on jack mackerel stock status at this meeting was based on stock assessments conducted using the Joint Jack Mackerel (JJM) statistical catch-at-age model as developed collaboratively by participants since 2010.

48. Conditions for the jack mackerel stock in its entire distribution range in the southeast Pacific shows a continued recovery since the time-series low in 2010. Under the two-stock model the Northern unit shows stable and relatively low biomass over the past decade.

49. Fishing mortality is estimated to be well below F_{MSY} levels and biomass at or just below interim B_{MSY} levels.

50. Recruitment in the most recent years shows signs of stronger incoming year-classes, including the 2015-year class although the information remains uncertain.

51. The previously identified large recruitment in 2016 has been confirmed as 2-year-old fish in 2017 and indicators of 2017 recruitment continue to be positive.

52. Near term spawning biomass is expected to increase from the 2017 estimate of 5.3 million t to 7.4 million t in 2018 (with approximate 90% confidence bounds of 5.5 – 9.9 million t).

> Given current stock status, the second tier of the Jack mackerel rebuilding plan could be applied, thereby substantially increasing the potential catch. Considering the uncertainties in the assessment however, the Scientific Committee adopts a precautionary approach and advises to **maintain 2018 catches for the entire Jack mackerel range in the southeast Pacific at or below 576 kt**.

53. A two-page summary of the advice on Jack mackerel is provided in **Annex 7**.

Table 1.Summary results for the short term catch prediction for the 2017 model. Note that "B" in all cases represents thousands of t of spawning stock biomass. The interim B_{MSY} is taken to be 5.5 million t of spawning biomass in all cases. The column "Reference multiplier F_{2017}" column refers to the multiplier to the 2017 fishing mortality estimate (which was 82% of the 2017 TAC).

Reference Multiplier F_{2017}	B_{2019}	$P(B_{2019} > B_{MSY})$	B_{2023}	$P(B_{2023} > B_{MSY})$	B_{2027}	$P(B_{2027} > B_{MSY})$	Catch 2018 (kt)
0.00	9 950	100%	15 237	100%	19 413	100%	0
0.50	9 491	100%	12 779	100%	14 684	100%	271
0.75	9 273	99%	11 744	100%	12 901	100%	403
1.00	8 992	99%	10 520	100%	10 950	100%	576
1.25	8 861	99%	9 991	99%	10 158	99%	658

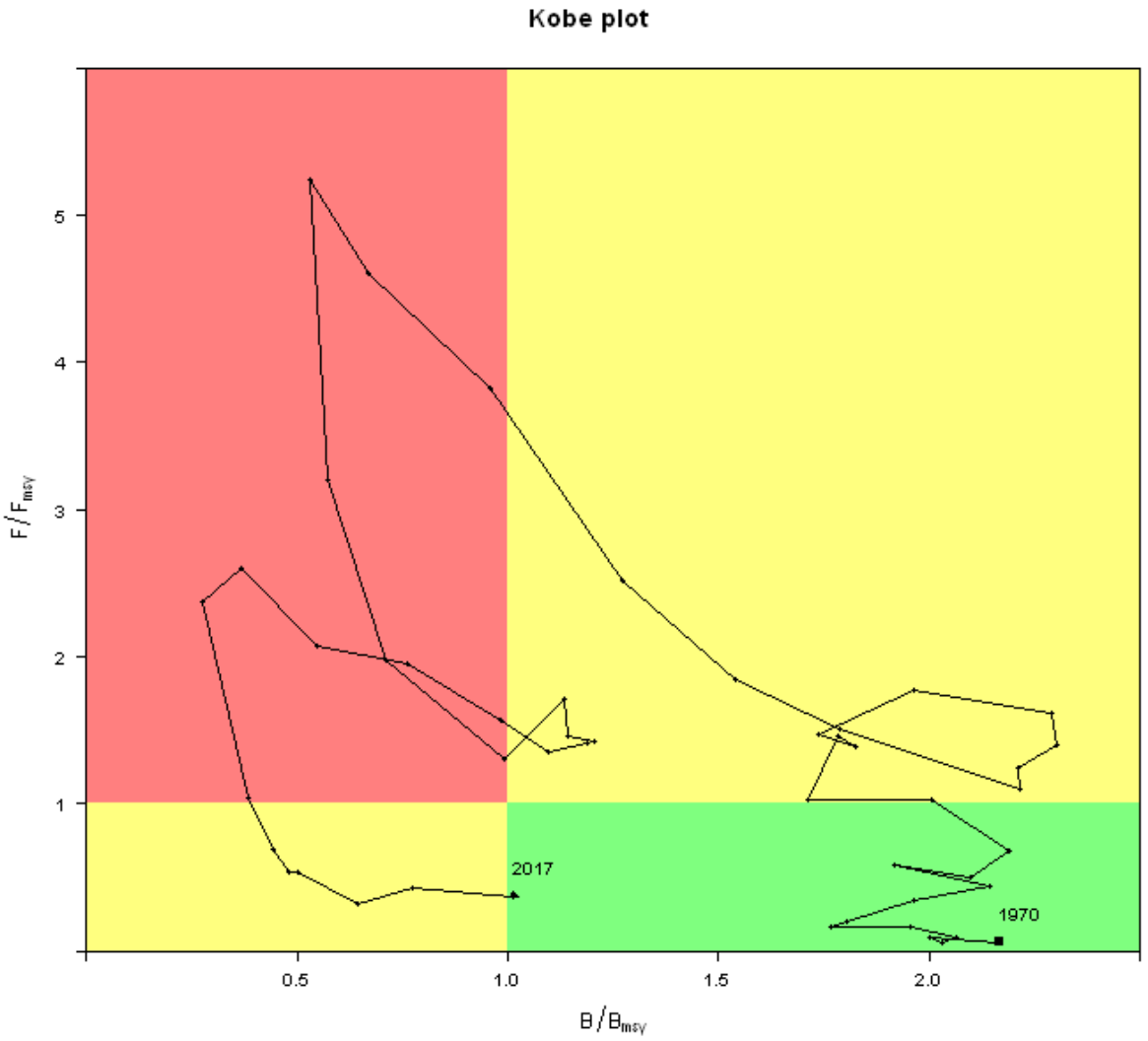

Figure 1. Phase plane (or "Kobe") plot of the estimated trajectory for jack mackerel under the updated 2017 assessment model. Note that annual estimates of B_{MSY} and F_{MSY} are used here.

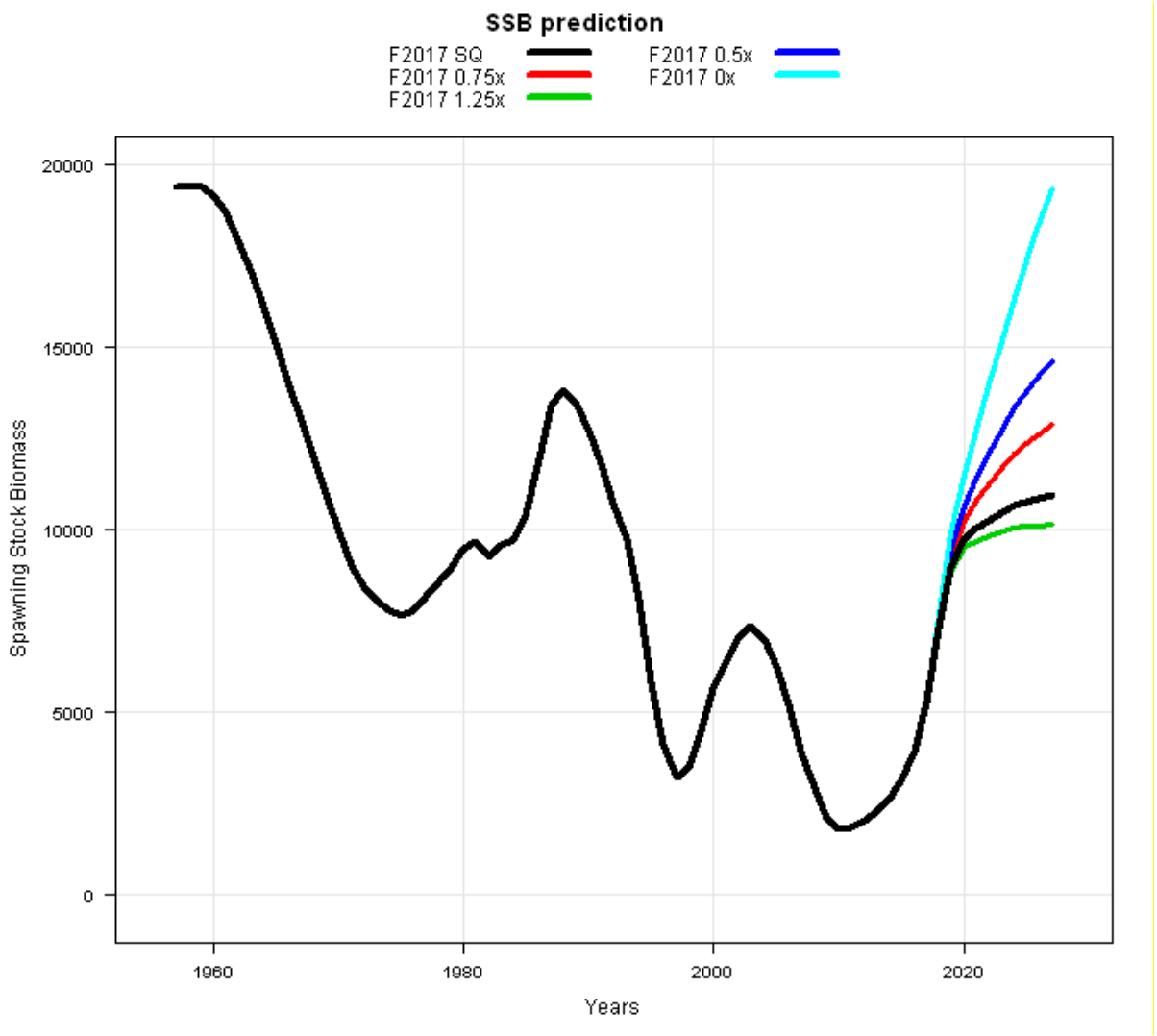

Figure 2. Projections of jack mackerel population trajectories for different multipliers of the reference 2017 fishing mortality rate under the updated 2017 stock assessment model. The interim B_{MSY} is 5.5 million t.

5.5. Other Jack Mackerel topics

There were no other topics discussed under this agenda item.

6. Deepwater Working Group

6.1. Applications to fish outside the footprint or above reference period catch levels

54. Paper **SC5-DW01** presented a proposal from the Cook Islands for an exploratory potting fishery pursuant to CMM13-2017. It described that the main target species were *Jasus* and *pro-jasus* spp. with a secondary bycatch species of *Chaceon* spp. The proposed fishery area is on the Foundation Seamount Chain in the SPRFMO Convention Area. The application proposes to set approximately 800-1000 traps in strings of 200 traps at 25 m intervals, with a 3-day set, soak and retrieve cycle. The traps are stationary and covered with a mesh size of 5 cm and an uninhibited entry/exit to the trap of 35 cm. The proposed exploratory fishery is considered to provide an opportunity to conduct extensive scientific investigation to enhance knowledge of these species and provide a basis for management in this and other areas where it or similar deep sea *Jasus* spp. are discovered. The proposal suggests a maximum annual catch of no more than 6 000 tonnes of product with the intention to harvest up to either 5 500 tonnes of lobster (split to a maximum of 4 000 t *Jasus* spp. and a maximum of 3 000 tonnes *Pro-jasus* spp.) or 5 000 tonnes of *Chaceon* spp. An analysis is provided to estimate biomass of relevant species in the area and provide some indication on the potential impact of the proposed fishing activity on these species. It is proposed that in each location, two or three traps per week will be designated as survey traps and the entire contents of these traps will be bagged and retained for onshore analysis and identification. In addition, a Daily Effort, Catch and Production Log and Daily Environmental Log will be maintained. Crustaceans representative of the main target species will be landed whole for onshore sampling. Samples will be bagged on a species by species basis and sent to the Ministry of Marine Resources or their nominated agent. It is proposed that no less than 10 fish of the main target species will be landed as samples after each voyage. It is intended to engage in approximately 210 days of fishing per annum, spread over the year, split into approximately 7 trips of 30 days. It is intended to commence fishing operation as soon as practicable and thereafter for the 3-year duration of the Fisheries Operation Plan.

55. In principle, the SC supported the development of a proposal for an exploratory lobster/crab fishery, but it was noted that the proposed catch limits in the current proposal may not align with the intent of the CMM for exploratory fisheries, which requires the gradual and precautionary development of new fisheries in accordance with Article 2 of the Convention. The SC noted that the proposal would benefit from a more robust plan for how the information collected would lead to assessment and eventual management of the stocks.

56. The SC suggested that a literature review of exploitation rates, stock assessment mechanisms and precautionary measures that are used in other similar fisheries would help to contextualise whether the 6 000 t catch limit proposed was appropriate as a precautionary fishery in this particular area. It was noted that the resource calculations contained a number of assumptions that would need to be better substantiated with data gathered from fishing operations and potentially through other research.

57. DSCC queried how potential damage to the seabed would be monitored. It was noted that the relevant VME form would be used and that move-on rules would apply as per the CMM. DSCC also queried how potential impacts of lost gear could be mitigated. It was noted that all efforts will be made to retrieve any lost gear and that there is thought to be very little risk that the gear would continue 'ghost' fishing after a few days as lice would remove the bait. It was also noted that there is an escape hatch in the top of the traps and nothing to impede fish and other animals from exiting the trap.

58. The SC discussed whether a subdivision of the area would assist in either spreading or localising effort to better understand the distribution and dynamics of the target stocks. Widespread effort would assist in understanding distribution, while localised effort could potentially be used to assist in understanding depletion rates.

59. In response to the discussion, the SC proposed a possible framework for a phased approach to the development of this fishery, which could inform a revised proposal. Australia and New Zealand offered assistance to the Cook Islands in developing such a phased approach. As part of this approach, phase 1 could include:

- Wide area surveys to understand distribution, relative abundance and/or density estimates for features
- Biological information collection (length info, sex ratio, maturity information etc.)
  (see exploratory protocols from NZ (*Chaceon*)/Western Australia for further guidance)
- VME monitoring – potential use of cameras on pots, identification of all benthic organisms, return to land of anything unidentifiable, possible bathymetric data collection
- Bycatch data collection - species identification, length data, otolith collection of main species

60. Phase 2 could include the design and implementation of depletion experiment(s) in identified area(s). Phase 3 could include work towards stock differentiation and stock assessment (including longer-term yield estimates). It

was discussed that these phases would not necessarily need to happen consecutively, but that elements of each phase could occur simultaneously.

61. The SC discussed that there were three options to progress the proposal:
    - Final proposal by end of SC5
    - Proposal by 7 December (for CTC), with input from a web (or other type) meeting
    - Defer to next year
62. Option 2 was generally deemed to be achievable, although it was noted that the SC could not guarantee that a revised proposal would necessarily be approved.
63. During the SC meeting, the Cook Islands was able to discuss the SC's suggestions with the vessel principals, and the following changes were suggested by them for a rev2 of the proposal:
    - A maximum annual catch limit of no more than 3 000 tonnes with the intention to harvest approximately 2 500 tonnes of lobster (to split this to a maximum of 2 000t *Jasus* spp. and a maximum of 1 500 tonnes *Projasus* spp.) or 2 500 tonnes of *Chaceon* spp.
    - It is proposed that in each location, seven traps per week designated as survey traps would help to provide more biological information on the target and any bycatch species.
64. It was noted that the vessel principals will comply with specific requirements as specified by the SC to meet scientific objectives. The intention is for this to be addressed intersessionally.
65. On considering the advice from the SC against the specific requirements of the exploratory fishing CMM, and the overarching intent of the CMM to develop new fisheries in a gradual and precautionary manner, the SC:
    - **Indicated** that it could not support the proposal in its current form
    - **Agreed** that it could consider a revised proposal that provides more information on how the data collected through a gradual development of the fishery could be used to assess and manage the stocks appropriately
    - **Noted** that work could be undertaken intersessionally to assist Cook Islands to revise the proposal
    - **Noted** that a potential phased approach to developing this fishery would help towards understanding the viability and for collecting the data necessary to ensure the sustainability of future catches
    - **Noted** that such a phased approach would need to include mechanisms for review of the data being collected
    - **Noted** that a revised proposal should include a better definition of objectives and a more explicit data collection plan.
66. Paper **SC5-DW02** provided an update on New Zealand's exploratory toothfish fishery. The 2-year programme of exploratory fishing provided for by CMM 4.14 has been successfully completed and new and important biological information has been collected on toothfish. The key findings are that the catch in 2016 was entirely Antarctic toothfish, *Dissostichus mawsoni*, that these were mostly male (~85%), and that most fish were in spawning condition or spent. In 2017 the catch was entirely Antarctic toothfish with the exception of one individual that was a Patagonian toothfish (*D. eleginoides*), and the sex ratio was far more even. Both surveys provide information on the life history of Antarctic toothfish that is consistent with the current hypothesis on Antarctic toothfish growth and movement, and have provided the first empirical scientific observations of spawning Antarctic toothfish. Information collected during these first two voyages will be shared with CCAMLR and is already being used in the current stock assessment of Antarctic toothfish in the Ross Sea region. Over the coming months, New Zealand will screen video footage and analyse all data collected in more detail than the timing of the voyages has allowed so far. In addition, to maximise the value of future data collection for both organisations' understanding of the distribution, dynamics and status of stocks of Antarctic toothfish, New Zealand will also assess the optimum quantity and nature of data required to enable the development of a spatially-explicit integrated stock assessment model of Antarctic toothfish in the region. It is anticipated that this model, targeted for completion in 2021, will include those components of the Antarctic toothfish stock residing in the SPRFMO Area as well as in the CCAMLR Area. At this stage, it is intended that a comprehensive proposal for the future of the exploratory fishery will be presented to SC6 in 2018.

67. The SC discussed that one of the reasons for the tagging programme was to study the straddling toothfish stock between CCAMLR and SPRFMO, and that the tagging rate was the same as for CCAMLR and information gathered from the fishing will be useful for CCAMLR in refining stock delineation (including transboundary movement) and assessment. The SC queried whether recaptures were near the location of tag releases. The response noted that the fish were tagged and recaptured by the same vessel in about the same location over the two fishing years (2016 and 2017). These data (C2 data) are available and have been shared with CCAMLR. In response to questions about what would be done with the data, it was discussed that there would be little value in SPRFMO duplicating stock assessment and modelling work undertaken by CCAMLR.

68. After considering the presentation of the paper, the SC:

- **noted** the New Zealand demersal longliner *San Aspiring* has completed the 2-year exploratory fishing programme approved under CMM 4.14;
- **noted** that substantial bathymetric, operational, and biological information was collected;
- **noted** that the retained catch each year was under the 30-tonne annual limit;
- **noted** the tag and release of Antarctic toothfish (*Dissostichus mawsoni*) at a rate of three fish tagged per tonne caught, the data from which have been shared with CCAMLR;
- **noted** New Zealand's intention to develop an integrated exploratory fishery programme to maximize the benefits of data collection for both CCAMLR and SPRFMO which will be submitted to SC6 in 2018.

6.2. Inter-Sessional assessments/research

69. Presented at the pre-SC workshop and taken as read at the SC meeting, paper **SC5-DW09** on Deepwater sharks characterized catches of chondrichthyans from bottom fisheries in the SPRFMO Area. Based on both observer and fisher-reported data, 58 nominal chondrichthyan taxa have been caught by New Zealand vessels in SPRFMO bottom fisheries from 2012-2016, of which 53 species were taken in trawl fisheries. Chondrichthyan species occurring in the SPFRMO Area which have had documented negative responses to fishing in other jurisdictions include gulper sharks (*Centrophorus* spp.), spiny dogfishes belonging to the *Squalus mitsukurii* species complex, the smalltooth sandtiger (*Odontaspis ferox*) and school shark. Misidentification of even relatively easily distinguished species (i.e. *S. acanthias* cf. *S. griffini*) is evident in the fisher-reported catch data indicating that species identification is an issue.

70. After considering the paper, the SC:

- **Noted** the potential for deepwater chondrichthyans to interact with bottom fisheries in SPRFMO
- **Noted** that chondrichthyans generally exhibit relatively slow growth rates, late age at maturity, low fecundity and low natural mortality, making them particularly vulnerable
- **Notes** that misidentification of bycaught chondrichthyans is evident in the reported catch data,
- **Agrees** that better species identification processes should be developed in conjunction with the FAO sharks' identification tools
- **Encouraged** all Members and CNCPs operating bottom fisheries in the SPRFMO Area to implement observer programmes that specifically task observers to document deepwater chondrichthyans interactions, record chondrichthyans species bycatch to the lowest possible taxonomic level, and report all such data using the prescribed methods
- **Agreed** on the need to assess data provided on chondrichthyans interactions with bottom fisheries to determine the nature and extent of these interactions at the scale of combined SPRFMO fishing activity.

71. Australia presented paper **SC5-DW10** on a Preliminary ERA for the effects of bottom fishing on deepwater sharks in the South Pacific, which updated the SC on preliminary work towards an ecological risk assessment (ERA) for the effects of demersal and midwater trawl, demersal line, dropline and demersal gillnet gears on deepwater chondrichthyans in the SPRFMO Area. The outputs of the preliminary Productivity-Susceptibility Analysis (PSA) include a number of assumptions that limit the interpretation of results. These results are expected to change based on refinement of the assumptions used in the analysis, including through a process of expert input. The preliminary ERA assessed 127 species that could interact with bottom fishing gears in the SPRFMO Area. The species list will also be refined iteratively. Ninety-six of these species were considered to have robust data and 31 were considered to be data deficient. Data deficient species are defined as those missing three or more productivity or susceptibility attributes.

72. The presenter noted that the next step of the analysis is to refine the various assumptions and identify 'expert overrides', including the identification of false positives (i.e. species assessed to be high risk that are actually low risk) and potential false negatives. It is intended to then undertake a Sustainability Assessment for the Effects of

Fishing (SAFE) analysis, which can provide an absolute measure of risk by determining a proxy for the fishing mortality rate as well as quantitative reference points associated with it (e.g. F_{CURR}/F_{MSY} ratio or similar)).

73. To enable the SAFE analysis, bottom fishing Members will need to provide:
    - Fishing effort footprint for demersal and midwater trawl, line gears and gillnet gears for the period 2011-2016, where available, at a 20-minute (or finer) resolution (as shapefiles).
    - Shark catch data for the aforementioned gears, to be used for
    - verifying the species list and
    - understanding the potential susceptibility of various sharks to certain gears.

74. These data are required from Australia and New Zealand. Once these data are provided, the next steps are to:
    - Critically review the species to be excluded from the final analysis (i.e. those that are not currently likely to interact with SPRFMO fisheries)
    - Critically review the productivity and susceptibility attributes for those species retained.
    - Agree to the final SAFE analyses and timetable for SC report preparation and clearance requirements of each agency.
    - Develop a workplan for other relevant tasks for the SPRFMO Deepwater Working Group.

75. New Zealand reiterated that it strongly supports hierarchical risk assessments (even though they have a slightly different approach) and expressed support for collaboration on this work and noted that it supported the necessary workplan. After considering the advice presented in paper **SC5-DW10** and verbally at the SC meeting, the SC agreed to:
    - **Request** Members with bottom fisheries to continue collaborations and apply more quantitative risk assessment methods to estimate current fishing mortalities (or proxy) for their SPRFMO bottom fisheries;
    - **Request** Members collaborating on the above analyses to develop advice for the Scientific Committee on the effects of fishing on deepwater chondrichthyans;
    - **Adopt** the proposed work plan outlined;
    - **Recommend** to the Commission that the committee's workplan and roadmap are amended to include the work described above.

6.3. SPRFMO Deepwater stock assessments

76. Australia presented a draft stock assessment framework for bottom fisheries within the SPRFMO Convention Area (**SC5-DW04**). The framework was produced collaboratively and with input from the DWG meeting in Hobart, Australia in May 2017. The framework has been proposed to provide direction for future work on bottom fisheries and to increase the efficiency of the SC's future considerations, given that the SC may be requested to provide scientific advice on stock status and catch limits for over 30 demersal species, as well as advice on the impact of fishing on associated and dependent species with which the fishery interacts. The quantity, quality and suitability of data will vary among species over time and space. This variability is likely to influence the parameters that can be estimated and associated uncertainties which, in turn, will influence the scientific advice that the Scientific Committee can provide to the Commission. To improve the efficiency of processes run by the Scientific Committee, a tiered framework for assessing and prioritising stocks for status assessment is proposed based on the parameters that can be estimated given the data available. Such a tiered framework is expected to assist the SC with developing transparent decision rules for advice on recommended biological catches and potential buffers (e.g. 'discount factors') that may be applied to account for assessment uncertainty. The recommended tiered levels consist of:

- Full Benchmark Assessment that utilises catch data from fishery monitoring, ideally in combination with stock abundance from independent surveys, catch rates and biological data with the purpose of estimating depletion levels and fishing mortality rates;
- Data Limited Assessment that may utilise catch only or simple indicators to track status (e.g. CPUE, size composition, Productivity-Susceptibility Analysis);
- No assessment necessary.

77. Two subsets may apply after initial classification of stocks into Tier 1 or Tier 2.

- Research Assessment where new methods or data types are applied which may require substantive review of the methods by the Scientific Committee; and
- Update Assessment where previous accepted assessments are updated with new data.

78. The presenter noted that a scoping analysis for each SPRFMO demersal stock should be undertaken to initially categorise each stock into Tier 1 or Tier 2. Prior to categorisation in Tier 1 or Tier 2 the SC may place some species into Tier 3 (no assessment required) based on the presentation of sufficient evidence that existing measures provide adequate precaution for the known interactions (for example, for species that rarely, if ever interact with the SPRFMO demersal fisheries). Categorisation into Tier 1 and Tier 2 should be based on the data available. Species/stocks with data suitable for estimation of current fishing mortality and depletion should be categorised to Tier 1. Species/stocks initially considered for Tier 1 may be subsequently classified for Tier 2 assessment if the Tier 1 assessment diagnostics fail to satisfy Scientific Committee review. Species not placed into Tier 1 or Tier 3 categories by default are placed in Tier 2.

79. Species/stocks placed into Tier 2 should be subjected to semi-quantitative risk assessment methods such as Productivity-Susceptibility-Analyses and/or Sustainability Assessment for Fishing Effects (SAFE). These methods rank species/stocks into priority from high to low relative risk, with SAFE also being capable of generating indicative estimates of fishing mortality. This step should identify to the Scientific Committee the Tier 2 species/stocks requiring immediate attention (if any). It may be determined by the Scientific Committee that stocks assessed to this level may not require further assessment if the risks from fishing are assessed to be low, or if adequate management measures are in place to mitigate moderate or high risks.

80. The stock assessment framework would eventually apply to up to 30 species which are commonly caught in bottom fisheries, however the main 5-10 species would be the initial focus. Species outside this top 5-10 would likely fall into Tier 2 or 3 and be assessed through risk assessment approaches like PSA, SAFE, or SEFRA methods. The differentiation of Tier 2/3 species is not yet defined, but using quantitative risk assessments would allow the differentiation based on estimates of fishing mortality in relation to proxy reference points (e.g. MSY).

81. Structured models would likely be considered Tier 2, but dependent on the quality of the estimates and level of uncertainty in relevant assessments and associated outputs, i.e. Tiers may be determined based on model outputs, not just methodologies.

82. The current jack mackerel management approach is consistent with the application of the harvest control rule and explicit rebuilding strategy. The approach provides a transparent mechanism for the setting of objectives for the deepwater fisheries (e.g. setting of target/limit reference points). Development and implementation of this framework will result in a fairly large piece of work for the SC which may require a staged approach and wider consultation with Members and stakeholders to get it right.

83. Following the discussion, the Scientific Committee:

- **Adopted** the proposed generalised assessment framework for bottom fisheries to provide direction for future assessment work and speed the committee's processes in developing advice for the Commission.
- **Requested** Members with bottom fisheries or an interest in finalising the framework to work together to develop proposals for biological reference points and harvest control rules for SPRFMO bottom fisheries.
- **Recommended** to the Commission that it agrees to the nature and structure of advice on precautionary catch limits for bottom fisheries that will stem from such an assessment framework.
- **Requested** Members with bottom fisheries to cooperate in the development of a Scoping Analysis for their SPRFMO bottom fisheries.
- **Requested** Members with bottom fisheries to work towards the development of Management Strategy Evaluations to develop robust Harvest Control Rules for their SPRFMO bottom fisheries.
- **Recommended** to the Commission that the Committee's Workplan and Roadmap are amended to include the work described above.

84. Australia presented **SC5-DW15_rev2** which summarises the available information on assessments of SPRFMO orange roughy stocks to enable the SC to make recommendations to the Commission. The assessments were considered by the 2nd Deepwater Workshop held on 21 September 2017. Summaries and technical discussion are detailed in the attached Deepwater Workshop Report (**Annex 5**).

85. The New Zealand High Seas Fishing Group expressed an opinion in relation to the reliability of the CPUE indices given the use of extrapolated data, and noted the conservatism inherent in the implementation of the catch history analysis (CHA) model and subsequent estimates of yield.

86. The appropriateness of the steepness estimates used in the models was questioned, and some information was provided to demonstrate that the estimate of 0.75 used is supported by Orange roughy data that is available from within the New Zealand EEZ.

87. It was also clarified that there are not currently any target or limit reference points agreed for SPRFMO Orange roughy stocks. The inclusion of the 20% B_0 in the work presented by New Zealand is intended to be illustrative, although 20% B_0 is the Limit Reference Point (LRP) used for NZ's MSC certified Orange roughy stocks and is considered a standard LRP in New Zealand, Australia, and a number of other places, where it may be considered the point below which recruitment would be impaired.

88. New Zealand also highlighted that the table provided in the report showing average catch from each area for the last five years does not reflect the actual catch from the Westpac Bank, which is a straddling stock managed by New Zealand. Based on a full Bayesian stock assessment, the catch limit for this stock set through New Zealand's domestic fisheries management regime was significantly increased from 1 October 2014 and catches have increased concurrently (118 tonnes in 2015 and 234 tonnes in 2016). The NZHSFG provided some information on catches for the relevant areas so far in 2017.

89. The SC was reminded that the Commission has been requesting information and guidance on the status of Orange roughy stocks in the SPRFMO Area for a number of years, and while they expressed confidence that Australia and New Zealand are committed to the collection of better data, it is unrealistic to expect that to be available and informing assessments in the next 12 months. Consequently, the SC should recommend precautionary interim catch limits.

90. The need to continue to collect data and develop robust stock assessments was highlighted, as well as the need to consider sub-area catch limits, especially in areas that may be more depleted than others. A point was made that the current catch limit was set based on an average catch during the reference period of 2002-06 and should therefore not be considered precautionary.

91. Following general agreement that there was a need to provide advice to the Commission on interim catch limits, the New Zealand High Seas Fishing Group expressed their position in opposition to implementation of catch limits based on advice that includes consideration of the CPUE/BDM approach as they consider the developed CPUE indices to be invalid and BDM inappropriate and the implementation flawed. They also reiterated their view of precaution built into the yield estimates from the CHA modelling (given the assumptions and model).
92. The SC noted the point of NZHSFG and reiterated the need for improved data collection to better inform the Commission's decisions on catch limits. There is a limit in place, and the question revolves around the appropriateness of that catch limit given the available indicative information.
93. New Zealand reminded the SC that the BDM and CHA approaches were both fully reviewed through New Zealand's domestic peer review process and the work contributing to the BDM was also reviewed at SC4 and the recommendations from that meeting implemented.
94. A suggestion was made for consideration of a mixture of input and output controls instead of only output controls as would be the case with a catch limit.
95. A table of estimated yields from the range of assessments and estimates of the lower 95% confidence interval of stock status was provided to inform discussions of the Scientific Committee on recommended catch limits.
96. It was also noted that the areas open to fishing may change based on the revision of the bottom fishing CMM which may impact (positively or negatively) on the data available to inform CPUE series if, better data became available as hoped, it may not be necessary to use CPUE indices in future.
97. The SC discussed the importance of these being interim catch limits with time limits for the collection of better information to inform more robust assessments of stock status. Discussions also included reiterating the highly uncertain output from the assessment methods used, consideration of the level of precaution required in relation to the potential levels of depletion, and the resolution at which advice should be provided.
98. Noting the urgent need to collect information to support robust assessments of orange roughy in the SPRFMO Area for sound management advice, the Scientific Committee considered the three approaches to assess SPRFMO orange roughy stocks as detailed in **SC5-DW11 to DW14, SC5-INF03**, and the Report of the 2nd Deepwater Workshop of the Scientific Committee (**Annex 5**). Although none of the methods is ideal for the assessment of SPRFMO orange roughy stocks, the SC considered them to be collectively indicative of stock status and potential yields. The development of advice on catch limits for individual stocks was considered but, because of the level of uncertainty in estimates of status and yield by stock, it was considered better to group the stocks for the development of advice.
99. The SC used the lower 95% CIs of estimated stock status to inform the level of precaution that might be appropriate. The group of stocks to the west of New Zealand (in the Tasman Sea) have a greater potential for low stock status than those to the east (Louisville Ridge) and a more precautionary approach was considered appropriate there.
100. With respect to the assessment of SPRFMO Orange roughy stocks and ensuring sustainable fisheries, the Scientific Committee:

- **Noting** that the stocks on the Louisville Ridge (Louisville North, Central and South) have a lower potential of having low stock status, **recommends** a catch limit for the whole of the Louisville Ridge based on the sum of the 50th percentile yield estimates provided in **SC5-DW14**, the CHA stock assessment method, of **1,140 tonnes to apply for the area for no more than 2 years**. A significantly more precautionary approach is recommended if insufficient advancement is made in data collection and stock assessments for the relevant stocks within 2 years. The SC recommends that, within this group, the Louisville Central stock should be prioritised for improved data collection and stock assessment.
- **Noting** that the stocks in the Tasman Sea (Lord Howe Rise, Northwest Challenger Plateau, and West Norfolk Ridge) are estimated to have a higher potential of being depleted, **recommends** a catch limit for the Tasman Sea stocks based on a 0.5 scaling of the 50th percentile yield estimates provided for relevant stocks in **SC5-DW14** (690 tonnes) from the CHA stock assessment method, resulting in a catch limit of **346 tonnes for the area to apply for no more than 3 years**. A significantly more precautionary approach is recommended if insufficient advancement is made in data collection to support stock assessments for the relevant stocks in 3

years. The SC recommend that, within this group, the Lord Howe Rise and Northwest Challenger Plateau stocks should be prioritised for improved data collection and stock assessment.

- **Notes** that New Zealand will advise the Commission on an allowance for Westpac Bank which would be in addition to the limit proposed above.
- **Recommends** no allowance be included for the South Tasman Rise area which is closed to fishing by Australian and New Zealand vessels.

6.4. Deepwater spatial management approaches

101. New Zealand presented **SC5-DW05** a Report from Stakeholder workshops held to gather views on revising the current CMM for Bottom Fisheries, which covered the use of decision support software to inform the design of spatial management areas for bottom fisheries in the western SPRFMO Area to avoid significant adverse impacts on VMEs while providing for fisheries. It is intended that the software tool Zonation will be used for this work, and the workshops were intended to inform scientists and officials on key inputs, settings, and approaches for the analysis. This work is a continuation of previous work to develop a revised a Conservation and Management Measure for bottom fisheries. Zonation begins by assuming that the landscape is fully protected, and then progressively identifies and removes cells that cause the smallest marginal losses in the representation of biodiversity features. Iteratively removing the cells with least value first leaves the cells with highest value until last, producing a nested hierarchical prioritization of the landscape based upon representation. 'Conservation cost curves' can be used to illustrate the relationship between the geographic extent of protection and the representation of VMEs (or other prioritised species/area of interest), as determined by the proportion of the predicted distribution of each VME taxa occurring within protected areas. The inclusion of a cost layer to reflect the value of areas to the fishing industry allows the software to find solutions that provide substantial conservation benefit at low cost to the fishing industry.

102. The presenter noted that the workshop report was intended to record the basic results and decisions from the workshops, and does not describe the Zonation software or other underlying data inputs in any detail. Those inputs have previously been presented to Scientific Committees and SC workshops. Key **agreements** from the workshops include:

- The area, depth, and fishing methods to be included
- The taxa to be included as indicators of VMEs
- Exclusion of EEZs from the Zonation analyses (but not from the underlying habitat suitability models)
- Use of Core Area algorithm
- Use of a naturalness layer (and the method to estimate the layer (**SC5-DW06**))
- Recognition of uncertainty in the habitat suitability models
- No use of edge removal or boundary length penalties

103. The next steps include the incorporation of final data layers, including the naturalness layer and updated habitat suitability models for the wider region included. Once the data layers have been included and the final models have been built, another workshop(s) will be held to discuss and advise on the design of a spatial management regime which will contribute to meeting the objectives of the SPRFMO Convention. The effectiveness of any new proposed management regime (in terms of maximising VME protection or minimising fishery impacts) can then be evaluated with additional Zonation analyses that can identify the location of spatial management measures and assess the benefits they deliver.

104. It was queried whether there was some indication of the level of model error in the Zonation outputs. In response, it was noted that there is some uncertainty in the prediction of VME occurrence and that different inputs and tweaks will give different optimization results in the benefits curve and that is why sensitivity analyses are being conducted. It was noted that some stakeholders have more concerns about the uncertainty inherent in the methods than others.

105. It was agreed that the model is an important tool and the SC supports its implementation, although it was observed that there is a need to collect data to test and challenge the underpinnings of the model and the model itself, and that the new CMM should include a process for validation and model updates.

106. It was noted that as the Zonation outputs come into play, spatial management changes may either hinder data collection for CPUE models if more areas are closed, or alternatively if more areas are open they may help with CPUE models. In view of the problems identified with CPUE, it was noted that the DWG workshop identified the

high importance of promoting the collection of fishery independent information, primarily acoustic biomass estimates and catch at age data, that covered the whole species distribution within any proposed stock unit.

107. It was noted that additional work is required to finalise input data and Zonation runs. It is anticipated this work will be done in the weeks following the fifth meeting of the Scientific Committee and in time for the drafting of a new CMM for the consideration of the Commission in 2018.

108. After considering the paper/presentation and ensuing discussion, the SC:

- **Noted** the series of workshops convened by New Zealand to include industry and environmental stakeholders together with researchers and officials from both Australia and New Zealand;
- **Noted** the substantial progress made in capacity development and agreement on analytical methods that can be used in the design of candidate spatial management areas to meet the objective of the SPRFMO Commission;
- **Agreed** that the analytical approach using Zonation decision-support software is scientifically defensible and appropriate;
- **Agreed** to support, if necessary, an additional deepwater working group in October or November 2017 to finalise the Zonation analyses and oversee scientific analyses required to underpin the design of candidate spatial management areas

109. New Zealand presented **SC5-DW06** on Spatial Impact Assessment Methodology containing a spatially explicit method to estimate bottom trawl impacts in deepwater fishing areas of the SPRFMO Convention Area. The method is based on an impact assessment framework developed for CCAMLR bottom impact assessment of longline fishing gear. The 'footprint' is defined as the area of the sea floor potentially contacted by bottom fishing gear. The 'footprint index' is a measure of the size of the footprint per unit of fishing effort (i.e. per linear km of trawl). 'Impact' is defined as the proportion of vulnerable benthic taxa that are damaged or destroyed by contact with bottom fishing gear within the area of the footprint. So, the 'impact index' is a measure of what proportion of vulnerable benthic organisms are damaged or destroyed with the area of the footprint per fishing effort. The impact index ranges 0 to 1 and varies depending on the fragility of the taxa in question. In practice impacts are often only estimated for the most fragile taxa. When combined with the results of spatial habitat mapping or applied within defined habitat zones (e.g. depth ranges) spatially explicit impact assessments of this nature can be used to estimate the current intact status (i.e. proportion of the taxon or habitat remaining undamaged, analogous to current biomass in fisheries) for VME taxa. Even in the absence of spatial distribution layers for VME taxa, a spatially explicit impact layer is useful to inform the design and evaluation of spatial management strategies, for example by showing which locations are already too heavily impacted to provide conservation benefit, and by making explicit the consequences of preventing or allowing future fishing in different locations.

110. The presenter noted that the next steps include the incorporation of non-New Zealand data and incorporation of impact index results into quantitative analyses which have only been applied to the footprint. It is intended that this work will inform the design and evaluation of spatial management measures through inclusion as a 'naturalness' layer in the zonation analysis.

111. After considering the paper, the SC:

- **Noted** the successful application to SPRFMO bottom trawl fisheries of the spatially explicit bottom fishing impact evaluation methodology originally developed for CCAMLR bottom line fisheries
- **Agreed** that this methodology is appropriate for assessing the impacted area, intensity of impact by location, and likely impact on benthic epifauna
- **Agreed** that the methodology should be applied to develop spatially-explicit bottom impact evaluations for all deepwater bottom fisheries in the western SPRFMO Area

6.5. Revised Bottom Fishing CMM

112. New Zealand presented **SC5-DW03** on a Bottom fishing CMM revision and updated the Scientific Committee on progress towards the development of proposals for a new Conservation and Management Measure (CMM) for bottom fishing throughout the SPRFMO Area. The main focus of the paper is on scientific aspects of the work related to current bottom fisheries in the western part of the SPRFMO Area and the Committee's approval for these methods is sought. Australia and New Zealand updated the Commission in January 2017 on progress as at the end of 2016 (paper Comm5-INF05) and this paper records progress against the work anticipated in that update.

113. The presenter noted that they anticipate that a new bottom fishing CMM can be prepared for consideration by the Commission meeting in early 2018. The CMM may include or provide linkages to other CMMs regarding matters that are not the main focus of this paper, including exploratory fishing, bycatch mitigation measures for

seabirds, etc. Australia and New Zealand have agreed to work very closely together to use the existing and anticipated scientific results to design a new CMM to meet the objectives of the SPRFMO Convention.

114. After considering the paper, the SC:

- **Noted** the progress that has been achieved in scientific analyses required to underpin a comprehensive bottom fishing CMM for the SPRFMO Area;
- **Noted** that further work is required and New Zealand and Australia will continue to progress the development of a revised bottom fishing CMM in order to submit a proposed draft CMM to the Commission meeting in early 2018;
- **Agreed** that the scientific approaches applied by Australia and New Zealand are appropriate to underpin a revised bottom fishing CMM;
- **Agreed** to convene or otherwise support, if necessary, an additional workshop in October or November 2017 to finalise the Zonation analyses and oversee scientific analyses required to underpin the design of candidate spatial management areas.

115. New Zealand presented **SC5-DW08** Utility of move on rules, which informs the Scientific Committee on the utility of move-on rules as part of a bottom fishing Conservation and Management Measure (CMM) designed to meet the Objective of the SPRFMO Convention and obligations under UNGA resolutions (insofar as these relate to impacts on habitat and vulnerable marine ecosystems, VMEs). Move-on rules provide a rapid response to evidence of vulnerable marine ecosystems in bottom fisheries and they can be used to develop protective measures for VMEs in the early stages of a fishery when information is scarce. However, once objectively-designed spatial management measures have been implemented to prevent significant adverse impacts on VMEs, move-on rules provide little additional benefit for VMEs and they have significant costs in terms of monitoring requirements and operational uncertainty for fishers. The paper considers that the potential information gathering benefits of move-on rules can be better met using structured and mandatory collection and review of benthic bycatch in bottom fisheries. Move-on rules are best viewed as an interim data collection and protection measure until evidence-based and comprehensive measures are in place.

116. Australia and New Zealand, with support and advice from Chile and EU, have used a series of stakeholder workshops to consider the best available science using decision-support tools to design potential spatial management areas to provide for sustainable fisheries while preventing significant adverse impacts on VMEs.

117. Move-on rules may have some utility within a spatial management regime designed to provide these joint outcomes if new and highly unexpected insights into the distribution or density of VME indicator taxa arose from the benthic bycatch in a particular trawl or a sequence of two or more trawls.

118. It was noted that the discussion around move-on rules was perhaps more of a policy question than a scientific question. However, there was general support of the benefits of retaining move-on rules as a useful tool to mitigate impacts on VMEs before objectively designed spatial management is in place.

119. The SC discussed trigger values for move on rules in the context of new spatial management measures as outlined in **SC5-DW05**. It was considered that if VMEs are already sufficiently protected within spatial management measures, there is a need to adequately determine the definition of 'high' thresholds for VME encounters so that the move-on rule is not needlessly triggered in cases where Significant Adverse Impacts on VMEs are not occurring. Consequently, the 'high' threshold for VME encounters should be informed by values that challenge the VME distribution models. The SC discussed the importance of feedback in refining the models feeding into spatial management measures in terms of data that supports or does not support the models.

120. It was noted that fishing is a crude mechanism for understanding the impact of fishing on benthic taxa and that landed VME catch may not be reflective of the true impact on VMEs. It was queried whether there was some way of comparing the likely impact on the seafloor with what is retained and brought on board vessels. In response, it was noted that the on-board bycatch was regarded as an indicator of potential VMEs and not a definite record of VME presence. It was noted that a potential solution may be the use of cameras to get better indications of the

level of retained catch to actual impact, but it was noted that this may be prohibitively expensive in many circumstances.

121. After considering the paper/presentation and ensuing discussion, the SC:

- **noted** the diverse guidance on Conservation and Management Measures for bottom fisheries available from UNGA resolutions, FAO documents and guidelines, published reviews, the SPRFMO Convention, and the existing CMM;
- **noted** the progress on the development and testing of methods to model and map VMEs in the western part of the SPRFMO Area and on the application of software-based methods to design candidate spatial management areas to provide for sustainable use while preventing significant adverse impacts on VMEs;
- **noted** the application of such decision-support tools by Australia and New Zealand in multi-stakeholder workshops in July-August 2017;
- **affirmed** its agreement at SC-01, SC-02, SC-03, and SC-04 that a revised comprehensive CMM for bottom fisheries in the SPRFMO Area should be based on a spatial management approach;
- **agreed** that move-on rules should be viewed only as "back-stop" measures (if required) to complement spatial closures developed using decision-support software and designed to prevent significant adverse impacts on VMEs;
- **agreed** that the potential information gathering benefits of move-on rules can be better met using structured and mandatory collection and review of benthic bycatch in bottom fisheries;
- **agreed** that, should a move-on rule be implemented as part of the revised CMM for bottom fisheries, the threshold for triggering such a rule should be high. Ideally a move-on response should follow more than one encounter involving weights of bycatch of benthic fauna that would indicate the models used to predict the distribution of VME taxa are misleading
- **agreed** that future research could investigate the relationship between indicator taxa retained in nets compared to actual presence of VMEs and associated impacts, for example through the use of cameras.

6.6. Other Deepwater topics

122. New Zealand presented **SC5-DW07** entitled BFIAS review, which provides for the SC's consideration an examination of the Bottom Fishing Impact Assessment Standard (BFIAS) in the SPRFMO Convention Area. The paper identifies criteria that may need clarification and proposes potential revisions. In doing this it draws on other RFMOs and describes some inconsistencies between current practices and convention requirements. Since the BFIAS was agreed in 2011, there have been new SPRFMO CMMs, updates to UNGA Resolutions, and experiences and learnings from other RFMOs. The paper suggests that an intersessional working group is formed to:

- Provide a full critique of the current BFIAS and its currency given new developments in demersal fisheries management for consideration by the Scientific Committee in 2018;
- Prepare a revised and updated BFIAS (if required) for agreement no later than the SC's meeting in 2019.

123. The SC suggested there is merit in reviewing and revising, as necessary, the existing BFIAS to reflect new measures, mechanisms, and terminology now used in SPRFMO.

124. The SC considered that any revisions made to the BFIAS should be made relatively timeless so that BFIAS doesn't need to be continually updated. However, as a matter of good practice, the SC could seek to review the BFIAS every five years to identify any improvements to the BFIAS taking into account best practice.

125. It was noted that the proposed schedule for refreshing the BFIAS (by 2019) is quite generous, and that this has been done in light of other SC commitments scheduled for 2018. Other Members were encouraged to contribute and share the workload with Australia and New Zealand.

126. It was acknowledged that it is important to consider a range of agreements that have come about since original adoption of the standard and that there is a lot of overlap with other FMOs, and there is a possibility of collaborating with other RFMOs on revising the standards.

127. The SC discussed the possibility of consultation workshops during development, and it was suggested that the process might be to first compile all the information at which point the SC could suggest consultations need to occur.

128. After considering the paper/presentation and ensuing discussion, the SC:

- **noted** the BFIAS was agreed in 2011 and much has since changed in SPRFMO
- **noted** that UNGA has issued resolutions which reinforce the importance of conducting impact assessments which take full account of the FAO Deep Sea Guidelines and assess the individual, collective and cumulative

impact; and further note that it would be appropriate for SPRFMO BFIAS to be revised to reflect these international developments to ensure current and future bottom fishing is assessed against a contemporary standard

- **agreed** that independent peer-review was important for the SC to consider as part of this process.
- **agreed** that the BFIAS should be refreshed to reflect changes in SPRFMO and international instruments since it was published
- **recommends** to the Commission that the SC's Workplan should include preparation of a revised and updated BFIAS for agreement no later than the SC's meeting in 2019

7. Squid Assessment

7.1. Inter-Sessional assessments/research

129. A number of papers were presented and discussed in detail and summaries are presented in **Annex 6**.

7.2. SPRFMO assessment approaches

130. The Chairperson of the squid working group presented the report of the workshop that took place 2 days prior to the SC meeting. The SC endorsed the report and adopted its recommendations as included below. The results of a preliminary assessment using a Bayesian state-space surplus production model with CPUE data from China that suggest that jumbo flying squid is not overexploited were extensively discussed. The SC also considered other information provided by Peru and agreed that at present there are no signs of jumbo flying squid being overexploited and that current catches appear to be below those corresponding to maximum sustainable. The assumptions and limitations associated with the application of the production model were discussed in the context of squid stock structure, life history, and population dynamics. The development of age or length structured models, which require more biological information, were discussed. In the meantime, exploration of data-limited stock assessment methods was also recommended. It is suggested that these models should be carefully evaluated and compared for their performance in capturing the squid stock structure and population dynamics.

131. It was recognized that Coastal States can react and adopt management decisions with respect to their EEZ stocks much faster than what the SFRMO could do with respect the Convention area, noting that the SFRFMO has to follow annual cycles in their stock assessments and their decision making, which may end it up having up to a 2 years delay from the time a severe decline requiring immediate management action may be detected and assessed (e.g. by the Scientific Committee) to the time proper management decision may be taken and implemented (e.g. by the Commission). This delay seems to be too long for squid that have a lifespan of 1 to 1.5 years. Essentially, SPRFMO management decisions would need to be based on recruitment projections since all squids die within 1 and 2-year time. In other areas, well managed squid fisheries are based on in-season stock assessment and escapement biomass at the end of seasons. The risk of applying a longer-lived finfish management frameworks to jumbo flying squid should be evaluated, giving proper consideration to the possible implementation of an in-season framework in the SPRFMO.

132. The uncertainty about the number of jumbo flying squid stocks in the Southeast Pacific is recognized and it is proposed that, as is being done in with jack mackerel assessments, different hypothesis about the number of stocks and stock structure be considered in future jumbo flying squid assessments. The need to conduct research on the number of stock units was also discussed, and several methods were mentioned. It was recognized that further discussions about this topic is required.

133. The use of current data templates for recovery of historical fishery data extended as far back as possible was agreed. The use of observer template was extensively discussed considering human observers and electronic monitoring because of jigging vessel limitations to accommodate human observers. The use of voluntary and specific data templates for squid stock assessment, in the same way as it is done in jack mackerel stock assessment, was proposed.

134. Some Members noted the difficulty of having observers on some vessels in the jumbo-flying squid fishery for data collection. The inclusion of a recommendation to analyse the minimum required coverage of sampling in the jumbo-flying squid fishery was controversial. One point of view was that the coverage level should be defined by the SC level and recommended to the Commission. The other point of view was that we need to wait for the final report of the observer program working group to be examined and agreed upon by the Commission. It was also mentioned that the level of coverage was a problem common with respect to several species and not only squid.

135. The SC **agreed** that a squid stock assessment workshop should be held prior to, or in conjunction with the next SC meeting. The terms of **reference, date and venue of such workshop** should be defined in an intersessional work of the squid working group. Some ideas for the terms of reference were discussed, considering modelling approaches including ensembles (to account for, among other things, uncertainty in stock structure).

136. SC5 endorsed the following squid workshop **recommendations** to:

- **Acknowledge** that Jumbo flying squid distributed in the Southeast Pacific straddles between the Convention area and the adjacent areas under national jurisdictions.
- **Evaluate** working hypotheses on **stock structure** using data combined from Members and CNCPs.
- Also **relative to stock structure**, research on the distribution, migration routes and intermixing patterns, should be pursued (e.g., samples for micro-constituents, genetics, morphometrics, tagging, etc.). This should include mature male and female length frequency distribution comparisons at fine temporal and spatial scales.
- **Promote** research on the **reproductive process** and the effect of environmental factors in determining the timing and the location and extension of spawning areas.
- Determine the **most suitable stock assessment** models and management alternatives to be applied for Jumbo flying squid for use in the Convention area. This could include research on methods for recruitment and escapement estimation.
- **Promote** research on fishing impacts relative to **predator-prey** interactions and cascading ecosystem impacts and changes in life history parameters including possible effects of changing environmental conditions.
- **Refine and develop** data templates to address data gaps for informing a full stock assessment, as not all required information is contained within the templates.
- **Encourage** Members and CNCPs to share data and information necessary for stock assessment.
- **Use** current detailed reporting forms to recover historical data and report the historical information to the extent possible.
- **Develop** an appropriate mechanism to achieve these objectives

8. Ecosystem Approach to Fisheries Management

8.1. Seabird monitoring

137. Paper **SC5-Doc28** discussed conservation concern for antipodean wandering albatross (*Diomedea antipodensis antipodensis*), which are endemic to the Antipodes Islands within New Zealand's EEZ. The risk of fisheries bycatch to this species in the SPRFMO Area was highlighted by Baird et al. in SWG-11-INF-02a. Due to the vulnerability of this long-lived and slow breeding sub-species to fisheries bycatch, their survival, productivity, recruitment and population trends have been monitored during almost all annual visits to Antipodes Island since 1994. The number of nests in census blocks increased until 2004, declined dramatically between 2005 and 2007, and has continued to decline since. At the current rate of decline there will be only 500 nesting pairs of albatrosses in 20 years, compared with 2900 nesting pairs in 2015-17. There was also a significant and dramatic decline in adult female survivorship in 2005, and much less dramatic declines in male survivorship and nesting success at the same time. Mark recapture estimates of population size indicate that since 2004, this population has declined: males at 6% per annum and females at 12%. Whereas the number of males and females in the breeding population were approximately equal before 2004, there are now more than two adult males per female. The rapid drop in numbers has been caused by high adult mortality, especially of females. Recent tracking data has highlighted the potentially extended foraging range of this population, particularly females. Birds are regularly foraging to the north-east of New Zealand and as far as the South American coast. The foraging range of Antipodean wandering albatross to the north and east across the SPRFMO area highlights the importance of actions to understand and minimise bycatch in SPRFMO fisheries in order to address this conservation concern. Further understanding the causes of and solutions to the high female mortality is urgently required as the high and sustained rate of decline has put this species into New Zealand's "Nationally Critical" conservation status category, and it is proposed to be up-listed from "vulnerable" to "endangered" by the IUCN Red List of Threatened Species.

138. The SC queried whether there were any explanations for the observed range expansion of the Antipodean wandering albatross since 2004. It was noted that food availability has been proposed as a hypothesis but that the reasons behind the expansion are uncertain (this includes uncertainty in data used for range estimation). Noting this uncertainty, the SC revised the second recommendation of the paper (included below).

139. The SC also clarified that CMM09-2017 refers to the ACAP best practice guidelines for mitigation. The SC **agreed** that the collection of information to determine that mitigation measures are being implemented was a priority. In this context inclusion of mitigation measures in Annual Reports would be sensible. A compiled form of this information could be forwarded to CTC for its consideration.

140. The SC queried whether the term bycatch included strikes as well as dead animals, and it was clarified that the definition of bycatch does include strikes. This led to a suggestion to amend recommendation 3 (below).

141. The relationship with the FAO International Plan of Action for Seabirds was queried. It was noted that the IPOA provides guidance for domestic jurisdictions to develop their own seabird plans, but that it could also assist RFMOs with guidance.

142. After considering the paper and recommending modifications to recommendations 2 and 3, the SC:

- **noted** the increased conservation concern for Antipodean wandering albatross based on the most recent demographic information.
- **recognised** that, because the foraging range of Antipodean wandering albatross may have extended further north and east across the SPRFMO Area since 2004, it has become increasingly important to better understand and minimise bycatch in SPRFMO fisheries in order to address this conservation concern.
- **encouraged** observers to identify and report bycaught (including strikes and other interactions) wandering albatross to the lowest possible taxonomic level, using photographic or genetic methods as required, to allow better identification of higher risk areas and fishing methods.
- **recommended** to review available data on seabird mitigation used by vessels (as required by CMM 09-2017) to assess the extent to which adequate mitigation measures are being used to minimise bycatch.

143. Paper **SC5-Doc30** detailed an Assessment of the risk of southern hemisphere fisheries to ACAP species. New Zealand takes a risk-based approach to managing the impacts of fishing activity on seabird species informed by a quantitative, spatially explicit assessment of risk. The Spatially Explicit Fisheries Risk Assessment framework (SEFRA) (MPI, 2016) estimates risk to individual seabird species which can be further disaggregated by fishery, target species, and/or fishing method. New Zealand intends to extend the risk assessment framework developed for the main fishing methods within the New Zealand Exclusive Economic Zone (EEZ) to a broader set of fisheries. This paper presents the progress on this to date, where the methodology is being iteratively applied to publicly available tuna RFMO fishing data throughout the southern hemisphere for the 26 ACAP-listed seabird species that breed in the southern hemisphere. This version of the risk assessment is updated from that presented to CCSBT in March 2017 through the inclusion of effort data from north of 25 degrees S from WCPFC. Across all the seabird species and surface longline fishing effort included in this study, the total estimated annual potential fatalities were 6275 (95% c.i.: 4918–8054). Species are ordered depending on the risk ratio, which is defined as the ratio of the annual potential fatalities to the population sustainability threshold (PST), the maximum number of mortalities that a population can sustain while still achieving a defined population outcome. Black petrel had the highest risk ratio, followed by three wandering-type albatross species (Tristan albatross, Amsterdam albatross, and Antipodean albatross). All other seabird species had risk ratios that suggested that fishing mortality alone is not having a significant impact on the population. Paper **SC5-Doc30** is a report on progress, and the data used in this initial iteration contain some deficiencies. In particular, the vulnerability of seabirds to capture was estimated using New Zealand data only; the seabird distributions were simplistic; and effort data was limited. The analysis can readily be updated however, if improved data become available.

144. The SC noted the progress to date and that the current focus has been surface longline and tuna RFMOs. The SC looks forward to the inclusion of SPRFMO fisheries in the analyses. Australia offered to collaborate on the project for its SPRFMO fisheries.

145. Korea noted that it has 100% Observer coverage on trawl vessels and they are tasked with reporting seabird interaction for 15mins before and during setting and hauling. No interactions have been observed since 2013.

146. The SC noted the importance of range information in the analyses and consequently the need to estimate the reliability of the distribution maps. Cross validation was suggested as a useful approach for validation. NZ noted that the methods are well developed for application in NZ and AU EEZs. The SC suggested that the methods be more extensively reviewed at SC6 when the analyses is more progressed for fisheries other than surface longline.

147. The SC noted that seabird identification can be difficult and time-consuming. Design and implementation of Observation programs will need to recognise these issues.

148. The level of confidence in the work was queried and it was noted that the work is still in progress. It was discussed that there is still some work to do before this work could be used to inform management, and it was proposed that a recommendation could consider this. It was also discussed that this is the SEFRA risk assessment method (which is similar to the Australian SAFE method), and it relies heavily on the quality of the spatial information inputs. It was noted that Australia and New Zealand have made good progress on these methodologies within their jurisdictions. New Zealand provided the meeting with background documents describing their Spatially Explicit Fisheries Risk Assessment (SEFRA).

149. In response to a question around the burden for observers in prioritizing this sort of data collection, it was noted that Australia's electronic monitoring in combination with human observers was helping to collected better data for input to such risk assessments.

150. After considering the paper and ensuing discussion, the SC

- **Noted** the progress to date in developing a southern hemisphere risk assessment for ACAP seabird species
- **Noted** the companion papers on seabird bycatch issues (conservation concern for Antipodean albatross and bycatch in squid jig fisheries)
- **Encouraged** all Members and CNCPs operating bottom, jack mackerel and squid jig fisheries in the SPRFMO Area to implement observer programmes that specifically task observers to document seabird interactions, and report all such data using the prescribed methods
- **Encouraged** Members and CNCPs to consider collaborating with New Zealand on this risk assessment, especially through the provision of data to determine the nature and extent of seabird interactions across all SPRFMO fishing activity.
- **Recommended** a thorough review of ecological risk assessment methodologies being used by Australia and New Zealand at SC6.

151. Paper **SC5-Doc29** discussed seabird interactions with squid jigging vessels. Light pollution from activities such as squid jig fishing is known to affect seabirds. Recent observer coverage in a small squid jig fishery in the New Zealand EEZ tasked observers to record details of seabird interactions with the fishing operation. A range of interactions were recorded, predominantly shearwaters and albatrosses becoming caught on the jigs, but also prions, petrels and shearwaters striking the vessel. Many birds were released alive, though no information on post-release survival is available. Because of the large scale of the squid jig fishery and the high degree of spatial overlap between seabird foraging distributions and the fishing fleets operating in the SPRFMO Area, we recommend the need for further data collection through observer programmes and reporting to better understand the nature and extent of seabird interactions with the fishery.

152. The SC reiterated the need to ensure that the definition of interactions included caught and other interactions.

153. The SC also noted that there is likely to be significant variability in squid species ecology and the underlying mechanisms as to why birds may interact with jig fisheries (e.g. some squid may be prey for seabirds). The SC also noted that the operations and behaviour of squid fisheries vary in space and time. The SC modified the 3rd recommendation of the paper to include this variability.

154. After considering the paper and related discussion, the SC:

- **Recognised** the potential for seabirds to interact with squid jig fishing activity at levels that may pose conservation concern for some seabird species.
- **Encouraged** all Members and CNCPs operating squid jig vessels in the SPRFMO Area to implement observer programmes that specifically task observers to document seabird interactions, and report all data in the prescribed manner.
- **Recommended** to assess data provided on seabird interactions with squid jig fishing to determine the nature and extent of these interactions at the scale of combined SPRFMO fishing activity. This should include analyses that evaluate how interactions vary between squid fisheries in the SPRFMO jurisdiction.

8.2. Proposal to create a task team on ecosystem and habitat monitoring

155. Paper **SC5-Doc11** presented a proposal for a SPRFMO task group on Ecosystem and Habitat monitoring. Ecosystem monitoring corresponds to a need in modern fisheries research. One way to produce information allowing habitat and ecosystem monitoring could be through the creation of a working group inside SPRFMO dedicated to this research. One strong limitation to perform such research, i.e. the lack of 3-D in situ data, was studied by the SPRFMO Task Group on "Fishing vessels as scientific platforms" lead by IREA, which stated in its final report that acoustic data from fishing vessels presented the same quality as scientific data and were likely to provide continuous information on the fishing grounds and new information extracted from the fishers' strategies. This information can be obtained from any modern industrial fishery, namely in the SPRFMO area fisheries on CJM and deep-sea mounts. Besides the new pieces of information that such research using fishers' data brings, one other output could be to help defining the actual structure of the populations, and especially that of CJM. So far indeed there are a series of options as listed by the ad hoc SPRFMO workshop in 2008, but since this date a series of hypotheses and works have been done and it is time to produce a new analysis taking advantage of all the new knowledge. Nevertheless, a conclusion seems still unlikely, due to the lack of synthetic knowledge of the CJM habitat. Habitat is a good indicator for exploring the population structure, as demonstrated by many recent works listed above. Having more information on habitat characteristics and dynamics thanks to this group, would help better understand CJM population structure.

156. It was noted that the plan for the proposed workgroup mostly focused on pelagic issues and that there are different requirements for deepwater species (e.g. Orange roughy).

157. Many Members noted that they would like to see a workplan for the group that was more focused and results-orientated, but that they support the proposal in principle. It was agreed that specific guidelines were needed to provide this clarity, but that this requirement was not incompatible with the overarching aim of the group. It was suggested that the proposal could be amended to clarify some of the key objectives and research goals that were directly applicable to CJM in the first instance.

158. China noted that some similar work has been done on climate change impacts on the distribution and abundance of squid and that the workgroup would contribute to improved stock assessment and improved management of fisheries resources.

159. Australia noted that the formation of such a group may be particularly useful for understanding and future assessment of some of the more bentho-pelagic species with which SPRFMO bottom fisheries interact. It was noted that there appear to be range shifts in some species distributions in Australia and other areas, and it was noted by many Members that the processes and protocols developed through this work could be very valuable in the years to come.

160. After considering the paper and the ensuing discussion, the SC decided that creating a working group on the wide theme of "Ecosystem Monitoring" inside SPRFMO is appropriate. Therefore, the SC **recommends**:

- **to evaluate the possibility** of constituting a dedicated group on the theme of "Habitat Monitoring" inside SPRFMO, with Habitat synthetic indicator as a way to analyze the environmental information, with the following mid- and long term main objectives: defining habitat structure and dynamics; understanding (and forecasting) the changes in spatial distribution and abundance; producing elements that would allow introducing information on habitat and behavioral ecology in assessment models; defining protocols for the elaboration of data formats and data analyses; defining necessary research and projects to be undertaken for improving the data collection, processing and analysis, and the habitat characteristics; providing information that allows a better definition of population structure.
- **to use the Chilean Jack Mackere**l as a first case study, with the ambition of extending the activities of the group to the other species of interest inside the Convention area (demersal fish, jumbo flying squid) when available knowledge of fish habitat, biology and ecology becomes sufficient.
- **For the year** 2018:
  E. Yañez (Chile) and F. Gerlotto (EU) will co-chair a task group gathering all the scientists of SPRFMO member states who could be interested, with the objective to prepare a proposal detailing the group structure, objectives, etc.

8.3. Other ecosystem considerations

161. Paper **SC5-Doc31** presented a summary of current SPRFMO bycatch records (including species of concern) held by the Secretariat.

162. Korea noted that it had commenced an observer program in its squid jigging fisheries, with a focus on bycatch of birds and other species. Korea noted that it will report these data to SPRFMO after two years.

163. There were no specific recommendations in paper **SC5-Doc31**.

9. Observer Programme and Monitoring approaches

9.1. Observer Programme

164. The SC was requested to comment on the 2017 2nd Draft CMM for a SPRFMO Observer programme (Document **SC5-Doc12**), which was introduced by the Executive Secretary. The SC noted that the Draft was an improvement from last year's version because it focused on the administration of the program, rather than the scientific need for the program, which is dealt with in other CMMs (such as data requirements and observer coverages). The SC recognized that its advice should focus on the scientific aspect of the Draft, and not provide drafting suggestions, but general recommendations.

165. A question was raised whether observer coverage rates would be included in the CMM, and the belief was not directly, but that the SC could provide guidance on the adequacy of the observer coverages for individual fisheries.

166. The SC was informed that an action item from the Commission consisted of a simulation study to determine adequate levels of observer coverage. This simulation study has already started. It was noted that different coverage rates may need to be established dependent on the number of vessels in a fishery; i.e. 10% of a few vessels may not be representative, but 10% of many vessels would be more statistically robust. The SC discussed that coverage rates could be more flexible to meet statistical needs and flag state's sampling programs.

167. Concerns were voiced whether the current coverage levels were sufficient to address compliance needs or whether higher level of coverage would be required given that the CMM states observer program may be used for functions of the SC and CTC. It was suggested that discussion be moved to the CTC on that, but thought would be that the focus would be on science needs, as stated in the Draft CMM.

168. A small working group was convened to provide recommendations on the Draft. The group briefly discussed whether it should address the SC workplan item "Review scientific appropriateness of observer coverage by fishery (also consider whether transhipment data would be useful for scientific purposes)". It was decided that observer coverage for scientific purposes would be better addressed by other CMMs and not by the observer program CMM.

169. The small working group noted that many means are available to collect scientific information. There was a discussion on the degree to which the draft CMM focused on human observer versus alternative means. Some methods may not be able to gather all scientific information that other methods may be able to collect. Note that a combination may be valuable.

170. Concerns were voiced that in some fisheries it might (at least currently) not be possible to place a human observer on board vessels. Participants noted that in such cases the use of alternative means of observation could be used but that these should also meet minimum standards and should require a process of accreditation, similar to that established for human observers. It was unclear if the CMM, in particular Annex C, addresses these other programs. It was discussed that the type of observation method was dependent on the type of data being collected, and that a combination of human and other methods could be considered to address specific data needs

171. For paragraph 11, the small working group expressed concern about the timeframe allowed. There was uncertainty about the extent of what is required within the time period.

172. Under paragraph 12, the group agreed that it would be favourable if observer programmes already accredited by other RFMOs would be cross-endorsed by SPRFMO provided that the standards for data collection and submission are sufficient.

173. For paragraph 23, a question was raised why measuring effort was specifically addressed in the Observer CMM and not in the Data Standard CMM or elsewhere as all the other specific data collection requirements for observers. The small working group recommended that the language in paragraph 23 be replaced with "the SC will periodically review and provide advice on the appropriate level of observer coverage that is required to support the work of the SC" to be general yet ensure activities are appropriate for the SC.

174. Point 1d in Annex B was also discussed. There was concern that allowing a captain to see the data before the observer left the boat could impact the quality and impartiality of the data and potentially result in biased data. It

was discussed whether to remove this or whether to possibly modify the language and specify that after the observer has left the vessel, the captain would be informed about the findings of the observer and be given the opportunity to provide any additional data and explanations, if appropriate and desired.

175. Recognising that the primary function of the SPRFMO Observer Programme is the collection of scientific data, the SC notes that these can be collected by diverse means.

176. The SC **recommends** that well trained and accredited human observers shall be the basis of the SPRFMO OP; for some fisheries (to be defined by the Commission with the advice of the Scientific Committee), other means of accredited observations can be considered as an alternative to human observers.

177. The SC **recommends** that Annex C of the CMM should eventually include minimum standards for alternative means of observation.

9.2. E-monitoring, self-sampling and study fleets

178. These issues were discussed under the OP CMM item and it was agreed they need to be addressed in more detail at the next SC meeting.

10. SC Research Program

179. The SC considered that the current research programme should be merged with the workplan in order to provide a clearer indication of research priorities for the Commission and the SC. This appears in **Annex 8** as a multi-annual workplan.

11. Other Matters

180. Capacity building within the Scientific Committee was discussed. The SC also recognised the need to assist with capacity building in developing countries. Australia expressed that there are opportunities for SC scientists to attend relevant scientific activities and training in Australia. Some participants expressed the desirability that the Secretariat offered internships; the Secretariat explained that it welcomed interns and was willing to support them within its financial means (and space limitations). Currently, the process for applying was informal.

181. The Secretariat reported that recently it had received several notifications from the CBD (Convention on Biological Diversity) related to Ecologically and Biologically Significant Marine Areas (EBSAs). Some were requests for information experiences and lessons learned in the implementation of marine spatial planning and the development and management of marine protected areas and other effective area-based conservation measures in marine and coastal areas and the Secretariat is looking for assistance from SC participants to provide the requested information. There has also been an invitation to an EBSA workshop in Berlin, Germany, from 5 to 8 December 2017 (“Expert workshop to develop options for modifying the description of areas meeting the criteria for ecologically or biologically significant marine areas (EBSAs), for describing new areas, and for strengthening the scientific credibility and transparency of the EBSA process”). Some funds were available for the participation of nominated experts who fulfilled the CBD criteria (scientific knowledge and experience regarding the EBSA criteria and significant experience on marine implementation of CBD work programme).

12. Collated advice

12.1. Jack mackerel

182. Para 16 - *In relation to the Jack mackerel data templates* The SC **requested Members fishing in the Jack mackerel fishery** to improve their internal processes including identification of "key persons" who would be directly responsible for submitting those templates.

183. Para 21 - … The SC **recommends** the use of provisional standard equations of Target Strength for CJM (**SC5-Doc10**):

- For 38 kHz:TS38= 20 log L – 68.9
- For 120 kHz: TS120 = 20 log L – 69.6 (where L = total length, in cm)

184. Para 22 - The SC **further recommends** that Members work toward a common database format including choice of metrics, indicators, and processing methods. Other future activities in fisheries acoustics will be undertaken according to specific needs inside a wider project on ecosystem monitoring.

185. Para 28 - The Scientific Committee:

- **Recommended** that there be an exchange of samples among countries to explore differences in growth curves and ageing techniques, with a goal ensure that samples exchanged would comprise a representative sample of the fisheries in terms of space and time. A plan should be developed to determine sampling design and coordinators should be identified.
- **Recommended** that sensitivity analyses to growth curve scenarios continue to be explored in the stock assessment model, e.g., those from **SC5-JM02, SC5-INF04_rev1**.

186. Para 35 - The Scientific Committee:

- **Agreed** to continue sampling of data across time and space to increase information to be able to determine stock structure.
- **Recommended** that further research to better determine stock structure hypothesis should continue and expanded. Potential methods identified include a comparable analysis over the entire jack mackerel range, assessing genetic differences or elemental differences in fish between areas; or a combination of methods.

187. Para 38 – *In relation to the standardized data templates for Jack mackerel.* The SC … **recommended that Members adhere to the protocols for submitting stock assessment data through the use of these templates.**

188. Para 52 - Given current stock status, the second tier of the Jack mackerel rebuilding plan could be applied, thereby substantially increasing the potential catch. Considering the uncertainties in the assessment however, the Scientific Committee adopts a precautionary approach and advises to **maintain 2018 catches for the entire Jack mackerel range in the southeast Pacific at or below 576 kt**.

189. Para 160 - After considering the paper and the ensuing discussion, the SC decided that creating a working group on the wide theme of "Ecosystem Monitoring" inside SPRFMO is appropriate. Therefore, the SC **recommends**:

- **to evaluate the possibility** of constituting a dedicated group on the theme of "Habitat Monitoring" inside SPRFMO, with Habitat synthetic indicator as a way to analyze the environmental information, with the following mid- and long term main objectives: defining habitat structure and dynamics; understanding (and forecasting) the changes in spatial distribution and abundance; producing elements that would allow introducing information on habitat and behavioural ecology in assessment models; defining protocols for the elaboration of data formats and data analyses; defining necessary research and projects to be undertaken for improving the data collection, processing and analysis, and the habitat characteristics; providing information that allows a better definition of population structure.
- **to use the Chilean Jack Mackere**l as a first case study, with the ambition of extending the activities of the group to the other species of interest inside the Convention area (demersal fish, jumbo flying squid) when available knowledge of fish habitat, biology and ecology becomes sufficient.
- **For the year** 2018:
  E. Yañez (Chile) and F. Gerlotto (EU) will co-chair a task group gathering all the scientists of SPRFMO member states who could be interested, with the objective to prepare a proposal detailing the group structure, objectives, etc.

12.2. Deepwater

190. Para 18 - … The SC **endorsed** the following key research priorities:

- Species identification and robust reporting remain issues in assessing the nature and extent of chondrichthyan species catches in SPRFMO bottom fisheries
- There remains a need to progress risk assessments for chondrichthyans to be more quantitative and allow for the estimation of absolute fishing mortality and potentially compare those to reference points
- The need for ongoing monitoring and/or refinement of the underlying data and habitat suitability models, including a focus on ongoing testing and updating of the habitat suitability models for the VME indicator taxa.
- Essential need for biological and age data and fishery independent abundance information for SPRFMO orange roughy stocks

191. Para 65 - On considering the advice from the SC against the specific requirements of the exploratory fishing CMM, and the overarching intent of the CMM to develop new fisheries in a gradual and precautionary manner, the SC:

- **Indicated** that it could not support the proposal in its current form
- **Agreed** that it could consider a revised proposal that provides more information on how the data collected through a gradual development of the fishery could be used to assess and manage the stocks appropriately
- **Noted** that work could be undertaken intersessionally to assist Cook Islands to revise the proposal
- **Noted** that a potential phased approach to developing this fishery would help towards understanding the viability and for collecting the data necessary to ensure the sustainability of future catches
- **Noted** that such a phased approach would need to include mechanisms for review of the data being collected.
- **Noted** that a revised proposal should include a better definition of objectives and a more explicit data collection plan.

192. Para 68 - After considering the presentation of the paper, the SC:

- **noted** the New Zealand demersal longliner *San Aspiring* has completed the 2-year exploratory fishing programme approved under CMM 4.14;
- **noted** that substantial bathymetric, operational, and biological information was collected;
- **noted** that the retained catch each year was under the 30-tonne annual limit;
- **noted** the tag and release of Antarctic toothfish (*Dissostichus mawsoni*) at a rate of three fish tagged per tonne caught, the data from which have been shared with CCAMLR;
- **noted** New Zealand's intention to develop an integrated exploratory fishery programme to maximize the benefits of data collection for both CCAMLR and SPRFMO which will be submitted to SC6 in 2018.

193. Para 70 - After considering the paper, the SC:

- **Noted** the potential for deepwater chondrichthyans to interact with bottom fisheries in SPRFMO
- **Noted** that chondrichthyans generally exhibit relatively slow growth rates, late age at maturity, low fecundity and low natural mortality, making them particularly vulnerable
- **Notes** that misidentification of bycaught chondrichthyans is evident in the reported catch data,
- **Agrees** that better species identification processes should be developed in conjunction with the FAO sharks' identification tools
- **Encouraged** all Members and CNCPs operating bottom fisheries in the SPRFMO Area to implement observer programmes that specifically task observers to document deepwater chondrichthyans interactions, record chondrichthyans species bycatch to the lowest possible taxonomic level, and report all such data using the prescribed methods
- **Agreed** on the need to assess data provided on chondrichthyans interactions with bottom fisheries to determine the nature and extent of these interactions at the scale of combined SPRFMO fishing activity.

194. Para 75 - … After considering the advice presented in paper **SC5-DW10** and verbally at the SC meeting, the SC agreed to:

- **Request** Members with bottom fisheries to continue collaborations and apply more quantitative risk assessment methods to estimate current fishing mortalities (or proxy) for their SPRFMO bottom fisheries;
- **Request** Members collaborating on the above analyses to develop advice for the Scientific Committee on the effects of fishing on deepwater chondrichthyans;
- **Adopt** the proposed work plan outlined;
- **Recommend** to the Commission that the committee's workplan and roadmap are amended to include the work described above.

195. Para 83 - Following the discussion, the Scientific Committee:

- **Adopted** the proposed generalised assessment framework for bottom fisheries to provide direction for future assessment work and speed the committee's processes in developing advice for the Commission.
- **Requested** Members with bottom fisheries or an interest in finalising the framework to work together to develop proposals for biological reference points and harvest control rules for SPRFMO bottom fisheries.
- **Recommended** to the Commission that it agrees to the nature and structure of advice on precautionary catch limits for bottom fisheries that will stem from such an assessment framework.
- **Requested** Members with bottom fisheries to cooperate in the development of a Scoping Analysis for their SPRFMO bottom fisheries.
- **Requested** Members with bottom fisheries to work towards the development of Management Strategy Evaluations to develop robust Harvest Control Rules for their SPRFMO bottom fisheries.
- **Recommended** to the Commission that the Committee's Workplan and Roadmap are amended to include the work described above.

196. Para 100 - With respect to the assessment of SPRFMO Orange roughy stocks and ensuring sustainable fisheries, the Scientific Committee:

- **Noting** that the stocks on the Louisville Ridge (Louisville North, Central and South) have a lower potential of having low stock status, **recommends** a catch limit for the whole of the Louisville Ridge based on the sum of the 50th percentile yield estimates provided in **SC5-DW14**, the CHA stock assessment method, of **1,140 tonnes to apply for the area for no more than 2 years**. A significantly more precautionary approach is recommended if insufficient advancement is made in data collection and stock assessments for the relevant stocks within 2 years. The SC recommends that, within this group, the Louisville Central stock should be prioritised for improved data collection and stock assessment.
- **Noting** that the stocks in the Tasman Sea (Lord Howe Rise, Northwest Challenger Plateau, and West Norfolk Ridge) are estimated to have a higher potential of being depleted, **recommends** a catch limit for the Tasman Sea stocks based on a 0.5 scaling of the 50th percentile yield estimates provided for relevant stocks in **SC5-DW14** (690 tonnes) from the CHA stock assessment method, resulting in a catch limit of **346 tonnes for the area to apply for no more than 3 years**. A significantly more precautionary approach is recommended if insufficient advancement is made in data collection to support stock assessments for the relevant stocks in 3 years. The SC recommend that, within this group, the Lord Howe Rise and Northwest Challenger Plateau stocks should be prioritised for improved data collection and stock assessment.
- **Notes** that New Zealand will advise the Commission on an allowance for Westpac Bank which would be in addition to the limit proposed above.
- **Recommends** no allowance be included for the South Tasman Rise area which is closed to fishing by Australian and New Zealand vessels.

197. Para 108- After considering the paper/presentation and ensuing discussion, the SC:

- **Noted** the series of workshops convened by New Zealand to include industry and environmental stakeholders together with researchers and officials from both Australia and New Zealand;
- **Noted** the substantial progress made in capacity development and agreement on analytical methods that can be used in the design of candidate spatial management areas to meet the objective of the SPRFMO Commission;
- **Agreed** that the analytical approach using Zonation decision-support software is scientifically defensible and appropriate;
- **Agreed** to support, if necessary, an additional deepwater working group in October or November 2017 to finalise the Zonation analyses and oversee scientific analyses required to underpin the design of candidate spatial management areas

198. Para 111- After considering the paper, the SC:

- **Noted** the successful application to SPRFMO bottom trawl fisheries of the spatially explicit bottom fishing impact evaluation methodology originally developed for CCAMLR bottom line fisheries
- **Agreed** that this methodology is appropriate for assessing the impacted area, intensity of impact by location, and likely impact on benthic epifauna
- **Agreed** that the methodology should be applied to develop spatially-explicit bottom impact evaluations for all deepwater bottom fisheries in the western SPRFMO Area

199. Para 114- After considering the paper, the SC:

- **Noted** the progress that has been achieved in scientific analyses required to underpin a comprehensive bottom fishing CMM for the SPRFMO Area;
- **Noted** that further work is required and New Zealand and Australia will continue to progress the development of a revised bottom fishing CMM in order to submit a proposed draft CMM to the Commission meeting in early 2018;
- **Agreed** that the scientific approaches applied by Australia and New Zealand are appropriate to underpin a revised bottom fishing CMM;
- **Agreed** to convene or otherwise support, if necessary, an additional workshop in October or November 2017 to finalise the Zonation analyses and oversee scientific analyses required to underpin the design of candidate spatial management areas.

200. Para 121- After considering the paper/presentation and ensuing discussion, the SC:

- **noted** the diverse guidance on Conservation and Management Measures for bottom fisheries available from UNGA resolutions, FAO documents and guidelines, published reviews, the SPRFMO Convention, and the existing CMM;
- **noted** the progress on the development and testing of methods to model and map VMEs in the western part of the SPRFMO Area and on the application of software-based methods to design candidate spatial management areas to provide for sustainable use while preventing significant adverse impacts on VMEs;
- **noted** the application of such decision-support tools by Australia and New Zealand in multi-stakeholder workshops in July-August 2017;
- **affirmed** its agreement at SC-01, SC-02, SC-03, and SC-04 that a revised comprehensive CMM for bottom fisheries in the SPRFMO Area should be based on a spatial management approach;
- **agreed** that move-on rules should be viewed only as “back-stop” measures (if required) to complement spatial closures developed using decision-support software and designed to prevent significant adverse impacts on VMEs;
- **agreed** that the potential information gathering benefits of move-on rules can be better met using structured and mandatory collection and review of benthic bycatch in bottom fisheries;
- **agreed** that, should a move-on rule be implemented as part of the revised CMM for bottom fisheries, the threshold for triggering such a rule should be high. Ideally a move-on response should follow more than one encounter involving weights of bycatch of benthic fauna that would indicate the models used to predict the distribution of VME taxa are misleading
- **agreed** that future research could investigate the relationship between indicator taxa retained in nets compared to actual presence of VMEs and associated impacts, for example through the use of cameras.

201. Para 128 - After considering the paper/presentation and ensuing discussion, the SC:

- **noted** the BFIAS was agreed in 2011 and much has since changed in SPRFMO
- **noted** that UNGA has issued resolutions which reinforce the importance of conducting impact assessments which take full account of the FAO Deep Sea Guidelines and assess the individual, collective and cumulative impact; and further note that it would be appropriate for SPRFMO BFIAS to be revised to reflect these international developments to ensure current and future bottom fishing is assessed against a contemporary standard
- **agreed** that independent peer-review was important for the SC to consider as part of this process.
- **agreed** that the BFIAS should be refreshed to reflect changes in SPRFMO and international instruments since it was published
- **recommends** to the Commission that the SC's Workplan should include preparation of a revised and updated BFIAS be developed for agreement no later than the SC's meeting in 2019

12.3. Squid

202. Para 135 - The SC **agreed** that a squid stock assessment workshop should be held prior to, or in conjunction with the next SC meeting. The terms of **reference, date and venue of such workshop** should be defined in an intersessional work of the squid working group. Some ideas for the terms of reference were discussed, considering modelling approaches including ensembles (to account for, among other things, uncertainty in stock structure).

203. Para 136 - SC5 endorsed the following squid workshop **recommendations** to:

- **Acknowledge** that Jumbo flying squid distributed in the Southeast Pacific straddles between the Convention area and the adjacent areas under national jurisdictions.
- **Evaluate** working hypotheses on **stock structure** using data combined from Members and CNCPs.
- Also **relative to stock structure**, research on the distribution, migration routes and intermixing patterns, should be pursued (e.g., samples for micro-constituents, genetics, morphometrics, tagging, etc.). This should include mature male and female length frequency distribution comparisons at fine temporal and spatial scales.
- **Promote** research on the **reproductive process** and the effect of environmental factors in determining the timing and the location and extension of spawning areas.
- Determine the **most suitable stock assessment** models and management alternatives to be applied for Jumbo flying squid for use in the Convention area. This could include research on methods for recruitment and escapement estimation.
- **Promote** research on fishing impacts relative to **predator-prey** interactions and cascading ecosystem impacts and changes in life history parameters including possible effects of changing environmental conditions.
- **Refine and develop** data templates to address data gaps for informing a full stock assessment, as not all required information is contained within the templates.
- **Encourage** Members and CNCPs to share data and information necessary for stock assessment.
- **Use** current detailed reporting forms to recover historical data and report the historical information to the extent possible.
- **Develop** an appropriate mechanism to achieve these objectives

12.4. Other

204. Para 4 - The SC reiterated its **recommendation** that papers be submitted on time following the SC protocol for submission of papers.

205. Para 5 - The SC **recommended** that an additional category for information papers be established so that it is easier to differentiate papers that have been submitted with the intention to inform substantive discussion from those papers provided as background information papers.

206. Para 9 - … **the SC adopted** paper **SC5-Doc07_rev3** as its new Guidelines for Annual reports.

207. Para 13 – *In relation to* the summary fish profiles contained in **SC5-Doc06**… The SC **recommended** to remove the section containing research information, to investigate mechanisms for automatically updating catch and effort and other dynamic data, to continue the necessary work to finalise the species profiles intersessionally. When these are completed, the SC **recommends** posting the summaries on the web.

208. Para 139 - …. The SC **agreed** that the collection of information to determine that mitigation measures are being implemented was a priority. In this context inclusion of mitigation measures in Annual Reports would be sensible. A compiled form of this information could be forwarded to CTC for its consideration

209. Para 142 - After considering the paper and recommending modifications to recommendations 2 and 3, the SC:

- **noted** the increased conservation concern for Antipodean wandering albatross based on the most recent demographic information.
- **recognised** that, because the foraging range of Antipodean wandering albatross may have extended further north and east across the SPRFMO Area since 2004, it has become increasingly important to better understand and minimise bycatch in SPRFMO fisheries in order to address this conservation concern.
- **encouraged** observers to identify and report bycaught (including strikes and other interactions) wandering albatross to the lowest possible taxonomic level, using photographic or genetic methods as required, to allow better identification of higher risk areas and fishing methods.
- **recommended** to review available data on seabird mitigation used by vessels (as required by CMM 09-2017) to assess the extent to which adequate mitigation measures are being used to minimise bycatch.

210. Para 150 - After considering the paper and ensuing discussion, the SC

- **Noted** the progress to date in developing a southern hemisphere risk assessment for ACAP seabird species
- **Noted** the companion papers on seabird bycatch issues (conservation concern for Antipodean albatross and bycatch in squid jig fisheries)
- **Encouraged** all Members and CNCPs operating bottom, jack mackerel and squid jig fisheries in the SPRFMO Area to implement observer programmes that specifically task observers to document seabird interactions, and report all such data using the prescribed methods
- **Encouraged** Members and CNCPs to consider collaborating with New Zealand on this risk assessment, especially through the provision of data to determine the nature and extent of seabird interactions across all SPRFMO fishing activity.
- **Recommended** a thorough review of ecological risk assessment methodologies being used by Australia and New Zealand at SC6.

211. Para 4 - After considering the paper and related discussion, the SC:

- **Recognised** the potential for seabirds to interact with squid jig fishing activity at levels that may pose conservation concern for some seabird species.
- **Encouraged** all Members and CNCPs operating squid jig vessels in the SPRFMO Area to implement observer programmes that specifically task observers to document seabird interactions, and report all data in the prescribed manner.
- **Recommended** to assess data provided on seabird interactions with squid jig fishing to determine the nature and extent of these interactions at the scale of combined SPRFMO fishing activity. This should include analyses that evaluate how interactions vary between squid fisheries in the SPRFMO jurisdiction.

212. Paragraphs 164 – 177 contain advice specific to the proposed CMM on the SPRFMO Observer programme.

13. Next Meeting

213. **Chile kindly offered to host SC6** with location to be confirmed. The SC gratefully accepted this offer. Various dates were considered by Members and there was agreement that the **week of the September 9th-14th 2018** was most suitable.

214. The SC also discussed alternatives timing workshops. Given the expectation of a full jack mackerel assessment, the SC proposed holding the workshop well in advance of the SC6 meeting (location and time to be determined, but likely May-June for jack mackerel assessment). Regarding the squid and deepwater workshops, if needed, the SC suggested that they may be held in conjunction with the SC6 meeting or with the jack mackerel workshop.

14. Adoption of Report & Meeting Closure

215. The report was adopted at 1845, September 27, 2017.

Annex 1. SC05 Agenda

1. Welcome and Introduction
2. Administrative Arrangements
   - 2.1. Adoption of Agenda
   - 2.2. Meeting documents
   - 2.3. Nomination of Rapporteurs
3. Discussion of Annual Reports
4. Commission guidance and other Inter-Sessional activities
   - 4.1. Commission SC Workplan
   - 4.2. Secretariat SC related activities
   - 4.3. Deepwater workshop report
   - 4.4. Pre-SC workshop
   - 4.5. Other SC Task Groups
5. Jack Mackerel Working Group
   - 5.1. Inter-Sessional assessment/research
   - 5.2. Inter-Sessional Progress with the Jack Mackerel Stock Structure Research Programme
   - 5.3. Jack Mackerel Stock Assessments – Technical Session
   - 5.4. Other Jack Mackerel topics
6. Deepwater Working Group
   - 6.1. Applications to fish outside the footprint or above reference period catch levels
   - 6.2. Inter-Sessional assessments/research
   - 6.3. SPRFMO Deepwater stock assessments
   - 6.4. Modelling VME taxa distribution and spatial management approaches in the Convention Area
   - 6.5. Revised Bottom Fishing CMM
   - 6.6. Other Deepwater topics
7. Squid Assessment
   - 7.1. Inter-Sessional assessments/research
   - 7.2. SPRFMO assessments approaches
8. Ecosystem Approach to Fisheries Management
   - 8.1. Seabird monitoring
   - 8.2. Proposal to create a Task team on Ecosystem and habitat monitoring
   - 8.3. Other Ecosystem considerations
9. Observer Programme and Monitoring approaches
   - 9.1. Observer Programme
   - 9.2. E-monitoring, self-sampling and study fleets
10. SC Research Program
11. Other Matters
12. Next Meeting
13. Adoption of Report & Meeting Closure

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Annex 3. Annual Reports - Summaries

Australia reported that three Australian-flagged vessels fished in the SPRFMO Area in 2016; one trawl vessel and two non-trawl vessels. Bottom longline was the only non-trawl method used in 2016. Logbook records from these vessels reported a catch of 84 t (12 trawl hours) for the trawl vessel and 156 t (710 000 hooks) for the two non-trawl vessels in 2016. The catch composition for the demersal trawl vessel was mostly orange roughy (~83 t, 99%). For bottom longline, redthroat emperor comprised the largest landed volume (44 t, 28% of total catch), with smaller quantities of yellowtail kingfish, Robinson's seabream, flame snapper, jackass morwong and other species comprising the remainder. Morwong species constituted the single largest component of the total Australian non-trawl catch between 2008 and 2015. A change in the composition of landed catches towards emperors, sweetlips and deepwater snappers (as well as other more sub-tropical species) reflects a change in the main fishing grounds used by Australian bottom longline vessels in 2016. There was no fishing effort directed at, or catch of jack mackerel or jumbo flying squid in 2016. In 2016, observer coverage levels met or exceeded the minimum requirement, which is 10% coverage for non-trawl and 100% coverage for trawl trips. Observers did not report any bycatch of marine mammals, seabirds or marine reptiles in trawl or non-trawl operations in the SPRFMO Area in 2016. A number of interactions with protected species were reported in logbooks and these data have been provided to the SPRFMO Secretariat. The threshold limits for vulnerable marine ecosystem indicators, which trigger Australia's move-on protocols, were not triggered in 2016.

Chile reported that accumulated catches of Jack mackerel for Chilean fleet arose to 250 300 ton, being 71% of the Chile's current catch limit until July 2017. Only 2 200 tons has been caught in the Convention Area. The industrial purse seine fleet operating on jack mackerel fishery between January and July 2017 consisted of 82 fishing vessels, slightly lower than previous years. Regarding the fleet composition, 66% was constituted by vessels with a hold capacity not exceeding 600 m3 which operated mainly in the north area of Chile. Unlike earlier years, when most of Jack mackerel catches in the north of Chile was incidental in anchovy fishery, fishing targeting Jack mackerel was registered in that area during 2017. During 2016 and the first half of 2017, the spatial distribution of jack mackerel catches in the center-south area was concentrated in the coastal areas (first 150 nm), while in the northern area catches were concentrated near to the coast, in the first 50 nm. Size structure of jack mackerel has shown a constant growth from 2015 to 2017. During the first half of 2017, size structure of jack mackerel varied between 10 and 68 cm in FL. The main mode was 24-25 cm in FL, which was provided mainly by the northern area of the country; two secondary modes between 30 and 34 cm in FL were provided by the center-southern area. In general, the observation indicates that during the first semester the structure of sizes was constituted by a large number of individuals in a wide range of sizes with several secondary modes, unlikely other years, where well-represented unimodal size structures are highlighted and minor or absent secondary modes.

The jumbo squid fishery includes the participation of small-scale and industrial fleets, with distribution percentages of the national annual catch quota of 80% and 20%, respectively (TAC2017= 200 000 ton). The small-scale fleet operates with hand jiggers and the industrial fleet operates mainly with mid-water trawling. National landings of squid in 2016 were 183 123 thousand tons. Total catch is entirely conducted within the EEZ of the country. Catches mainly concentrate during the first nine months of the year due to the low availability of the resource during the last quarter. Catches of small-scale fleet shows a unimodal distribution composed of 99% of adult specimens larger than 60 cm mantle length (ML), whose main mode is around 80.5 cm ML.

China reported that two pelagic trawlers operated in the Convention Area of SPRFMO in 2016. Catch of target species, jack mackerel was 20 208 tons with 1 616 tons chub mackerel. Fishing days, as well as trawling hours were decreased compared to 2015 due to the decreasing number of vessels. The nominal and standardized CPUE showed a small decrease in 2016, but still higher than that in 2010-2014. The trawlers shifted to the north area a month earlier than 2015. Catch and effort in the south area in 2016 decreased compared to 2015, whereas they increased in the high seas off northern Chile. The observer boarded on March 5 and stared his work until October 29. A total of 112 fishing days and 134 tows were observed.

276 Chinese squid jigging vessels were recorded to target jumbo flying squid in the South-East Pacific in 2016. Total annual catch in 2016 dropped to 223 300 tons, however, the number of operated fishing vessels and fishing days showed a small increase, resulting in the nominal CPUE in 2016 decreased sharply, only 3.6 tons per day per vessel. The fishing grounds mainly located in the high seas off Peru, while some fishing boats might be operating in the waters off Chile and Ecuador, even near the equator. No observers were sent to work on board but biological sampling continued into 2016. 508 biological samples of the jumbo flying squid derived from the studying vessels were measured and analysed.

The **Cook Islands** in the past has had vessels fishing for Jack Mackerel but currently has no vessels participating in this fishery. However, four bunker vessels are included in the SPRFMO vessel record. There are no relevant data or information to provide regarding Cook Islands fisheries operating under SPRFMO jurisdiction in 2017 or recent years due to a lack of fishing activities. Cook Islands expressed continued interest in the fisheries managed by SPRFMO and may have vessels that enter these fisheries in the future.

Ecuador did not provide an annual report summary.

The **European Union (EU)** fishing fleet activity in 2016 in the South Pacific Regional Fisheries Management Organization (SPRFMO) area outside the Exclusive Economic Zone (EEZ) is presented in this report. The data on catches of jack mackerel by EU trawlers in 2017 cover the period from March to the end of June. Based on the data presented in the EU Report for the 4th Meeting of the Science Committee (Corten, 2016) the 2017 length distribution of jack mackerel indicated that the 2012-year class continued to dominate in the 2017 fishing season.

Two **Korean** flag trawlers operated in the SPRFMO Convention area in 2016. Total catch from the trawlers were 6 931 tons including 6 430 tons of *Trachurus murphyi* and 486 tons of *Scomber japonicus*. More than three modes appeared in the length frequency and the relationship between body weight (g) and fork length (g) was BW=0.005FL3.211 (R2=0.937). Observer coverage rates were kept for 100 % in the Convention area since 2013. To minimize the seabird mortality, Korean trawl vessels used seabird mitigation devices, such as streamer line, baffler during operating. There were no injured or dead seabirds that have been observed and reported so far.

New Zealand has only bottom fisheries in SPRFMO. The catch and effort for orange roughy has remained relatively steady at around 1 000 tonnes for several years, although an increasing proportion has been taken from the recovered straddling stock on the southern Challenger Plateau in the past 3 years. This may be one driver of more frequent observer records of deepwater sharks, coral, and sponges and there was one move-on event for VMEs from the 69 tows where the New Zealand move-on rule applies. There was some midwater trawling for alfonsinos (80 tonnes). The bottom line fishery took 20 tonnes of bluenose and about 50 tonnes wreckfish, but CPUE has been highly variable. The exploratory fishery for toothfish took just under 30 tonnes in each of 2016 and 2017 and close links with CCAMLR are being maintained to develop the best data collection needs and protocols for future assessments. Observer coverage met or exceeded requirements (100% for trawl, >10% for line). One white-faced storm petrel was captured in 2016, and it was released alive. New Zealand has been working very closely with Australia (with support from Chile, EU, and other Members) to develop a new bottom fishing CMM. This work on stock assessment and measures to avoid significant adverse impacts on VMEs, including spatial management areas, is described in more detail in separate papers to the SC.

Peru stated that none of the 98 Peruvian vessels registered and authorized to fish within the SPRFMO Convention area participated in the jack mackerel (*Trachurus murphyi*) fishery in the Convention area during 2016 or the first part of 2017 and there are there are no jack mackerel fishing activities or jack mackerel catches to report for this period. A limited catch of 1 122.31 t of chub mackerel (*Scomber japonicus*) was taken in the SPRFMO Convention area off Peru during a short 5-day period between 12 and 16 October 2016 by 5 Peruvian vessels with holding capacities between 450 and 600 m3 that were part of a large local industrial purse seine fleet participating in a typically more coastal chub mackerel fishery. The sizes of chub mackerel caught in the Convention area were between 22 and 32 cm (fork length) with modal size in 28 cm.

In addition, Peru updated information on the biology and fishery of jack mackerel (*Trachurus murphyi*) in the Peruvian EEZ which it had presented in previous SPRFMO Scientific Committee meetings. During 2014, 2015, 2016 and the first part of 2017 the Peruvian coastal areas have been affected by warmer than normal conditions typical of a weak El Niño during 2014, a strong El Niño during 2015 and 2016, and a moderate coastal El Niño in early 2017. With these warmer than normal environmental conditions, the front usually formed by the mixed layer of warm Subtropical Surface Waters and Cold Coastal Waters almost disappeared and moved closer to the coast, disrupting what is known to be the preferred habitat of jack mackerel off Peru. This contributed to low observed abundance and low catches of jack mackerel in 2014 and particularly in 2015, 2016 and the first part of 2017. During these years jack mackerel concentrations were mostly found in coastal areas, within 20 nm and sometimes within 10 nm from the coast, within reach of the artisanal and small-scale fleets but outside of the usual fishing grounds of the industrial purse seine fleet. In December 2016, the Peruvian Institute of Marine Research (IMARPE) updated the available 2016 jack mackerel assessment made for the Peruvian (far-north) stock during the SC-04 to estimate a TAC for 2017, using the same latest version of the JJM model. This resulted in an estimated TAC of 107 000 t and an F2017 = 0.045 with an estimated risk of 15.5% that the biomass projected to January 1st, 2018 will be lower than that estimated for January 2017.

In 2017 only one **Russian Federation** trawler Alexander Kosarev worked in the high seas of the Southeast Pacific. The total catch was 3 188.4 t for jack mackerel and 37.4 t for chub mackerel in 73 fishing days. The average catch from April to July 2017 was 6.6 tons per hour and 43.7 tons per day. The highest catch was reached in May (1 551 tons). The Russian scientific observer was onboard the trawler "Alexander Kosarev" during the whole period of activities in 2017. In 2017, 14 803 specimens of jack mackerel, 1 112 specimens of chub mackerel were measured. 2 100 specimens of jack mackerel, 800 specimens of chub mackerel were fully analysed, according to CMM`s. For 600 specimens of jack mackerel the age samples were taken. 70 bird observations were performed. The size composition of the fished jack mackerel during the entire period of operations did not change significantly comparatively with 2015. The individuals 32-38 cm length predominated, the modal length class was constantly equal to 36 cm.

Chinese Taipei noted that jumbo flying squids in the eastern Pacific have been targeted by Chinese Taipei's squid-jigging fleet since 2002. The number of vessels varied from 5 to 29 between 2002 and 2016. The catch of jumbo flying squid increased to 12 989 tons in 2016. The nominal CPUE of this fishery has been stable in recent years. The major fishing ground for this fishery is around 76–83°W and 15–20°S. Data of logbook, transhipment and landing of Chinese Taipei's squid-jigging fleet have all been collected and submitted. Research on the stock status and spatial dynamics of jumbo flying squid has been conducted. The length composition of jumbo flying squid was converted from weight category. Neither observer nor port sampling program is implemented.

The **United States of America (USA)** became a full member of SPRFMO in February 2017. Currently, it has no vessels participating in the fisheries managed by SPRFMO. The USA had a limited squid jig fishery that may have been operating on the high seas in the Convention Area over 10 years ago, and information regarding this historical fishery has been provided to the Secretariat in the past. As such, the USA has no data or information to provide regarding USA fisheries operating under SPRFMO jurisdiction in 2017 or recent years. The USA has a continuing interest in the fisheries managed by SPRFMO and may have vessels that enter these fisheries in the future.

Vanuatu reported that two vessels fished in 2016. These were the same freezer trawlers as used in previous years. The total catch of jack mackerel was 15 563t, representing 97% of Vanuatu's available quota following a transfer of 5 500t to Chile. There was also a by-catch of chub mackerel of 1 145t. Observers were present on the vessels. Tori lines were used to mitigate bird interactions with the warps. At the end of the season both vessels were sold and have left the fishery. However, Vanuatu maintains its interest in the SPRFMO fisheries and may have fishing activities in the SPRFMO Area in the future

Annex 4. Deepwater Working Group Report

The report of the SPRFMO deepwater workshop that was held in Hobart Australia from 23-25 May 2017 is available as SC5-Doc08_rev1

Annex 5. 2nd Deepwater Working Group Report

The report of the 2nd SPRFMO deepwater workshop that was held immediately prior to the Main Scientific Committee meeting in Shanghai, China on 21st September 2017 is available here.

Annex 6. Squid Working Group Report

The report of the SPRFMO squid workshop that that was held in immediately prior to the Main Scientific Committee meeting in Shanghai, China on 20th September 2017 is available here.

Annex 7. Jack mackerel advice sheet

South Pacific Regional Fisheries Management Organisation

Stock status summary for Jack mackerel, September 2017

Stock: Jack Mackerel (*Trachurus murphyi*)
Region: Southeast Pacific

Advice for 2018

The SPRFMO Science Committee advises to increase 2018 catches to or below 576 000t.

Stock status

		2015	2016	2017
Fishing mortality in relation to	F_{MSY}	Below	Below	Below
Spawning stock biomass in relation to	B_{MSY}	Below	Below	Below

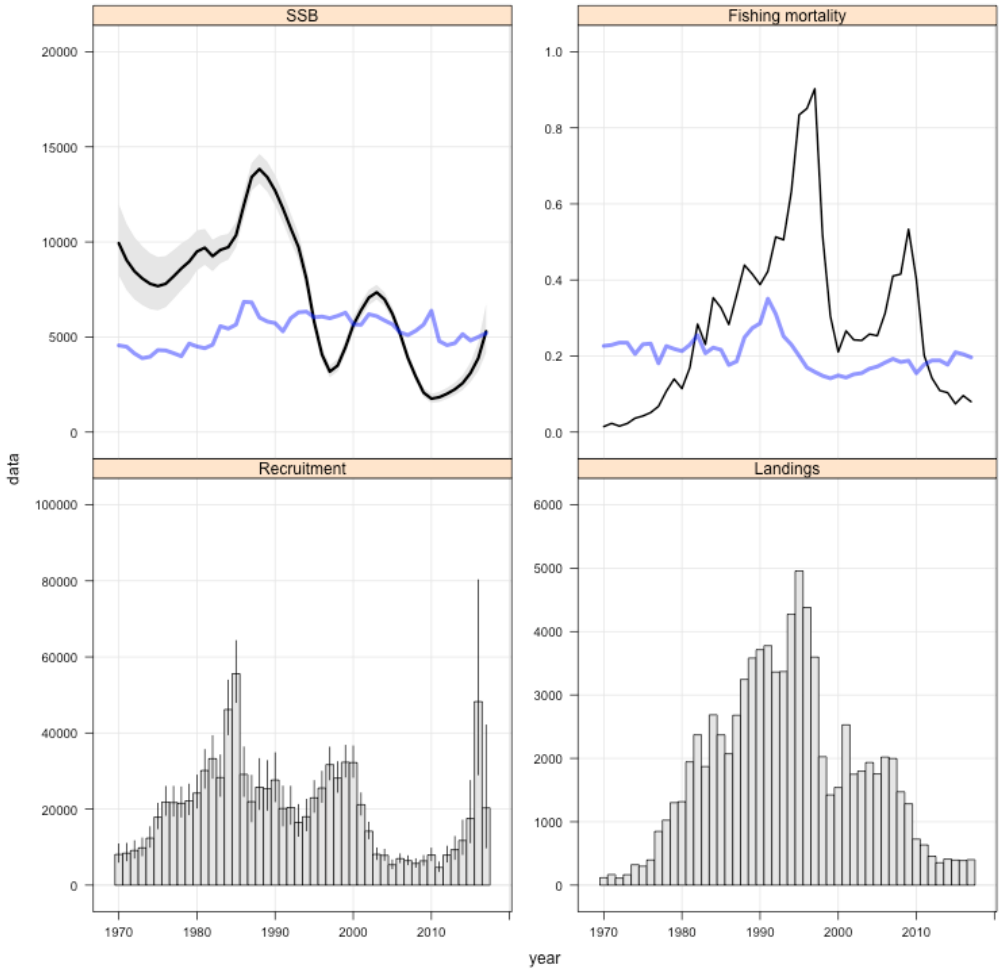

Figure 1. Jack mackerel in the southeast Pacific. Summary of stock assessment. Recruitment (age one) is measured in thousands, catch and SSB in thousands of tonnes, and harvest (fishing mortality) as a rate per year. Note that *dynamic* values for F_{MSY} and B_{MSY} are shown by horizontal blue lines.

Constant fishing mortality scenarios were explored at 125%, 100%, 75%, 50% and 0% of F_{2014}. Advice is based on maintaining the likelihood of spawning biomass to increase (above the 2017 estimate of 5.3 million t).

Table 1.Summary results for the short term catch prediction for the 2017 model. Note that "B" in all cases represents thousands of t of spawning stock biomass. B_{MSY} is provisionally taken to be 5.5 million t of spawning biomass in all cases. Reference F_{2017} refers to the fishing mortality assuming the full TAC will be taken in 2018 (TAC uptake estimated to be 82% in 2017).

Reference F_{2017}	B_{2019}	$P(B_{2019} > B_{MSY})$	B_{2023}	$P(B_{2023} > B_{MSY})$	B_{2027}	$P(B_{2027} > B_{MSY})$	Catch 2018 (kt)
0.00	9 950	100%	15 237	100%	19 413	100%	0
0.50	9 491	100%	12 779	100%	14 684	100%	271
0.75	9 273	99%	11 744	100%	12 901	100%	403
1.00	8 992	99%	10 520	100%	10 950	100%	576
1.25	8 861	99%	9 991	99%	10 158	99%	658

Table 2: Advised and reported catch of Jack Mackerel in the southeast Pacific.

Year	Advised maximum catch	Reported catch
2008		1 472 631
2009		1 283 474
2010		726 573
2011	711 783	634 580
2012	520 000	454 774
2013	441 000	353 123
2014	440 000	395 085
2015	460 000	394 212
2016	460 000	388 575
2017	493 000	402 050*

2011, 2012 & 2013 advice was given by the Science Working Group.
* As estimated at SC05

Annex 8. SC Multi-annual workplan

Deep water

Task	Objective	Time-line
Orange roughy assessment	Conduct an assessment of Orange roughy stocks Details include: Explore alternative stock assessment models Estimate stock status Provide advice on sustainable catch levels	2019 – Louisville Ridge stocks 2020 – relevant Tasman stocks
Orange roughy assessment data	Ageing of selected orange roughy otoliths Design acoustic surveys for relevant stocks	2019-2021
Deep water stock structures	Establish a sampling plan to ensure appropriate genetic samples are being collected from deepwater stocks Provide priority list for deepwater stock structure analyses based on Tier 2 and 3 Risk Assessment Use modelling and observation data to predict connectivity and seasonal to decadal variability herein Details include: • Using genetic, microchemistry, morphometric, parasite prevalence and tagging experiments	2018 2019 2021
Stock assessment framework	• Scoping analysis of stocks to be included • Define relevant reference points for key stocks	2019
Spatial management	Collect and review VME catch and other benthic sampling data Update and re-assess VME and habitat suitability modelling as appropriate	2020
Deepwater shark assessment	Complete quantitative risk assessment of sharks caught in SPRFMO bottom fisheries	2018
Ecological risk assessments	Critique of the current BFIAS Revise and update BFIAS	2018 2019

Squid

Task	Objective	Time-line
Squid assessment	Develop further assessment approaches	2019-2021
Squid assessment data	Identify data needs and recover historical data Details include: Sample biological information year-round in its entire distribution area Reconstruct historical total catch records Record and analyse diet data	2018-2020
Squid connectivity	Use modelling and observation data to predict connectivity and seasonal to decadal variability herein Details include: Using genetic, microchemistry, morphometric, parasite prevalence and tagging experiments	2019-2022

Ecosystem

Task	Objective	Time-line
Evaluate the applicability of acoustics data collected from fishing vessels		
Further developments of standardized oceanographic data products and modelling	Characterize jack mackerel habitat Provide ecosystem status overview for SC at seasonal to decadal scale	
Seabird / bycatch monitoring	Analyse observer-collected seabird interaction data to inform risk assessment Progress southern hemisphere quantitative risk assessment (SEFRA)	2018
Develop VMS/logbook based indicators for use in resource assessments		

Jack mackerel

Task	Objective	Time-line
Jack mackerel assessment	Conduct an assessment of Jack mackerel Details include: An evaluation of alternative stock structure hypotheses Provide TAC advice Review appropriate data weightings Explore alternative stock assessment models Review the rebuilding plan	2018
Jack mackerel assessment data	Review input data that is under consideration of the JM assessment Details include: Age-Length keys in relation to newly estimated growth parameters Standardization of commercial tuning indices Review industry data availability and usability	2018
Estimation of growth	Analyse growth estimation in light of spatial-temporal changes using a variety of techniques such as daily increment, carbon dating, tagging	2019-2020
Predict recruitment under climatic drivers	Investigate SPRFMO specific drivers of recruitment such as El Nino to improve productivity prediction	2020-2025
Jack mackerel connectivity	Use modelling and observation data to predict connectivity and seasonal to decadal variability herein	2019-2021

Annex 9. Tables and Figures for the 2017 CJM Assessment

Available here.