Annex 6

Report of the Working Group
on Statistics, Assessment and Modelling
(Virtual meeting, 27 June to 1 July 2022)

Contents

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Introduction

1.1 The meeting of the Working Group on Statistics, Assessments and Modelling (WG-SAM) was held online from 27 June to 1 July 2022, starting at 04:00 UTC. The meeting was convened by Dr T. Okuda (Japan). Dr Okuda welcomed the participants (Appendix A), noting that the Co-Convener of WG-SAM, Dr C. Péron (France), was unable to attend due to extraordinary circumstances, but will remain closely engaged with future work of WG-SAM and the reporting of the meeting to the Scientific Committee.

Opening of the meeting

Adoption of the agenda and organisation of the meeting

2.1 The meeting's provisional agenda was discussed, and the Working Group adopted the proposed agenda (Appendix B). Documents submitted to the meeting are listed in Appendix C.

2.2 The Working Group noted that its agenda followed topics assigned through the 2016 Scientific Committee workplan. Review of the current terms of reference for WG-SAM was included as a discussion topic under future work.

2.3 The Working Group report was prepared by the Secretariat and the Convener. Sections of the report dealing with advice to the Scientific Committee and other working groups are highlighted in grey and collated in 'Advice to the Scientific Committee'.

Development and progress of stock assessments

Stock assessments for krill

3.1 Dr C. Darby (UK) reported on the progress of the 'CM 51-07 revision' e-group. He noted the process that was undertaken by the working groups in 2021 to review the three elements of the revised krill management approach (acoustic biomass estimates, krill stock assessment yield estimates and risk assessment) and thanked all those involved. Although the Scientific Committee did not recommend any changes to the krill management framework in 2021, resulting in a rollover of Conservation Measure (CM) 51-07 for another 12 months, Dr Darby considered that the process was now well understood by Member scientists and Commissioners. The role of WG-SAM in reviewing the application of the krill stock assessment model and discussing input parameters was reiterated, and the outcomes of WG-ASAM-2022 in providing biomass estimates for management areas in Subarea 48.1 were highlighted (WG-ASAM-2022, Table 9).

3.2 The Working Group thanked Dr Darby for the update and his coordination of the process, noting the extensive efforts by many scientists to further develop the krill management approach, as well as the time constraints imposed by online meetings.

3.3 WG-SAM-2022/29 presented a report from a training workshop on fitting krill assessments with the generalised R yield model (Grym) held online on 13 and 14 January 2022. The paper highlighted the usefulness of such workshops as they allow potential users an opportunity to gain an understanding of the structure of assessments and the functioning of the underlying code.

3.4 The Working Group thanked Mr D. Maschette (Australia) for leading the workshop and noted the availability of the workshop code on the GitHub (github.com/Maschette/Krill_Grym_Workshop) repository for scientists to continue to develop the model, as well as recordings of the workshop for training purposes on the CCAMLR YouTube channel. The current version of the Grym model for krill assessment is available at (https://github.com/ccamlr/Grym_Base_Case /tree/Simulations).

3.5 WG-SAM-2022/10 and WG-EMM-2022/32 presented the results of an experiment conducted to estimate the length-weight relationship of krill on board a krill fishing vessel by grouping krill specimens into length classes and weighing them together, to reduce the impact of vessel movement on weight measurements.

3.6 The Working Group welcomed the study, and endorsed its future work plan by noting that determining the minimum number of individuals to be weighed in each length bin relative to the desired precision would be valuable. It, however, noted that weighing individual krill is a time-consuming task that would best be undertaken by having an additional observer or designing a specific research task, rather than tasking CCAMLR Scheme of International Scientific Observation observers with this work.

3.7 WG-SAM-2022/26 presented a summary of the status of the krill assessment fitted using the Grym following work undertaken during 2021. While recalling that the Grym model for krill stock assessment is ready for use, the paper noted that agreement on some parameter values has not yet been reached, in particular for the proportional recruitment parameters, the weight-at-length relationship and the maturity-at-length relationship. Regarding proportional recruitment, the authors identified two sets of parameter values that they deemed appropriate (recruitment scenarios (1) and (4) in Table 4 of WG-FSA-2021/39). The authors noted that scenario (1) showed the most overlap with the expected natural mortality range, used a clear and biological well defined age class (R2) as the recruitment, and estimated the recruitment with data collected by the recommended sampling net (RMT8), which can reduce net avoidance. The scenario (4) results overlapped with the expected natural mortality in acceptable level, and used data collected based on a sampling net with a similar mouth opening (6 m^2) with RMT8.

3.8 The Working Group noted that several options for the parametrisation of the stock assessment using the Grym, other than those presented in WG-SAM-2022/26, were discussed in 2021. It further noted that recruitment and mortality were linked in the model, and recalled the important improvement brought by WG-SAM-2021/09 in allowing higher variability to be modelled by the proportional recruitment model used for krill.

3.9 The Working Group discussed the relationship in the proportional recruitment model (WG-SAM-2021/09) between recruitment variability and natural mortality and noted that in the model high recruitment variability was associated with highly variable natural mortality estimates. The Working Group suggested this relationship in the model requires further investigation.

3.10 WG-EMM-2022/01 presented a review of recruitment studies collected by CCAMLR Members over the last 30 years and previously discussed at WG-Krill, WG-ASAM and WG-EMM. The authors considered that the proportional recruitment parameter values should be derived using data from long-term monitoring programs in the area in which the fishery occurs, using standard techniques, and including recently collected data if possible. The authors demonstrated that three long-term studies (the US AMLR Program, Palmer LTER and German surveys), all show that much of the recruitment variability is a result of multiple years of low recruitment, including years with no recruitment, and that recruitment is correlated with various environmental parameters. They further highlighted issues with other data sources that are currently considered potentially useful to estimate recruitment parameters for the krill stock assessment. Specifically, the authors concluded that the recruitment parameters from recruitment scenarios (1) and (4) in Table 4 of WG-FSA-2021/39 (see also paragraph 3.7) were not representative of recruitment in Subarea 48.1, and also noted the recruitment parameters for these two scenarios excluded surveys with observation of zero or low recruitment.

3.11 The Working Group agreed that the periodic nature of krill recruitment was an important characteristic that should not be ignored and would, ideally, be mechanistically incorporated in future stock assessment methodology. It noted that krill size distributions are highly variable in space and time and ensuring that a population is sampled representative is of vital importance but resource intensive. The Working Group further noted that addressing the data needs of the krill management framework would benefit from an evaluation of existing survey data (e.g. by comparing variability in survey haul data to model-based estimates of biomass from acoustic data) to ensure data used for parameter estimation was fit for purpose. This would assist in evaluating different parameter estimates proposed, as well as future survey designs to estimate recruitment and contemporary population demographics.

3.12 Dr S. Kasatkina (Russia) noted that the significant spatial and temporal variability in krill length distributions indicated that estimates of recruitment indices should be based on current krill demographics and, to a lesser extent, on data from historical long-term programs or on the reanalysis of data from existing surveys, taking into account differences in their methodology for collecting and processing data. Instead, Dr Kasatkina noted that it would be advisable to conduct additional surveys to assess the current recruitment parameters.

3.13 The Working Group noted that the estimation of krill recruitment in Subarea 48.1 would benefit from a better understanding of the different contributions of adjacent areas (e.g. Weddell Sea and Bellingshausen Sea contributions to the Antarctic Peninsula) which would be addressed through the establishment of a stock hypothesis. Such a hypothesis would provide a framework for interpreting patterns observed in survey and fishery data, and provide a crucial tool to evaluate the appropriateness of time series used to estimate proportional recruitment. The Working Group encouraged Members to communicate in the 'CM 51-07 revision' e-group and submit research to WG-FSA-2022 towards this end.

3.14 The Working Group recalled the request from the Scientific Committee to develop a database for biological and survey data from the krill fishery (SC-CAMLR-40, paragraph 8.4(ii)(c)) and encouraged Members to submit data to facilitate any survey evaluation process.

3.15 WG-EMM-2022/02 presented an analysis of krill proportional recruitment indices in Subarea 48.1 based on seven different data sources and using different size thresholds below which individuals are considered as recruits. The choice of size threshold was found to have a larger effect on proportional recruitment parameters than differences among datasets, and, given the importance of gear selectivity, the authors argued that length-frequency distributions should be adjusted prior to the computation of proportional recruitment parameters.

3.16 The Working Group noted that traditionally, proportional recruitment is fitted to cohorts (age classes) due to interannual variation in growth. Therefore, the choice of the size threshold used to consider krill as recruits was an important component in the estimation of proportional recruitment and a long-standing issue that needed to be considered alongside selectivity and availability.

3.17 WG-SAM-2022/27 presented an analysis of the methodological aspects of measuring the selectivity of gears in the krill fishery, focusing on the study by Krag et al. (2014) which was used to estimate the selectivity parameter values for the krill stock assessment model. Noting some methodological issues with the data collection protocols described in Krag et al. (2014), the authors highlighted that these protocols did not meet the International Council for the Exploration of the Sea (ICES) recommendations in a number of significant aspects (Wileman et al., 1996). In the authors' opinion, the published selectivity functions for gears in the krill fishery (Krag et al., 2014) should be treated with some caution. The authors highlighted the need for the development of a unified approach to estimating gear selectivity in the krill fishery, taking into account ICES recommendations on that subject, and noting the usefulness of vessels towing two gears simultaneously.

3.18 The Working Group noted that the points raised by the authors constituted useful suggestions for future work and that the selectivity function described by Krag et al. (2014) was currently the best available information.

3.19 WG-SAM-2022/28 Rev. 2 presented an alternative method of computing precautionary yield in the krill stock assessment projections. Instead of using the current implementation of the decision rules which compare the spawning stock biomass (SSB) under different fishing mortalities to pre-exploitation SSB (SSB_0), SSB in each year of fishing is compared to the same projections without fishing. As a result, non-zero yield is possible under simulations of high recruitment variability, which may not be the case when using the current decision rules.

3.20 The Working Group noted that such an implementation had similarities with that of the icefish assessment (which relies on frequent surveys) and that considering the lifespan of krill, the frequency of assessment update was also worth considering when calculating a precautionary harvest rate. It noted that progress towards a revision of the krill management approach needed to balance the short-term need for the provision of advice and the long-term testing of different management approaches though formal management strategy evaluations.

3.21 The Working Group recommended comprehensive management strategy evaluation be undertaken to assess the impacts of any changes to the decision rules as future priorities.

3.22 The Working Group agreed that the Grym and krill assessment model implementations are fit for purpose as a numerical projection tool. It noted no new parameter estimates had been provided for testing since WG-FSA-2021. It further noted that a range of opinions regarding parameter values and the implementation of the decision rules as applied to krill persisted, and that WG-EMM could help constrain the range of potential scenarios by providing expected bounds to output values from the models. An evaluation of a smaller set of parameter values could then be provided by Members to WG-FSA-2022.

Stock assessment for established toothfish fisheries

3.23 WG-SAM-2022/11 presented a laboratory-based experiment investigating the dynamics of odour release by two different types of bait (squid, fish) using a spectrophotometer. The authors noted that the two different samples of bait release odour at different rates, and recommended that bait type, size and thawing prior to use should all be standardised and integrated into the design of CCAMLR toothfish research proposals.

3.24 The Working Group thanked the authors for the study and encouraged further research on bait preference and detectability by toothfish, including an increase in sample size of the initial experiment and consideration of different bait sizes, as the experimental design had only been completed once. The Working Group noted that when data are collected for the purpose of catch-per-unit-effort (CPUE) analyses, not all operational factors can be standardised when setting longlines, and there will be a need for a post-hoc standardisation of variables. It also noted that standardisation of variables in a CPUE analysis is a different issue to standardisation of survey design.

3.25 The Working Group noted that fish are often attracted to combinations of amino acids and these attractants would diffuse below detection thresholds quickly due to currents, thereby constraining the area where bait is likely to be effective. The Working Group also noted that the type of bait deployed and soak time of longlines are recorded in the C2 data and that this information is currently used in CPUE standardisation analyses.

3.26 WG-SAM-2022/14 presented a comparison of CASAL and Casal2 model implementations using the 2021 CASAL assessments of Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.1 and small-scale research units 882A–B (Ross Sea region) and Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 (South Georgia). The comparisons show that the two software packages provided equivalent estimates of key parameters for the two case studies. Diagnostics derived from the CASAL and Casal2 models provided identical conclusions on model fits and Markov chain Monte Carlo (MCMC) outcomes, including stock status and catch limit projections. In addition, optimised performance compared to CASAL allows a faster estimation process in Casal2.

3.27 The Working Group noted that Casal2 models for other integrated toothfish assessments were in development, and further noted WG-SAM-2022/P01 which presented the Casal2 user manual for age-based models.

3.28 The Working Group noted that a length-based version of the Casal2 model is also being developed which may allow it to be used to conduct krill stock assessments. Planned developments for Casal2 include adding the ability to estimate parameters such as growth curves using age-length paired data.

3.29 The Working Group recommended that the Secretariat conduct a similar validation procedure of the Casal2 stock assessment results as has previously been agreed for CASAL models (e.g. WG-FSA-2021, paragraph 3.13).

3.30 The Working Group further noted that while Casal2 requires specifying more data and model characteristics than CASAL, it also has more advanced unit testing procedures and error messages. The Working Group also noted the complementary R package r4Casal2 (https://github.com/NIWAFisheriesModelling/r4Casal2) which can be used for visualisation, interpretation and diagnostics of Casal2 outputs.

3.31 The Working Group recommended that:

(i) Casal2 be accepted as being validated for use by CCAMLR for integrated statistical catch-at-age toothfish stock assessments

(ii) CASAL models for each area be presented alongside the equivalent Casal2 models for the next toothfish stock assessments presented to working groups to further demonstrate the equivalence of the CASAL and Casal2 software packages

(iii) the guidelines given in Appendix B of WG-SAM-2022/14 for validating Casal2 files be used for any Casal2 models presented to CCAMLR (Appendix D)

(iv) the version of Casal2 used is described in assessment reports, and models are validated using 'asserts' with backwards compatibility checks for each model implemented using Casal2

(v) Casal2 compatibility switches used for equivalence with CASAL be set to the 'casal' option for comparing between CASAL and Casal2, and to the default 'casal2' option for new models using Casal2

(vi) further research be encouraged to consider the use of parameter transformations (log, average-difference and simplex) to improve stability and MCMC performance in Casal2 models.

3.32 The Working Group noted the UK's intention to present a stock assessment for Subarea 48.3 using both CASAL and Casal2 to WG-FSA-2022, and welcomed the proposal by New Zealand to facilitate a future workshop to introduce Members to using Casal2 to conduct stock assessments.

3.33 WG-SAM-2022/15 presented a methodology to predict spatio–temporal changes in macrourid by-catch in the Antarctic toothfish fishery in the Ross Sea region using a spatio–temporal delta-generalised linear mixed models implemented in the R package vector autoregressive spatio–temporal (VAST) models. Preliminary results suggest that the methodology is useful to examine spatial patterns in key by-catch species, to monitor trends in species' catch rates when there is strong spatio–temporal variability in fishing effort, and to identify by-catch hotspots.

3.34 The Working Group welcomed this contribution, noting that this analysis was based on a subset of the available data, because by-catch hotspots were likely to be better identified by vessels that have operated over a longer period of time and in a consistent manner in the Ross Sea region. The Working Group suggested that future analyses could include data collected using other gear types, also noting that this would need to account for differences in by-catch reporting by vessels with different gear types. The Working Group noted that a 10 km × 10 km spatial prediction grid was used, but that the results would be qualitatively unchanged if a finer prediction grid was used.

3.35 The Working Group discussed the need to establish by-catch limits and management options for the two main macrourid species in the Ross Sea region. The Working Group noted that the VAST model provides spatial density estimates of by-catch species but is not designed to disentangle direct and indirect impacts of the fishery through by-catch mortality and predation release. The Working Group noted that such an approach requires the development of a multi-species model accounting for trophic interactions.

3.36 The Working Group recommended that the authors continue their efforts to understand the impacts of the Ross Sea toothfish fishery on by-catch species, and present this information for discussion at WG-FSA-2022.

3.37 WG-SAM-2022/17 presented estimates of tag loss rates for *D. eleginoides* in Subarea 48.3 tagged between 2004 and 2020. Initial single tag loss was estimated as 2.8% (95% confidence interval (CI) 2.0%–3.6%), as well as the ongoing single tag loss rate, estimated as 0.037 y^{-1} (95% CI 0.035–0.041 y^{-1}) in the best-fitting model. The estimates also showed no trend in initial tag loss or ongoing tag loss by season, suggesting that initial tag retention has remained consistent for different annual cohorts of releases. The results demonstrated a minor change between the updated tag loss parameters and those parameters currently used in the stock assessment.

3.38 The Working Group noted that the updated tag loss parameters will be used in future Subarea 48.3 stock assessment model updates.

3.39 WG-SAM-2022/21 and 2022/19 presented alternative CASAL stock assessment models of *D. eleginoides* in Subarea 48.4 and their diagnostics. Alternative models were presented for discussion (where L_∞ and k were either estimated, or fixed while otolith data was excluded), which aimed to address a lack of convergence in model fit owing to memory allocation issues caused by the increasing quantity of data.

3.40 The Working Group welcomed the update to the CASAL stock assessment for Subarea 48.4. Mr A. Dunn (New Zealand) offered to assist with further investigations into model inputs or parameter switches that may result in better estimation of parameters in the MCMC analysis.

3.41 WG-SAM-2022/24 presented a statistical comparison of age at maturity and length at age for *D. eleginoides* in Subarea 48.3 between 2011 and 2020 under alternative approaches for selecting otoliths from observer-collected samples. For the period considered, revising the otolith selection regime from random to stratified random to provide coverage on the full length-class distribution of the catch had no influence on the estimation of maturity. However, the revised otolith sampling procedure led to substantial changes in the estimated growth parameters for the time period 2011–2015.

3.42 The Working Group noted that the study presented age and length data for separate sexes and welcomed the future addition of separate sex modelling as well as updated biological parameters into the Subarea 48.3 stock assessment. The Working Group recommended investigating the effects of fishing selectivity and stratified length sampling on the estimation of growth parameters (see e.g. 2018 Summary Report of the CCAMLR Independent Stock Assessment Review for Toothfish – SC-CAMLR-XXXVII/02 Rev. 1).

3.43 The Working Group noted that the time of year during which sampling occurred may affect the macroscopic staging used to estimate maturity. The Working Group further noted that the revised maturity-at-age function predicted that some young fish in the age range of 1–7 are mature. This appears to be inconsistent with the expectation of the life-history characteristics of a long-lived deep-water species. The Working Group recommended that an adjusted function, assuming that all fish up to the age of 5 years are immature (similar to that presented in WG-FSA-2021/21) may be more appropriate for the assessment.

3.44 The Working Group encouraged the presentation of further work at WG-FSA-2022, on resampling and reading of historic otolith samples for length and age classes that are currently under-represented to allow the comparison of parameter estimates across a longer time series. The Working Group further noted that the availability of an extensive database of age readings would allow determining minimum sample size requirements by comparing biological parameter estimates between the entire database and sub-samples of the database.

3.45 WG-SAM-2022/20 and 2022/22 presented stepwise updates to a CASAL stock assessment of *D. eleginoides* in Subarea 48.3 and the diagnostics for its fully updated version (step 5). Updates were applied to recruitment assumptions, growth parameters, age compositions, weightings and survey uncertainty estimation.

3.46 The Working Group welcomed the large amount of work that had been devoted to the additional analysis in the Subarea 48.3 stock assessment model and noted the utility of regularly reviewing underlying assumptions and parameters. The Working Group further noted that the updates that had been applied were requested by WG-FSA-2019 (WG-FSA-2019, paragraph 3.61) and WG-FSA-2021 (WG-FSA-2021, paragraph 3.27). The Working Group noted that additional recommendations from the CCAMLR Independent Stock Assessment Review for Toothfish (SC-CAMLR-XXXVII/02 Rev. 1) were also addressed through the analyses developed to support the Subarea 48.3 stock assessment model.

3.47 The Working Group noted that the stock assessment process undertaken was the best available approach for the Subarea 48.3 toothfish stock assessment.

3.48 The Working Group noted that the graphical summaries of stock performance presented in WG-SAM-2022/18 demonstrated that the current fishing selection pattern and harvest rate in Subarea 48.3 is precautionary in achieving the CCAMLR objective of a long-term average of 50% of B_0. In addition, in relation to the Scientific Committee's objective to examine the utility of target and limit exploitation rate objectives within the CCAMLR decision rules, the Working Group noted that the graphical analysis showed that the Subarea 48.3 toothfish stock is exploited at a fishing mortality that is currently at around half of F_{MSY}. It is therefore well below the thresholds that regional fishery management organisations would consider appropriate limits or targets.

Stock assessment for data-limited toothfish fisheries

3.49 WG-SAM-2022/08 presented a provisional trend analysis for research blocks in data-limited toothfish fisheries and requested feedback from WG-SAM.

3.50 The Working Group thanked the Secretariat for the analysis, considered the requested feedback, and recommended that:

(i) time-at-liberty constraints remain unchanged

(ii) fishable area calculations be made within the 600–1 800 m depth range and that a comparison of estimates be provided to WG-FSA-2022 with fishable areas computed using other depth ranges if the proponents provide a scientific basis for an alternative range

(iii) the decision tree diagram include a new step for those research blocks where fishing restarted after a five year period without fishing. In such cases, after one year of effort-limited fishing, the next catch limit would be computed as 4% of the latest CPUE-by-seabed area biomass estimate. Once two years of data would be available, the trend analysis would be applied in subsequent years

(iv) all papers cited in the report be included in the reference list at the end of the document

(v) the trend analysis code be made available on the CCAMLR GitHub page

(vi) while retaining the map of all research blocks, investigate different display options to distinguish those research blocks that do not require catch advice in a given year from those that do.

3.51 The Working Group recalled that the trend analysis was intended to be a stepping stone towards the development of both a stock hypothesis and a stock assessment in data-limited areas. It is intended to provide precautionary catch advice in the absence of a stock assessment. The Working Group noted that customisation of the presentation and summary of trend analyses within individual research blocks was possible but needed to be driven and justified by proponents, with support from the Secretariat. It further noted that assessing the trend analysis (as well as other data-limited statistical approaches) within a management strategy evaluation using simulation models would be beneficial, and that a draft plan built in collaboration between Members and with the support of the Secretariat, should be submitted to WG-FSA-2022.

3.52 WG-SAM-2022/16 presented a survey design tool (R Shiny interface) to create simulated survey outputs by resampling historic catch, effort and observer data, and test survey designs in areas where longline fishing has previously occurred.

3.53 The Working Group welcomed this initiative and noted its usefulness as a testing tool to assess models and in developing statistically robust methods. It noted that additional visualisations of summary statistics and graphics would be helpful in such assessments. The Working Group also noted the value of such a tool to analyse the impact of CPUE gear standardisation approaches on abundance estimates. It recommended the development of a power analysis functionality within the tool to assist users in their survey designs.

3.54 WG-SAM-2022/23 presented an analysis comparing estimates of *D. eleginoides* fishing mortality in Subarea 48.3 between three approaches to estimating fishing mortality in recent years: the integrated CASAL assessment, the percentage tag return rate, and a simple per-cohort catch-curve analysis of tagging data. The similarity of exploitation rate estimates (4%) across the three methods provides support from independent methods that the current assessment and management of the Subarea 48.3 toothfish stock is consistent with the CCAMLR management objectives.

3.55 The Working Group noted the value in using different numerical approaches to corroborate stock assessment outputs. It further supported the idea of using simple methods and graphical approaches to communicate fishery performance to Commissioners and encouraged all Members to consider such an approach in parallel to the communication of stock assessment outputs.

Management strategy evaluations: consideration of alternative toothfish harvest control rules, including F based rules for stocks with integrated assessments

4.1 WG-SAM-2022/18 presented an assessment of the utility of surface plots in the evaluation of the CCAMLR decision rules and their future development, and to aid in interpretation and discussion of modelling outcomes. Graphical approaches showing various alternative management and fisheries metrics (e.g. the use of exploitation rates as well as historic biomass) were illustrated using the Subarea 48.3 toothfish fishery as an example. The approaches offer simple and effective reporting tools to communicate a range of fisheries management strategies and performance metric summaries to managers.

4.2 The Working Group welcomed this contribution and agreed that the inclusion of graphics describing fisheries performance relative to specified targets would be a useful addition to stock assessment documents. The Working Group noted that some additional intersessional work will be needed to adapt some of the graphical summaries such as yield per recruit plots or Kobe plots to incorporate exploitation rates in decision rules, as the current approach simulates constant catch rather than a constant fishing mortality.

Review of new research proposals

Ross Sea region under CM 24-01

5.1 WG-SAM-2022/13 presented a review of the Ross Sea shelf surveys, which were first undertaken in 2012 for monitoring the recruitment of juvenile *D. mawsoni*. The surveys were expanded in 2016 to monitor trends and biological characteristics in Terra Nova Bay and McMurdo Sound and to collect data that would contribute to the research and monitoring plan (RMP) for the Ross Sea region marine protected area (RSRMPA).

5.2 The Working Group congratulated New Zealand and collaborating Members on the successful outcomes of the research, noting the extensive list of publications, breadth of scientific information, and data generated which is used for stock assessment and fisheries management in the region.

5.3 WG-SAM-2022/01 Rev. 1 presented a proposal to continue the Ross Sea shelf survey for an additional three years from 2022/23 to 2024/25 under CM 24-01. The main objectives of the plan are the continuation of the existing annual time series of research surveys, to monitor trends in abundance and biological characteristics of the larger (sub-adult and adult) toothfish in McMurdo Sound and Terra Nova Bay, and to collect and analyse a wide range of data and samples to contribute to the RMP for the RSRMPA.

5.4 The Working Group noted that the proposal was using the same methods and design as in previous surveys, had used standardised gear and methods in the design, was an important time series for informing the Ross Sea region stock assessment by delivering a long-term time series of recruitment, and provided the ability to track cohorts as they move from the shelf to the slope and then to the seamounts.

5.5 The Working Group noted that while the acoustic component was valuable to the RMP of the RSRMPA, it would benefit from further documentation on the acoustic instruments used and the aim of the acoustic component of the survey and suggested presenting the acoustic monitoring plan at WG-ASAM-2023.

5.6 The Working Group supported the proposed method to determine the catch limit using catches of previous surveys, with the 95th percentile used for the core strata and the 90th percentile for McMurdo Sound and Terra Nova Bay. The Working Group recommended that additional power analyses in the Terra Nova Bay and McMurdo Sound strata would be beneficial to assess the appropriate frequency for sampling these strata to achieve the survey objectives and requested the proponents to submit such analyses to WG-FSA-2022. The Working Group further noted that this survey constituted a notable example of fishing vessels being successfully used as scientific research platforms.

5.7 The Working Group evaluated the proposal and the self-assessment provided in Appendix 1 of WG-SAM-2022/01 Rev. 1 and recommended that the Ross Sea shelf survey continue for another three years.

Divisions 58.4.1 and 58.4.2 under CM 21-02

5.8 WG-SAM-2022/07 presented a multi-Member report on the exploratory fishing activities for *D. mawsoni* undertaken in Divisions 58.4.1 and 58.4.2 between fishing seasons 2011/12 and 2021/22.

5.9 WG-SAM-2022/09 presented a review of the *D. mawsoni* stock hypothesis in East Antarctica and the spatial design of research in Divisions 58.4.1 and 58.4.2. Based on habitat modelling, genetics, fish movement, and egg and larvae transport modelling, the paper concluded that *D. mawsoni* in Divisions 58.4.1 and 58.4.2 should be considered as a single stock. The paper also provided a qualitative assessment of research blocks in these two divisions and concluded that the spatial design of the proposed research plan in WG-SAM-2022/04 was likely to: (i) achieve the stated research objectives, (ii) support a viable fishery, and (iii) provide data to further support the development of the stock hypothesis. The assessment found that many of the research blocks in both divisions scored consistently well in suitability against the factors examined. However, most research blocks in Division 58.4.1 scored overall lower on criteria which depended on fishery data compared to the previous analysis in WG-SAM-18/17 since there has not been any fishing allowed in this division since the 2018 season.

5.10 The Working Group noted that despite directed fishing having not been allowed in Division 58.4.1 since the 2018 season, considerable desktop research has been undertaken by all Members involved, and has provided valuable information on the stock structure and life history of *D. mawsoni* in this region.

5.11 The Working Group supported the proposal to consider *D. mawsoni* in Divisions 58.4.1 and 58.4.2 as a single stock, based on data available, and considered the spatial design of the research to be appropriate.

5.12 WG-SAM-2022/04 presented a multi-Member proposal for exploratory fishing under a new research plan for 2022/23 to 2025/26 by Australia, France, Japan, the Republic of Korea and Spain to continue research in the exploratory fishery for *D. mawsoni* in Divisions 58.4.1 and 58.4.2 in accordance with CM 21-02, paragraph 6(iii). The four-year plan was based on the low-risk profile of this fishery and to allow more time for the review of stock assessments by working groups in 'non-assessment' years.

5.13 The Working Group noted that many previous recommendations regarding the design of this research plan had been incorporated. Most participants agreed that the proposed research plan presented was of high quality, and that research in this area greatly contributed to the objectives of the Commission.

5.14 Dr Kasatkina considered that the multi-Member research plan in the exploratory fishery for *D. mawsoni* in Divisions 58.4.1 and 58.4.2 required standardised sampling gear types to meet its objectives and did not support the proposal.

5.15 Most participants noted that gear standardisation was not required in the research proposal for this exploratory fishery for which one of the main objectives is to develop a tag-based stock assessment. Such an assessment relies mainly on data of tag-releases and the ratio of tagged to untagged fish in the catch which are independent of the gear types used. Several participants further noted that gear standardisation was not required in any other CCAMLR fishery or multi-vessel research activities that collect data for assessment purposes.

5.16 The Working Group noted that CPUE by seabed area calculations are not an objective of this proposal. Most participants therefore considered that standardisation of gear types is not needed for the success of this proposal in meeting its objectives.

5.17 The Working Group noted that different longline gear configurations and bait may influence some aspects of the catch and recalled extensive discussions on this subjects in previous meetings, including WG-SAM-2019, paragraphs 6.1 to 6.7 and 6.54 to 6.72, WG-FSA-2019, paragraphs 4.89 to 4.114, SC-CAMLR-38, paragraphs 3.102 to 3.123, SC-CAMLR-39, paragraphs 4.10 to 4.13, WG-SAM-2021, paragraphs 8.8 to 8.14, WG-FSA-2021, paragraphs 4.17 to 4.28 and SC-CAMLR-40, paragraphs 3.100 to 3.104.

5.18 Dr Kasatkina considered that the fishery in Division 58.4.1 should be classified as a 'new' fishery rather than an exploratory fishery operating under CM 21-02.

5.19 The Working Group noted that CM 41-11 identifies the toothfish fishery in Division 58.4.1 as an exploratory fishery, this topic has previously been discussed (SC-CAMLR-40, paragraph 3.103 and CCAMLR-40, paragraph 6.44) and that this was a matter for the Commission.

5.20 The Working Group was unable to provide consensus advice on the design of the WG-SAM-2022/04 research plan.

Review of ongoing research plan results and proposals

Research results and proposals from Area 48

6.1 WG-SAM-2022/02 provided an update to the efforts involved in the research plan pertaining to Subarea 48.6 in 2021/22–2023/24 under CM 21-02, paragraph 6(iii). This is the second year of an ongoing three-year plan, with no significant changes proposed. An overview of the key objectives and methods involved were provided, with preliminary results reported.

6.2 WG-SAM-2022/02 was not discussed as it was in year two of a three-year plan and was therefore not required to be reviewed by WG-SAM (CCAMLR-38, paragraph 5.64).

6.3 WG-SAM-2022/03 presented an updated analysis of the dynamic sea-ice concentration (SIC), sea-ice temperature and winds in research blocks 4 and 5 of Subarea 48.6. Results indicated a decreasing trend in annual sea-surface temperature spikes through time later shifting to an increase in 2022, suggesting the cooling phase of a 5–6-year periodical cycle may have concluded. Further, warmer southward winds in early 2022 may have contributed to fast ice melting, influencing offshore oceanographic conditions, followed by weaker winds in June stimulating less spatial mixing. These results suggest an increased temperature of surface water near the continent.

6.4 The Working Group thanked the authors for this paper, and suggested conducting further analysis, potentially through the integration of a statistical model used to predict SICs as described within a paper to be presented at WG-EMM (WG-EMM-2022/P13).

6.5 WG-SAM-2022/06 presented a proposal to conduct a local acoustic trawl survey of mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.2 within the shelf and slope regions of the South Orkney Islands. Objectives of the research include estimating the pelagic biomass in the survey area, improving information on biological parameters, and furthering understanding of the spatial and bathymetric distribution of by-catch species.

6.6 The Working Group recommended the proponents address the following for submission to WG-FSA-2022:

(i) incorporate biomass and biological results as well as acoustic data from the 2018 Chilean trawl survey (WG-SAM-18/25, WG-FSA-18/05) to estimate and evaluate the expected coefficient of variation (sampling variability) of survey estimates to improve survey design given the proposed transects

(ii) clarify how many years of fishing is planned, noting three years of research milestones scheduled in the proposal

(iii) rotate acoustic transects connecting the gridded trawl stations to progress the survey in an on–off shelf pattern (perpendicular to bathymetry contours)

(iv) include maps of planned transects

(v) add a strata boundary around the survey transects (typically half a transect spacing) to indicate coverage

(vi) consider if there may be benefits to using a smaller trawl net, and describe how the trawls will be conducted (i.e. targeting acoustic aggregations or using oblique tows)

(vii) clarify number of trawls, noting that target trawls will be required for acoustic marks and random/gridded trawls for random length-density distribution

(viii) clarify trawl implementation for gridded trawls, oblique tows or set depths, and provide justification for the 30-minute time duration

(ix) consider impacts of time of day of trawling on survey design

(x) describe how video observations could be used to estimate catchability, with the methodology further reviewed by WG-FSA

(xi) clarify ways to distinguish acoustic signals from krill and icefish (see paragraph 6.8)

(xii) remove icefish ageing milestones from the table within the paper

(xiii) evaluate the appropriate working group that milestones might be delivered to, noting for example, that acoustic biomass estimates are best suited to WG-ASAM.

6.7 WG-SAM-2022/12 presented a potential survey design to estimate the biomass of *C. gunnari* in Subarea 48.3 through combined midwater acoustic surveys and bottom trawl surveys. The suggested methods would be intended to provide further information on the ecology and population dynamics of *C. gunnari* in Subarea 48.3.

6.8 The Working Group thanked the authors for their work and noted that conducting acoustic surveys for icefish still had many challenges, including difficulty in distinguishing icefish and krill using solely the dB difference technique (Fallon et al., 2016), and the lack of a validated target strength model to convert acoustic data to biomass (see also WG-ASAM-2022, paragraph 3.3). The Working Group also noted the merit of such surveys regarding the pelagic component of the icefish, including its ecological interaction with krill. The Working Group suggested that this should be further considered by WG-ASAM.

6.9 The Working Group further considered that the survey design, as suggested, would provide information on the pelagic component of the stock (mostly the first two age groups of fish) but would not provide information on natural mortality of icefish in the pelagic population. Additional research such as the survey methods outlined in WG-SAM-2022/12, especially icefish diet analysis, would enhance understanding of the ecology of the pelagic component of the population.

6.10 Dr Darby noted that during the current UK survey series acoustic information data have been collected during several surveys, as analysed by Fallon et al., 2016, analysis of which could be made available at WG-ASAM. The current survey could potentially be adapted to collect acoustic information on a regular basis. Ecological sampling has been reported in all survey reports submitted to WG-FSA.

6.11 The Working Group noted that the current survey methodology for icefish was appropriate for the provision of highly precautionary catch limit management advice. Should acoustic methods prove successful in the future, inclusion of the pelagic component would increase catch limits.

Research results and proposals from Area 88

Subarea 88.3

6.12 WG-SAM-2022/25 presented a progress report on research conducted in 2022 under CM 24-01 on *D. mawsoni* in Subarea 88.3 by the Republic of Korea and Ukraine. The report indicated that CPUE was higher in research blocks 883_3 and 883_4 than in research blocks 883_6 and 883_7. A vessel calibration study in research block 883_4 indicated differences in CPUE between the two survey vessels. Large *D. mawsoni* individuals were found in research blocks 883_3 and 883_4, while juveniles were observed in research blocks 883_6 and 883_7. Otoliths, stomach contents, gonad, fin and muscle samples were collected. The main by-catch species and main prey of toothfish were macrourids, 95.5% of which were identified as *Macrourus caml*.

6.13 The Working Group noted WG-SAM-2022/05, presenting a proposal by Korea and Ukraine for the continuation of a research plan from 2021/22 to 2023/24, for *Dissostichus* spp. under CM 24-01, paragraph 3, in Subarea 88.3. This is the second year of an ongoing three-year plan, with no significant changes proposed. Following the research proposal review process (CCAMLR-38, paragraph 5.64), the Working Group did not review this paper. This research proposal will be reviewed at WG-FSA-2022.

6.14 The Working Group welcomed this research plan and congratulated the authors on successfully addressing a number of the recommendations from WG-FSA-2021.

6.15 The Working Group encouraged the proponents to:

(i) conduct work towards addressing the by-catch analysis milestones of the research proposal (as requested by WG-FSA-2021, paragraph 4.44)

(ii) include latitudes and longitudes in maps in the proposal

(iii) evaluate the purpose and value of research blocks 883_9 and 883_10.

Future work and comments on draft strategic plan (2023–2027)

7.1 On behalf of the Chair of the Scientific Committee, Dr S. Parker (Secretariat) presented the report of the CCAMLR Scientific Committee Symposium that met virtually on 8 and 10 February 2022 (WG-ASAM-2022/01). The informal Scientific Committee meeting discussed the progress and outcomes from the first CCAMLR Scientific Committee's workplan (SC-CAMLR-XXXVI/BG/40) and provided an opportunity for participants to propose long-term priorities and strategies to inform the development of the next five-year strategic plan

(2023–2027). Recommendations and plans will be reviewed and refined during the intersessional period by all working groups and agreed at SC-CAMLR-41 according to the Scientific Committee's Rules of Procedure.

7.2 The Working Group welcomed and endorsed such an approach that will enable the working groups and the Scientific Committee to identify and focus their efforts on the priorities. The Working Group undertook to review the priority research topics presented in Table 2 of the document and preliminary discussions and recommendations for work sequencing took place, however, due to the time constraints of the meeting, a comprehensive review was not possible.

7.3 The WG-SAM Convener provided a template to organise the WG-SAM topic areas according to the year in which the topic would be progressed. The Working Group thanked Dr Okuda for preparing this tool and endeavoured to review and update the work program by correspondence in the 'Scientific Committee Symposium 2022' e-group.

7.4 The Working Group noted that whilst some tasks in the Scientific Committee's workplan had multiple working groups assigned, some of these (for example acoustic biomass estimates) fell outside the terms of reference and expertise of WG-SAM and could be removed to allow more focus on pressing tasks of the Working Group.

7.5 Due to the recurrence of discussions regarding gear standardisation in research fishing and fishing operations, the Working Group noted that formal analyses regarding the effect of bait and fishing gear on catchability could be included in the work plan.

7.6 The Working Group discussed its terms of reference and initiated some editorial changes but could not complete this task due to time constraints. The Working Group undertook to continue progressing these tasks through the 'Scientific Committee Symposium 2022' e-group, with results to be presented at SC-CAMLR-41 by the WG-SAM Co-conveners.

Other business

Data access rules (Data Services Advisory Group)

8.1 WG-ASAM-2022/15 presented the implementation of the Rules for Access and Use of CCAMLR Data (hereafter referred to as "the Rules") in the CCAMLR data request procedure, and the procedure for publication of derived materials in the public domain.

8.2 The Working Group reflected on the procedure to request permission to publish the data from the data owners and noted that the Rules could be interpreted to require that data requesters consult directly with data owners during their analyses of the data and prior to deciding to create a paper to be published in the public domain.

8.3 The Working Group recommended that:

(i) Members identify alternate representatives for approving data requests to account for periods when the Scientific Committee Representative might not be available.

(ii) The Secretariat reduces the length of the data request procedure to two weeks after the abovementioned alternate representatives have been identified.

(iii) The Secretariat investigates assigning digital object identifiers (DOIs) to its data holdings and to data extracts to facilitate data citation in papers submitted to peer-reviewed journals.

(iv) The Data Services Advisory Group (DSAG) considers whether the Rules can discriminate between different categories of data such as fishery data and research data. Additional specifications could apply to research data for which the originator indicates that they are still being analysed with the intent to publish.

(v) The Rules be modified to specify that the following statement needs to be included in the acknowledgement section of papers using CCAMLR data published in the public domain:

'This work makes use of data under the competence of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The authors acknowledge that they received permission to publish this work from the CCAMLR data owners.'

(vi) Paragraph 7 of the Rules be modified to allow the Secretariats of other organisations such as the Southern Indian Ocean Fisheries Agreement (SIOFA), the South Pacific Regional Fisheries Management Organisation (SPRFMO) and the South East Atlantic Fisheries Organisation (SEAFO) to initiate requests for CCAMLR data on behalf of their members.

(vii) A footnote be added to the Rules in order rectify the contradiction between the Rules and CM 10-04, paragraphs 17 and 23.

Advice to the Scientific Committee

9.1 The Working Group's advice to the Scientific Committee is summarised below; these advice paragraphs should be considered along with the body of the report leading to the advice:

(i) toothfish stock assessments using Casal2 (paragraph 3.31)
(ii) characteristics of the Ross Sea shelf survey (paragraphs 5.6 and 5.7)
(iii) data access requests and rules (paragraph 8.3).

Adoption of report and close of meeting

10.1 The report of the meeting was adopted.

10.2 At the close of the meeting, Dr Okuda thanked all participants for their hard work and collaboration that had contributed greatly to the successful outcomes of WG-SAM this year, also acknowledging the work of Dr Péron. Dr Okuda also thanked the Secretariat, Interprefy staff and the stenographers for their support, noting the length of the meeting had been shorter than an in-person event, a large body of work had been accomplished and a considerable future workplan developed for WG-SAM.

10.3 On behalf of the Working Group, Dr Darby and Dr X. Wang (China) thanked Dr Okuda for his guidance during the meeting, with additional mention to Dr Péron for her support outside of the meeting. Dr Wang made special mention to the success of the meeting, noting in particular the value of acoustic advice discussed. The Working Group thanked the Secretariat for its work compiling the report, the technical support provided by the Interprefy team, and the provision of official advice to the Scientific Committee.

References

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Appendix A

List of Registered Participants

Working Group on Statistics, Assessments and Modelling
(Virtual Meeting, 27 June to 1 July 2022)

Co-conveners	Dr Clara Péron (did not attend the meeting) Muséum national d'Histoire naturelle
	Dr Takehiro Okuda National Research Institute of Far Seas Fisheries
Australia	Dr Jaimie Cleeland Institute for Marine and Antarctic Studies (IMAS), University of Tasmania
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Claire van Werven
Research, Monitoring and Compliance Analyst

Appendix B

Agenda

Working Group on Statistics, Assessments and Modelling
(Virtual meeting, 27 June to 1 July 2022)

1. Introduction

2. Opening of the meeting

    2.1 Adoption of the agenda and organisation of the meeting

3. Development and progress of stock assessments

    3.1 Stock assessments for krill
    3.2 Stock assessment for established toothfish fisheries
    3.3 Stock assessment for data-limited toothfish fisheries

4. Management strategy evaluations: consideration of alternative toothfish harvest control rules, including F-based rules for stocks with integrated assessments

5. Review of new research proposals

6. Review of ongoing research plan results and proposals

    6.1 Research results and proposals from Area 48
    6.2 Research results and proposals from Subarea 58.4
    6.3 Research results and proposals from Area 88

7. Future work and comments on draft strategic plan (2023–2027)

8. Other business

9. Advice to the Scientific Committee

10. Adoption of report and close of meeting.

Appendix C

List of Documents

Working Group on Statistics, Assessments and Modelling
(Virtual Meeting, 27 June to 1 July 2022)

WG-SAM-2022/01	Proposal to continue the time series of research surveys to monitor abundance of Antarctic toothfish (*Dissostichus mawsoni*) in the southern Ross Sea, 2022/23–2024/25: Research Plan under CM 21-02, paragraph 6(iii) Delegation of New Zealand
WG-SAM-2022/02	Continuation of the research proposal on Antarctic toothfish (*Dissostichus mawsoni*) in Statistical Subarea 48.6 in 2022/23 from a multiyear plan (2021/22–2023/24): Research Plan under CM 21-02, paragraph 6(iii) Delegations of Japan, South Africa and Spain
WG-SAM-2022/03	2022 updated analysis of the sea ice concentration in research blocks 4 and 5 of Subarea 48.6 with sea surface temperature and winds T. Namba, R. Sarralde, T. Ichii, T. Okuda, S. Somhlaba and J. Pompert
WG-SAM-2022/04	New research plan for the *Dissostichus mawsoni* exploratory fishery in East Antarctica (Divisions 58.4.1 and 58.4.2) from 2022/23 to 2025/26; Research plan under CM 21-02, paragraph 6(iii) Delegations of Australia, France, Japan, Republic of Korea and Spain
WG-SAM-2022/05	Continuing research plan for *Dissostichus* spp. under CM 24-01, paragraph 3, in Subarea 88.3 by Korea and Ukraine from 2021/22 to 2023/24 Delegations of Korea and Ukraine
WG-SAM-2022/06 Rev. 1	Proposal to conduct a local acoustic-trawl survey of *Champsocephalus gunnari* in Statistical Subarea 48.2 Delegation of Ukraine
WG-SAM-2022/07	Report on exploratory fishing in Divisions 58.4.1 and 58.4.2 between fishing seasons 2011/12 and 2021/22 G. Phillips and P. Ziegler
WG-SAM-2022/08	2022 provisional trend analysis – preliminary estimates of toothfish biomass in research blocks Secretariat

WG-SAM-2022/09	Review of the Antarctic toothfish stock hypothesis in East Antarctica and the spatial design of research in Divisions 58.4.1 and 58.4.2 J. Cleeland, P. Ziegler, C. Miller, G. Phillips, P. Yates, T. Okuda, C. Péron, S. Chung and R. Sarralde
WG-SAM-2022/10	A pilot study on the length-weight relationship of fresh Antarctic krill with weight-at-length based on multiple individuals G. Fan, Y. Ying, J. Zhu and X. Zhao
WG-SAM-2022/11	A study of odour parameters for different bait types used in the toothfish fishing in CCAMLR area O.Y. Krasnoborodko
WG-SAM-2022/12	Proposal for complex acoustic and trawl surveys for the mackerel icefish (*Champsocephalus gunnari*) estimates in the CCAMLR Statistical Subarea 48.3 S. Kasatkina
WG-SAM-2022/13	A review of the Ross Sea shelf survey J. Devine
WG-SAM-2022/14	Integrated toothfish stock assessments using Casal2 A. Dunn, A. Grüss, J.A. Devine; C. Miller, P. Ziegler, D. Maschette, T. Earl, C. Darby and F. Massiot-Granier
WG-SAM-2022/15	Using VAST (vector autoregressive spatio–temporal) models to predict spatio–temporal changes in macrourid by-catch in the Ross Sea region Antarctic toothfish (*Dissostichus mawsoni*) fishery: Methods and preliminary results A. Grüss, B.R. Moore, M.H. Pinkerton and J.A. Devine
WG-SAM-2022/16	A tool for creating simulated survey outputs from longline data M. Kerr and T. Earl
WG-SAM-2022/17	Estimates of tag loss rates for Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 tagged between 2004 to 2020 J. Marsh, T. Earl and C. Darby
WG-SAM-2022/18	The utility of surface plots in the development of the CCAMLR Decision Rule, its interpretation, and the rationalisation of current management and fishery metrics C. Darby and T. Earl

WG-SAM-2022/19	Stock assessment of Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.4: assessment diagnostics L. Readdy, T. Earl and C. Darby
WG-SAM-2022/20	Stock assessment of Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 – proposed model updates L. Readdy and T. Earl
WG-SAM-2022/21	Stock assessment of Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.4 – addressing the convergence issues encountered in the 2021 assessment L. Readdy, T. Earl and C. Darby
WG-SAM-2022/22	Stock assessment of Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3: assessment diagnostics L. Readdy and T. Earl
WG-SAM-2022/23	A comparison of fishing mortality estimates derived using data-rich and data-limited approaches C. Darby and T. Earl
WG-SAM-2022/24	A comparison of estimates of Patagonian toothfish (*Dissostichus eleginoides*) maturity and growth in Subarea 48.3 using different otolith selection procedures J. Marsh, T. Earl, P. Hollyman and C. Darby
WG-SAM-2022/25	Progress report on the joint research for *Dissostichus* spp. in Subarea 88.3 by the Republic of Korea and Ukraine in 2022 Delegations of the Republic of Korea and Ukraine
WG-SAM-2022/26	The status of Grym simulations developed in 2021 Y. Ying, X. Wang, X. Zhao and Q. Xu
WG-SAM-2022/27	Methodical aspects of measuring the selectivity of gears in krill fishery S. Sergeev and S. Kasatkina
WG-SAM-2022/28 Rev. 2	An alternative method of calculating precautionary yield D. Kinzey and G.M. Watters
WG-SAM-2022/29	Report from a training workshop on Grym krill assessments D. Maschette and S. Wotherspoon

Other documents

WG-SAM-2022/P01	Casal2 User Manual for Age-Based Models Casal2 Development Team *NIWA Technical Report*, 139 (2022): ISSN 1174-2631. User manual for age-based models with Casal2 v22.06 (2022-06-07)
WG-ASAM-2022/01	Report of the Chair of the Scientific Committee on the CCAMLR Scientific Committee Symposium Chair of the Scientific Committee
WG-ASAM-2022/15	Review of the Rules for Access and Use of CCAMLR Data Chair of the Data Services Advisory Group (DSAG)
WG-EMM-2022/01	Recruitment variability along the Antarctic Peninsula: What's the best way forward C.S. Reiss and G.M. Watters
WG-EMM-2022/02	Recruitment variability in Antarctic krill in Subarea 48.1 expressed as 'proportional recruitment' D. Kinzey, J.T. Hinke, C.S. Reiss and G.M. Watters
WG-EMM-2022/32	Preliminary results on the length-weight relationship of fresh Antarctic krill with weight-at-length based on multiple individuals Y. Ying, G. Fan, J. Zhu and X. Zhao

Appendix D

Validation of Casal2 Parameter Files

1. The process of validation requires that WG-FSA are satisfied that Casal2 model parameter files contain the parameter values and model assumptions described in accompanying assessment papers, and that the parameter files can be used to reproduce the key results reported by those papers.

2. Such validation comprises a number of discrete steps, and the guidelines to assist WG-FSA and the Secretariat in carrying out validation are described below.

Part A: Secretariate validation of the supplied input configuration files and the reproducibility of outputs

3. Part A of the process of validation requires that the Secretariat verify that the Casal2 parameter files can be used to reproduce the key results reported by those papers and confirm that:

(i) from a simple run (casal2 -r), the software used in the assessment accepts the input files and produces no error messages

(ii) from an estimation run (casal2 -e), the parameter files match the MPD results reported in the assessment papers

(iii) the MCMC data, when projected using the CCAMLR decision rules, produce the yields reported in the assessment papers

(iv) the accepted base case from the previous accepted assessment passes the above validation using the current version of software and uses the total objective function and B_0 @assert commands in the configuration files; and confirm that the proposed assessment models contain equivalent @asserts for testing in future years.

Part B: Working Group validation of the contents and model structure defined in the supplied input configuration files and outputs

4. Part B of the process of validation requires that WG-FSA verify that the Casal2 parameter files contain the parameter values and structure as outlined in accompanying assessment papers, and further, that the structure and assumptions in the paper have been reviewed by the Working Group. The Working Group should then confirm that:

(i) the version of Casal2 that was used was clearly specified, a recent and appropriate version of the Casal2 software has been used to run the assessment, and that there are no inappropriate warnings, information message, or errors resulting from running the model

(ii) the biological parameters, catches and other parameters used in the input configuration files are the same as described in the accompanying assessment paper

(iii) the reported output quantities (B_0, current status and precautionary yields) are the same as described in the accompanying assessment paper

(iv) the key model population structure, observation, estimation and other assumptions are those described in the accompanying assessment paper.

Additional notes on the validation process

5. The Casal2 input configuration files (commonly referenced by the config.csl2 file and including population.csl2, observation.csl2 estimation.csl2, and report.csl2 – but specific names depend on the user choices) contain all the information required by the stock assessment program Casal2 to run an assessment model.

6. Output from Casal2 is directed to the std::err, or std::out stream, and can be redirected by the user to appropriate files. These files contain all requested reports from Casal2 but may differ in their appearance and content depending on the run mode being undertaken and the user options chosen to run the model.

7. The Casal2 output can sometimes depend on the computer central processing unit (CPU) model and make, and/or the operating system being used. Hence, the results may not be identical to those produced here as the operating system, CPU and other local aspects of implementation may be different than those used to produce the runs reported in accompanying assessment papers. However, the results would always be the same to at least 3–6 significant digits, and, in most circumstances, more than 6 significant digits. Any conclusions drawn from model output should be robust to minor differences in accuracy of output.

8. Rounding of key output parameters may have been used in reporting the results in the accompanying assessment paper. Where appropriate rounding has been used, this should not be flagged as an error.