Report of the Working Group on Statistics, Assessments and Modelling
(Buenos Aires, Argentina, 26 to 30 June 2017)

Contents

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Introduction

Opening of the meeting

1.1   The 2017 meeting of WG-SAM was held in the Palacio San Martín, Buenos Aires, Argentina, from 26 to 30 June 2017. The meeting Convener, Dr S. Parker (New Zealand), welcomed participants (Appendix A). The Argentinian Commissioner to CCAMLR (Mr Maximo Gowland) welcomed the participants to the historic palace and wished the participants every success in their meeting and an enjoyable stay in Buenos Aires.

Adoption of the agenda and organisation of the meeting

1.2   Dr Parker recalled the terms of reference for WG-SAM and noted that the priorities identified by the Scientific Committee in 2016 for the work of WG-SAM this year were the estimation of local biomass in research blocks, including the uncertainty associated with those estimates, and the review of fishery research survey plans (SC-CAMLR-XXXV, Table 1). The meeting agenda was adopted (Appendix B).

1.3   Documents submitted to the meeting are listed in Appendix C and the Working Group thanked all authors of papers for their valuable contributions to the work presented to the meeting.

1.4   In this report, paragraphs that provide advice to the Scientific Committee and its other working groups have been indicated in grey. A summary of these paragraphs is provided in Item 7.

1.5   The Working Group used the Secretariat's online meeting server to support its work and facilitate the preparation of the meeting report.

1.6   The report was prepared by M. Belchier and C. Darby (UK), A. Dunn (New Zealand), T. Earl (UK), C. Jones and D. Kinzey (USA), K. Reid and L. Robinson (Secretariat), M. Söffker (UK), S. Somhlaba (South Africa) and D. Welsford and P. Ziegler (Australia).

Development and progress of integrated assessments

Krill

2.1   WG-SAM-17/31 described recent developments towards an integrated stock assessment for krill in Subarea 48.1. The work identified that not all parameters in the model could be successfully estimated, and investigated approaches for estimating parameters in stages.

2.2   The diagnostics presented in the paper focused on the performance of the optimiser used in the model and retrospective fits, rather than the fit of the model to the data. The Working Group suggested that further diagnostics showing the fit of the model to the survey data and likelihood profiling would be required to evaluate the suitability of the model. In particular, the Working Group considered that it was important to test sensitivities to the assumption that the survey has a catchability of 1 at the oldest age.

2.3   The Working Group noted that when natural mortality was estimated, the value was 2−3 times higher than had previously been assumed. When age-varying natural mortality was estimated, it varied without trend between ages. This estimation of high and variable mortality may be the result of emigration or other violated assumptions within the model. Some Members considered that quantifying the flux of krill through Subarea 48.1 from the Weddell Sea and Bellingshausen Sea would be important for managing the stock, quantifying the stock–recruit relationship and understanding the age structure of the assessment unit. Other Members considered that over management timescales, this flux could be neglected.

2.4   WG-SAM-17/32 responded to a request from WG-SAM-16 to describe how the process of model development had incorporated, and responded to, the recommendations of previous working groups. The review highlighted the significant work and degree of model development that has taken place.

2.5   The Working Group noted that there are no plans for further US AMLR surveys in the same form as in previous years. These are currently used as an important source of data within the model, and so the Working Group noted the importance of making the best use possible of data from surveys by commercial fishing vessels, such as the transects identified by SG-ASAM that cover the US AMLR survey area. The following transects in Subarea 48.1 overlap the area covered by the US AMLR survey: 7 to 14 and 22 to 24 (SC-CAMLR-XXXIV, Annex 4, Appendix D, Figure 2a).

Toothfish

2.6   The Working Group considered four papers on toothfish population integrated assessments and management advice relating to research on: (i) the sensitivity of assessments to migration from and to the stock area (WG-SAM-17/11), (ii) the sensitivity of the CASAL model estimates to the number of years at liberty of released tags (WG-SAM-17/35), (iii) a simulation study of the data required to achieve a stock assessment of the Amundsen Sea region (WG-SAM-17/40) and (iv) the proposed assessment approach to accommodate the impact of the Ross Sea region marine protected area (MPA) implementation on the assessment of the Ross Sea region (WG-SAM-17/41).

Divisions 58.5.1 and 58.5.2

2.7   WG-SAM-17/11 evaluated the sensitivity of the CASAL tag-based toothfish stock assessments to migration of fish in and out of the assessed area and estimated annual migration between Divisions 58.5.1 and 58.5.2. Both emigration and immigration to the stock can violate the single stock assumptions of the tag-recapture models used in the assessments. This study used a fisheries simulation model to evaluate the impacts of migration on biomass estimates

and sustainable catch limits, demonstrating that emigration of tagged fish out of the assessed area results in initial and current spawning biomass and stock status being overestimated.

2.8   Annual migration rates of toothfish from Division 58.5.2 to Division 58.5.1 were estimated to be 1.1% using longline releases from 2007 to 2014 and 0.7% using longline releases from 2009 to 2014. The annual migration rate from Division 58.5.1 to Division 58.5.2 was estimated to be 0.4% and was insensitive to the time period of longline tag releases used. There was insufficient tagging data to distinguish whether the migration was related to maturity or sex, although it did include tags from across a large range of sizes.

2.9   Annual migration rates of up to 1%, consistent with those estimated between Divisions 58.5.2 and 58.5.1 on the Kerguelen Plateau, resulted in simulated bias in spawning biomass estimates of <2%. The authors demonstrated that the bias can be corrected by increasing the tag-shedding parameter in CASAL, providing a simple approach to correct for the effects of emigration. They recommended that for tag-based assessments for stocks where emigration occurs, the tag-shedding parameter should be increased by the estimated emigration rate to adjust for migration-related bias.

2.10   The Working Group recommended that the authors examine the development of a simple diagnostic to quantify the effects of migration in the next toothfish stock assessment. The Working Group also asked the authors to evaluate an alternative approach to representing emigration, by including an additional fishery that would impact the population of tagged and untagged fish, rather than through increasing tag loss, which only applies to tagged fish.

Subareas 48.3 and 48.4

2.11   WG-SAM-17/35 evaluated the sensitivity of the CASAL toothfish assessment estimates for Subareas 48.3 and 48.4 to the number of years at liberty that recaptures were included in the model. The assessment in Subarea 48.3 currently uses recaptures within four years of their release as input data, whereas the assessment in Subarea 48.4 uses all available recapture data (excluding within-year recaptures). Truncation to four years at liberty in the Subarea 48.3 assessment is used to prevent bias in the assessment estimates resulting from a mismatch between the CASAL model formulation for tag loss of single-tagged fish, while tag loss is estimated from double-tagged fish. Sensitivity tests on both stocks show that this bias occurs in practice and that truncation to four years is appropriate for the assessments.

2.12   The Working Group noted that two studies by Candy (WG-SAM-11/12) and Dunn (WG-SAM-11/18) had also examined bias resulting from tag loss and reached similar conclusions, noting that differences in the analytical approaches used to date may be useful to explore. The Working Group agreed that the number of years of tag liberty in the Subarea 48.4 assessment should be reduced to four.

Subarea 88.2

2.13   WG-SAM-17/40 presented a simulation study of the two-area stock assessment of the Amundsen Sea region. The authors concluded that the current research plan is providing tag recaptures in the south and north as intended and should yield sufficient data to allow a robust

assessment of the toothfish stock in the Amundsen Sea region (ASR) in future years. They further showed that at the current level of tag release, there is a low probability that tagged fish will be caught after having moved from the south to the north or vice versa.

2.14 The Working Group noted that local biomass estimates for the north and south using the tagging information available would be required for WG-FSA-17 in order to help evaluate whether the current catch limits were precautionary and for WG-FSA to be able to provide additional advice on the continuation of the research plan. Due to the low probability of recapture of tags moving between the north and the south, the Working Group urged Members to consider other mechanisms that may help to determine population linkages, such as using pop-up satellite archival tags (PSATs) or otolith microchemistry to investigate toothfish movements in the ASR and other areas.

Subarea 88.1

2.15 WG-SAM-17/41 presented a proposed approach to updating the stock assessment in 2017 of the Ross Sea region in light of the implementation of the Ross Sea region MPA (Conservation Measure (CM) 91-05). The authors concluded that CM 91-05 would not impact on the 2017 assessment of stock status, but would impact on the forward projections and setting catch limits using the 2017 assessment. They further noted that the implementation of CM 91-05 would require further work to address potential bias in the assessment resulting from the redistribution of effort resulting from the MPA. This would be particularly important in the provision of advice on regional catch allocations as the assessment develops in the future.

2.16 The Working Group recommended that the 2017 stock assessment of toothfish in the Ross Sea region be an update of the 2015 assessment, with sensitivity analyses carried out on the allocation of catch limits used in projections.

2.17 WG-SAM-17/41 noted that additional options should be developed for catch splits between the shelf, slope and north areas of the Ross Sea region prior to the 2019 assessment. Dr S. Kasatkina (Russia) suggested that it would be important to clarify the methods used for developing these options prior to the 2019 assessment, taking into account the changes in fishing grounds and areas of toothfish habitats accessible to the fishery arising from the coming into force of the Ross Sea region MPA.

2.18 The Working Group recommended that the WG-SAM and WG-FSA strategic programs of work include a priority for reviewing and evaluating the potential bias in the assessment and advice due to changes in the location of catch and effort, including those in relation to the spatial distribution of tagged fish. These should be developed further, along with the scientific rationale for catch allocations to regions of Subarea 88.1, in advance of WG-FSA-21, as per CM 91-05.

Icefish

2.19 WG-SAM-17/36 compared two methods for bootstrapping the haul data from biomass surveys for icefish in Subarea 48.3. The current method (WG-FSA-96/38) resamples across data from all strata, weighted by the number of samples per unit area in each stratum. In this

method, the number of samples within each stratum may differ between repetitions of the bootstrap. In the rescaled bootstrap, the number of samples in each stratum is consistent with the data for every repetition.

2.20   The estimated percentiles of the mean biomass density were nearly identical between the two methods. The largest difference between the methods was when sample sizes were low (fewer than two haul samples per stratum).

2.21   The current method of bootstrapping is used for icefish assessments in both Subarea 48.3 and Division 58.5.2. In Division 58.5.2, the method is applied to both biomass and the length distribution, whereas in Subarea 48.3 the length distribution is calculated deterministically. The Working Group noted previous work (Hillary et al., 2010) suggesting that the rescaled bootstrap is less suitable for length distributions due to the potential for small sample sizes in individual length classes in some strata.

2.22   For consistency between the areas, the Working Group recommended retaining the existing approach in Subarea 48.3 rather than the rescaled bootstrap.

Biomass estimation, including estimation of uncertainty

3.1   The Working Group noted that the Scientific Committee referred discussion of the most appropriate analytical methods to be used to generate local biomass estimates with different levels of information available, as well as uncertainty in those estimates, to WG-SAM for recommendations (SC-CAMLR-XXXV, paragraph 13.17).

3.2   The Working Group noted WG-SAM-17/12, which developed a bootstrap method to estimate the uncertainty around both the Chapman and catch per unit effort (CPUE) by seabed area analogy biomass estimates. This work was developed in response to the request to develop such approaches from the Scientific Committee (SC-CAMLR-XXXV, paragraph 3.187ii). The paper noted that while CPUE by seabed area and Chapman bootstrapped confidence intervals generally overlapped for research blocks where Patagonian toothfish (*Dissostichus eleginoides*) are dominant, they generally did not overlap in research blocks where Antarctic toothfish (*D. mawsoni*) were dominant. The Working Group agreed that comparisons of confidence intervals around biomass estimates in the same research blocks derived from different methods were a useful indicator of whether the independent methods were appropriate.

3.3   The Working Group noted that in instances where the two confidence intervals around the estimates did not overlap, this suggested that there were issues with the underlying data, parameter values, and/or a violation of methodological assumptions (such as post-release mortality, spatial overlap of release and recapture effort, or different catchability between the reference and research areas) that warranted further investigation.

3.4   The Working Group noted WG-SAM-17/13, which described a simulation study to investigate the implications of realised tag recaptures being different to the expectation in a tag-release and recapture experiment. It noted that the Chapman biomass estimates were unbiased when large numbers of tagged fish are available for recapture, however, in instances when observed recaptures are lower or higher than the expected number, biomass estimates were asymmetrically distributed. The simulations showed that in a best-case scenario, when tagging mortality, tag shedding and natural mortality parameters used in the Chapman estimator reflect

what is occurring in the population, the recapture of fewer than expected tagged fish results in biomass estimates that can be several times the actual biomass. This effect was more pronounced when the number of tag recoveries is much lower than expected in any one season.

3.5   The Working Group noted that the effects of lower than expected numbers of recaptures (WG-SAM-17/13) may, in part, explain the observed large variations in Chapman biomass estimates between seasons, and the difference between CPUE by seabed area and Chapman biomass estimate in some research blocks (see WG-SAM-17/12). It agreed that these analyses further emphasised the need for an evaluation of fishing and tagging effort in research plans to increase the number of tagged fish recovered to a point where the chance of large biases is reduced. This could be achieved through increased tag-release rates, increased tag-detection rates and increased numbers of scanned fish.

3.6   The Working Group noted WG-SAM-17/37, which reviewed the derivation of the CPUE by seabed area biomass estimation method, and highlighted the large differences between point estimates of biomass derived using the CPUE by seabed area method relative to those derived using the Chapman mark-recapture method. The Working Group recalled that the CPUE by seabed area method assumes a proportional relationship between CPUE and toothfish density (SC-CAMLR-XXXV, Annex 5, paragraph 2.28), and noted that a regression of Chapman-estimated biomass and CPUE in 100×100 km cells from the Ross Sea region fishery showed a significant relationship, which provided support for the CPUE by seabed area method to provide an interim biomass estimate for research plans.

3.7   The Working Group noted that the estimated relationship between CPUE and density was likely to be sensitive to the choice of cell size, movement of tagged fish, fish size distribution, gear type and functional relationship. However, it noted that the CPUE by seabed area analysis presented in WG-SAM-17/37, provided finer-scale and a more habitat-specific reference area than the Ross Sea region assessment, and could be useful in future analyses.

3.8   The Working Group also noted that the sum of the Chapman biomass estimates provided in WG-SAM-17/37 in the shelf/slope and northern seamount areas approximated the vulnerable biomass estimate from the integrated assessment, which provided some confidence that this method was producing reasonable density estimates. Consequently, the Working Group recognised that the proposed changes to the reference areas had the potential to improve the accuracy of CPUE by seabed area estimates in research blocks that currently used the entire Ross Sea region as the reference area.

3.9   The Working Group requested that additional analysis on how the cell-by-cell density estimates are translated to an overall CPUE-to-biomass density relationship be considered by WG-FSA before the separate shelf/slope and northern seamount reference area estimates are used to estimate biomass in research blocks. The additional details to be considered would include issues such as the interannual variability in the spatial distribution of catch and effort and vessel-specific variability in tag-recovery rates and how uncertainty could be best estimated for the resulting biomass estimates.

3.10   The Working Group recalled its advice from WG-SAM-16 that current biomass should be used from the reference area for CPUE by seabed area calculations, and noted that this had been interpreted as the current spawning stock biomass. The Working Group noted that the gear used in toothfish fisheries typically select immature as well as mature fish, and that the estimated biomass using the CPUE by seabed area would be for the part of the stock vulnerable

to fishing. Consequently, the current vulnerable biomass from a reference area should be used in the CPUE by seabed area calculations. The Working Group agreed that the vulnerable biomass for the relevant reference area should be used to update CPUE by seabed area biomass estimates.

3.11   The Working Group noted that the seabed areas used from the Ross Sea region in CPUE by seabed area calculations had used the entire fishable area from all the Ross Sea region. It agreed that the fishable area within the open small-scale research units (SSRUs) in the Ross Sea region should be used, rather than the fishable area for all of Subarea 88.1 and SSRUs 882A–B, in revised calculations where the Ross Sea region is the reference area. It requested that the Secretariat provide revised CPUE by seabed area biomass estimates for exploratory fisheries in research blocks based on the revised parameter values, to be presented at WG-FSA-17.

3.12   The Working Group noted that WG-SAM-17/37 proposed a method of combining Chapman and CPUE by seabed area biomass estimates by using a Bayesian analysis where the CPUE by seabed area distribution is used as a prior that was updated by the tag release and recapture observations. The Working Group noted that this concept had potential to resolve the issue of choosing a 'best' estimate where CPUE by seabed area and tag release and recapture data were both available, and requested that Members work in the intersessional period to develop this method.

Review of research plan proposals and results

General issues on research proposals in data-poor
exploratory fisheries and closed areas

Harmonising conservation measures related
to conducting research on toothfish

4.1   The Working Group noted that toothfish exploratory fisheries such as those in Subarea 48.6 and Division 58.4.1 are conducted under CM 21-02, while research fishing in Subareas 48.1, 48.2 or 88.3 is conducted under CM 24-01. Despite the different conservation measure, these fishing activities are often at different stages of working towards similar objectives. However, activities conducted under CM 24-01 have a much more limited set of restrictions for fishing, e.g. no by-catch limits or move-on rules, no requirement for the use of bird exclusion devices at the hauling station.

4.2   To harmonise research fishing activities in exploratory fisheries and research exemptions under CM 24-01, the Working Group recommended (i) an evaluation of CM 24-01 and its application of exemptions from other conservation measures to research fishing targeting toothfish where catch limits are similar to those in exploratory fisheries, and (ii) the consideration by the Scientific Committee and the Commission of a conservation measure or measures for research fishing targeting toothfish not already included within other conservation measures.

Streamlining the review of research plans

4.3   The Working Group noted that the efficiency of its work has been impacted where research proposals in the same area had been submitted by individual Members and encouraged the development of single coordinated multi-Member proposals and progress reports be submitted for review by working groups.

4.4   The Working Group recalled that Members who submit a multi-Member and multi-vessel research proposal could identify a coordination process or group for a given research area to facilitate coordination of research proposals, operations at sea and data analyses. It was further recalled that such multi-Member multi-vessel research proposals (WG-SAM-17/08) include outlining milestones, operational contingency plans and progress made (SC-CAMLR-XXXV, Annex 5, paragraphs 4.76 and 4.77).

4.5   The Working Group noted the large number of newly proposed research blocks this year, and, when combined with the existing research blocks, this generates a significant number of areas for the Working Group to track and manage, as well as high demands on proponents to develop stock assessments in these areas (Figure 1). The Working Group expressed concern that the proliferation of research blocks could increase the development of research activities involving fishing faster than the data required to evaluate the impacts on stocks.

CCAMLR strategy on research plans in data-poor fishery areas

4.6   The Working Group recognised that the uncertainty in the processes for developing research plans targeting the development of toothfish stock assessments in data-poor areas created difficulties in the review of research plans in the evaluation of progress in ongoing research.

4.7   The Working Group recalled that over the past few years it had identified a number of requirements for research on toothfish and that bringing these agreements and review criteria together in a single document would greatly facilitate the future review of progress in research, both by proponents and the Working Group.

4.8   The Conveners of WG-SAM and WG-FSA undertook to provide an overview document to WG-FSA-17 that brought together the relevant advice and process on developing, and reviewing progress on, research plans related to toothfish. Such a review is intended to provide suggestions for the redesign of the research proposal form so that equal emphasis is placed on the non-fishing elements of the research plan, such as research into available data from a region, otolith ageing, model development, etc.

4.9   The Working Group agreed that presenting summary results of activities by individual research blocks would assist in evaluating whether the research design as implemented is achieving its objectives and requested that the Conveners of WG-FSA and WG-SAM include this consideration in their review.

4.10   The Working Group recommended that, prior to consideration of the establishment of new research blocks, proposals should include, inter alia, a:

(i)   summary of work that has been undertaken in the proposed areas

(ii)	preliminary or revised stock hypothesis and how the research helps develop management advice

(iii)	scientific rationale and objectives as to how the research will lead to an assessment in these areas or other objectives beyond basic collection of data

(iv)	rigorous experimental design that optimally meets CCAMLR research objectives

(v)	sea-ice analysis of the proposed area.

4.11	The Working Group agreed that there are often significant questions and clarification required when evaluating submissions where new research in a closed area, or the intention to participate in an existing multi-Member or multi-vessel research activity in the Convention Area, is proposed. As such, the Working Group encouraged that relevant scientists from the Member submitting the proposal participate in the meetings of WG-SAM and WG-FSA.

Stock assessment development in areas with IUU fishing

4.12	Based on the discussions around research plans in regions with historic illegal, unreported and unregulated (IUU) fishing, the Working Group considered how to assess stocks and provide management advice in such areas. The Working Group recalled that the 4% exploitation rate (Welsford, 2011) was introduced as a conservative and precautionary limit to not prevent recovery in stocks that may have been overfished by IUU fishing. Research plans in regions with large potential IUU fishing would need to consider how to address this issue in assessments and in developing advice, as without that information it is difficult to evaluate whether the research design is adequate to achieve its objectives.

4.13	The Working Group discussed whether there were any options in the short-term to improve the understanding of IUU fishing affecting estimations of $B_{current}$, such as using CASAL to estimate $B_{current}$ without back-calculating to B_0, based solely on size distribution and tag recaptures. While that is not directly possible, there is scope to explore whether CASAL can be used to determine harvest strategies similar to a constant F, which would complement the estimation of $B_{current}$ (e.g. through Chapman or CPUE by seabed area). The Working Group recalled that previous work has used CASAL to provide a model to estimate IUU fishing year by year (paragraph 4.53 and WG-FSA-15/22 and 15/23).

4.14	The Working Group recalled that this issue has been identified on several occasions before, and that this subject was already recommended as a focus topic to WG-SAM (SC-CAMLR-XXXV, Annex 5, paragraph 3.262). The Working Group acknowledged that the issue of historic and current IUU fishing, its estimation and inclusion in biomass estimations and resulting management advice is difficult and complex, and that, in the current format where the agenda of WG-SAM is driven by submissions, it is challenging to dedicate the necessary time. Going forward, the Working Group suggested that with the change of priorities and work plans of the working groups (WG-EMM-17/02) there is an opportunity for defining this as a focus topic under future work (paragraph 5.2). The Working Group encouraged its members to intersessionally consider how to progress this issue, including contributions to a dedicated agenda item for WG-SAM.

Geographic information system (GIS) and spatial information

4.15   The Working Group welcomed the updates to the CCAMLR GIS R package (WG-SAM-17/47) that now allowed the generation of polygon data that can either be used directly in R, or exported for use in other programs. The Working Group encouraged Members to engage with the CCAMLR GitHub repositories. The authors thanked Dr M. Sumner from the AAD for contributing to the CCAMLR GIS R package.

4.16   The Working Group requested that proponents of research plans with research blocks provide coordinates for the research block boundaries to the Secretariat both with fishery notifications and with the submission of research plans to the CCAMLR working groups, and that geographical figures in research plans provide the projection used. The Working Group recommended that the Secretariat prepare a map with existing and proposed research blocks for its working groups each year (Figure 1). The Working Group noted that the CCAMLR GIS R package was a good tool for that purpose.

Proposals and research results from Subarea 48.6

4.17   The Working Group considered five papers relating to research plans and results of research conducted in Subarea 48.6, including a summary of by-catch results from research fishing carried out by Japan and South Africa (WG-SAM-17/44), an updated analysis of sea-ice concentration in the south of Subarea 48.6 (WG-SAM-17/10), a proposal to extend the spatial extent of research block 486_2 (WG-SAM-17/09), an updated joint proposal to continue research fishing in Subarea 48.6 submitted by Japan and South Africa (WG-SAM-17/03) and a proposal for a prospecting phase effort-limited research fishing by Norway for the 2017/18 season (WG-SAM-17/06).

4.18   The Working Group welcomed the joint progress report on research fishing from South Africa and Japan (WG-SAM-17/03) and noted the updated Chapman estimations of biomass using tagr (WG-SAM-17/13) that provided the expected number of tags from the research. The Working Group also welcomed the provision of research milestones in the paper which included a summary of research progress to date and an overview of future research, including an indication of how various components of the research would be shared between the proponents (WG-SAM-17/03, Table 8). The Working Group noted that the proposal from South Africa and Japan was largely unchanged from the existing plan.

4.19   The Working Group noted that the research fishing was now into its fifth year and that over this period most fishing had taken place in research blocks 486_2–4, and in 486_5 for the first time in five years. The Working Group noted that an inability of vessels to consistently return every year to a research block to deploy or catch tagged fish remained a major constraint on the development of an assessment.

4.20   The Working Group recalled its advice from WG-SAM-16 that the lack of a robust stock hypothesis was impacting on the ability to develop an integrated stock assessment for Subarea 48.6. It noted that the further development of a stock hypothesis for *D. mawsoni* in this subarea would benefit from data from the shelf region in research block 486_5 but access had previously been limited by sea-ice.

4.21   The Working Group welcomed the sea-ice analysis carried out by Japan (WG-SAM-17/10) which examined accessibility of research blocks 486_4 and 486_5 in the southern region of Subarea 48.6 over the period 2002–2017 using satellite-derived data, and noted that the latter research block had been fished in 2016/17 given the low sea-ice concentration. The paper also noted that these data showed that there appeared to be a strong negative correlation between the levels of sea-ice and the sea-surface temperature anomaly. The Working Group noted that further analyses could be conducted that investigate correlations between sea-ice coverage and to wider global weather phenomena such as El Niño/El Niño Southern Oscillation or rising temperatures/increased variability in observed temperatures such as may be expected from climate change.

4.22   WG-SAM-17/44 presented a preliminary analysis of by-catch from the C2 data in the research fishery for *Dissostichus* spp. in Subarea 48.6. The Working Group noted that the report showed that *Macrourus* spp. and blue Antimora (*Antimora rostrata*) were the most common by-catch in the fishery which were caught in all the research blocks. Channichthyidae was also a common by-catch species, but mainly found in research blocks 486_4 and 486_5. The Working Group suggested that additional analyses on the by-catch could be undertaken to help explain the interannual and spatial variability, including alternative statistical methods and analyses of the observer data. In addition, the Working Group noted that the effect of different fishing gear on by-catch ratios and by-catch variability is not yet fully understood in the region, and such analyses could be undertaken in any future updated paper.

4.23   WG-SAM-17/46 presented a preliminary analysis of the movement of tagged fish recaptured in Subarea 48.6. The paper showed that both *D. eleginoides* and *D. mawsoni* are typically recaptured close to where they were released; typically, 90% and 97% of each species respectively were recaptured within 50 km of their release location. The Working Group agreed that the focus of research should continue to be on efforts to resolve the movements of fish between research blocks and to improve the tag-recapture rate. The Working Group noted that the few movements of tagged fish that had been observed to date were typically east–west and between subareas, and not north–south between the southern and northern research blocks within Subarea 48.6. The Working Group noted that additional work on the stock hypothesis of *D. mawsoni* in Subarea 48.6 would support the research proposal.

4.24   The Working Group considered WG-SAM-17/09 by Japan that proposed a possible future extension to the spatial extent of research block 486_2. The rationale for the extension to the research block was that it is adjacent to an area of higher *D. mawsoni* density within the existing research block which could increase the possibility of the catch limit for the research block being taken. There would be no increase in catch for this research block but it would come from the limit for the existing research block 486_2. The Working Group noted the proposal for the addition of a future research block in Division 58.4.2 (WG-SAM-17/10) and agreed that little information was presented to link this new area to the stock hypothesis for the region. This proposed research block also overlapped with another research plan proposal (WG-SAM-17/07).

4.25   The Working Group noted that the expansion of research blocks was likely to distribute fishing effort across a larger area and, therefore, could reduce the ability of vessels to scan tagged fish and dilute tagging effort in the research block, especially given that the catch limit in research block 486_2 is typically not taken. However, the Working Group noted that tags recaptured from research block 486_2 had occurred mainly in a cluster in the south of the research block, and recommended that the proponents present a revision to the analysis that subdivided research block 486_2 to account for tagging heterogeneity.

Norwegian proposal for research fishing in Subarea 48.6

4.26   The Working Group considered a proposal by Norway to conduct research fishing in Subarea 48.6 (WG-SAM-17/06). The Working Group noted that Norway was not represented at the meeting, and that this had hampered the Working Group's ability to resolve questions it had on the proposal.

4.27   The Working Group questioned what additional scientific knowledge the research proposal would bring to the management of toothfish in the region and how this would integrate with the research proposals from South Africa and Japan. The Working Group recommended that, should Norway wish to progress its research proposal, it would require further development and Norway should coordinate its research efforts with Japan and South Africa, including by attending WG-FSA.

Proposals and research results from Subarea 58.4

Proposals and research results from Divisions 58.4.1 and 58.4.2

4.28   There were three papers relating to exploratory fishery research efforts in Divisions 58.4.1 and 58.4.2 tabled for consideration by the Working Group.

4.29   WG-SAM-17/08 provided a joint multi-Member research notification by Australia, France, Japan, Republic of Korea and Spain for continuation of the *D. mawsoni* exploratory fishery research in Divisions 58.4.1 and 58.4.2.

4.30   The Working Group noted that a similar approach to initial research catch allocation among participating Members, as was undertaken in 2016/17, was proposed, although there were some other minor changes set out in WG-SAM-17/08. Specifically:

(i)   Australia could potentially include an additional vessel during the research in Division 58.4.1

(ii)   the milestone pertaining to estimation of local biomass within research blocks was removed, as this is now undertaken by the Secretariat.

4.31   The Working Group noted that the catch limit of macrourids in research block 5841_6 (SSRU 5841G) for the 2016/17 season of 14 tonnes was reached on 27 January 2017, and the fishery was subsequently closed with 39 percent of the total catch limit (90 tonnes) for *D. mawsoni* remaining. It was recommended that WG-FSA explore strategies for mitigating fishing impacts on macrourids while endeavouring to meet research objectives.

4.32   WG-SAM-17/27 provided a progress report on the exploratory longline fishery by the Republic of Korea for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 during the 2016/17 season. The Working Group noted that the areas of fishing operations were specifically selected to overlap, as far as possible, with areas where tagged fish were previously released in order to increase the probability of recapture. It was also noted that only about half of the agreed catch limit was taken, which may have reduced the probability of recaptures. Dr S.-G. Choi (Republic of Korea) indicated that there were issues with heavy sea-ice in parts of the proposed research areas.

4.33   The Working Group recalled that the geographic extent of existing and proposed research blocks (Figure 1) includes additional buffer zones where research can be undertaken if the specified research block is inaccessible as a result of sea-ice (CM 41-01, Annex 41-01/B, footnote 1). It was further noted that there may be circumstances where buffer zones overlap with other research blocks. The Working Group recommended that this issue should be further explored to ensure that fishing in one research block's buffer zone does not geographically overlap with another research block.

4.34   WG-SAM-17/07 provided a research plan by Ukraine to participate in the 2017/18 exploratory longline fishery for *Dissostichus* spp. in Division 58.4.2. It was noted that there were three new research blocks proposed in the westernmost SSRUs of Division 58.4.2 (located within SSRUs 5842A and 5842B).

4.35   The Working Group noted that there were no sea-ice analysis plots provided in WG-SAM-17/07, which are important for evaluating the geographic positions of these proposed research blocks, and it was unclear as to how the positions of these research blocks were selected. The Working Group noted that the proposed research blocks substantially overlapped with the proposed research blocks detailed in WG-SAM-17/10 (paragraph 4.24).

4.36   The Working Group noted that the current endorsed catch limit for the research block within SSRU 5842E is 35 tonnes, and that WG-SAM-17/07 suggested that an appropriate combined research catch in the three proposed new research blocks is 75 tonnes. The Working Group agreed that the proposal should provide details on previous work that has been undertaken in the area, some rationale as to why the proposed research blocks were positioned where they were in relation to the objectives of the research, and details as to how the proposed research catch limit was developed.

4.37   The Working Group noted that research in this division should be coordinated with other Members that are currently undertaking research in the region.

Proposals and research results from Divisions 58.4.3 and 58.4.4

4.38   WG-SAM-17/45 summarised the results of a comprehensive by-catch analysis for the research fishery for *D. eleginoides* in Divisions 58.4.3a and 58.4.4b, as part of the progress report of the research plan. The results showed that the most common by-catch species were grenadiers and *Antimora*, and noted a clear decrease in the number of individuals over time. The model results highlighted that the fishing method and gear types may influence the observed results in by-catch patterns.

4.39   The Working Group noted the use of two different gear types on two different vessels, which operated in separate locations over time, and recommended the use of mixed models (GLMM, GAMM) to establish whether factors such as year, vessel, or fishing location drive the observed results, or whether the patterns observed were independent of the patterns in fishing activities (see also paragraphs 4.22 and 4.41).

4.40   The Working Group noted the different specificity in the use of taxonomic codes between the two Members contributing to this research, and suggested coordination of by-catch identification in the future. The Working Group further suggested to consider by-catch

identification at WS-SISO, as, although responsibility for by-catch identification and reporting lies with the Flag State, the observer is often asked by the vessel operator to support the crew in species identification to ensure accuracy.

4.41   WG-SAM-17/20 formed the second part of the progress report for Division 58.4.3a, summarising the data collected to date in this division. The paper highlighted the differences in gear use, depth of fishing and spatial locations between the two vessels, and summarised the research objectives, methods and milestones of the research carried out in this division over time. In addition, WG-SAM-17/04 provided an updated research plan with a changed survey design for Division 58.4.3a, taking into account the discussion around WG-FSA-16/55 (SC-CAMLR-XXXV, Annex 5, paragraphs 4.128 to 4.134).

4.42   The Working Group noted that the two vessels fished with two different gear types, targeting different depths and locations within the same fishing season. As a result, the vessels were catching different size classes of toothfish. The Working Group discussed how to distinguish between vessel and location effects by redesigning the survey to understand this variation better. The Working Group recommended overlapping fishing locations in depth and space between the two vessels to calibrate between them.

4.43   The Working Group discussed the large variation in effort over time, noting that catches were not, or barely, taken since 2013/14. The expectation of tag availability after three years is low, and thus it is difficult to generate the necessary information to meet the research objectives without dedicated participation. Therefore, the Working Group recommended the use of the tagr package to estimate how many tagged fish are expected to remain in the population at present (as in WG-SAM-17/12). The Working Group further suggested to assemble a CPUE time series for both gear types separately, to potentially allow tracking of year classes through length distributions from the two gear types.

4.44   The authors confirmed that the new survey design included the notification of a new fishing vessel, ensuring commitment to this research going forward. The authors further noted that in the past seasons, in one year the work could not be completed due to engine failure, while in the current season there was a low CPUE and an unusual problem with sea lice, so the vessel master discontinued research fishing.

4.45   The Working Group enquired about the plan for otolith ageing from this research, noting it should form an integral part of the plan. The authors noted that the improved sampling design has the tag-recapture of toothfish as its main objective to work towards tag-based stock assessment, acknowledging that otolith ageing is also an important part of the research going forward.

4.46   The Working Group noted that WG-SAM-17/04 identified and acknowledged issues with the past survey design, and encouraged the authors to incorporate the feedback given on the survey design to achieve the objectives of the research. The Working Group recommended the spread of survey effort and the overlap between gear types/vessels over space and depth.

4.47   WG-SAM-17/02 Rev. 1 presented an updated research plan for research blocks 1 and 2 in Division 58.4.4b, proposing to continue the current research operation with the same survey design as to date, as well as proposing additional research blocks and amendments to the research design.

4.48   The Working Group discussed the details and rationale regarding the survey design in the proposed research blocks, highlighting past information available for these regions and recommending changes to the design.

4.49   Following this feedback, the proponents concluded to proceed only with the unchanged established research design, without expanding research block options or changing the survey design at this time.

4.50   The Working Group noted that the data collected on depredation, consistent with the work carried out around Kerguelen and Crozet Islands, enables this research program to get an improved understanding of the loss of biomass to depredation and thus include this in future stock assessments.

4.51   The Working Group discussed the timetable for the proposed research, which outlined a preliminary CASAL assessment for WG-FSA-17, noting that a preliminary CASAL assessment would also need to come to WG-SAM, and queried why the design of the survey is proposed to be changed now, at a point where data collected begins to contribute towards a tag-based assessment.

4.52   The authors recalled the discussions around the CASAL assessments in previous WG-FSA meetings (e.g. SC-CAMLR-XXXV, Annex 7, paragraphs 5.79 to 5.91), noting that, at present, without a good understanding of historic IUU fishing in the region, the Working Group had concluded that a CASAL assessment would be difficult to achieve. The timetable in the research plan will reflect this in the future by removing this milestone. The survey design change was proposed to investigate the movement of toothfish, which is a key question for the involved proponents, despite expected low catch rates associated with the design change (paragraphs 4.12 to 4.14).

4.53   Agreeing that completing a CASAL assessment was premature at present, the Working Group discussed how to achieve the objective of developing an assessment for this region, noting that an integrated assessment does not mean it would need to be a CASAL assessment. The data available to date provide a time series of information on this fishery, allowing to monitor CPUE and thus population trends, allowing to give management advice based on that information. The Working Group encouraged the investigation of other forms of assessment, including tag-based assessments, which may be more appropriate to the objectives of this research.

4.54   The Working Group noted that when the initial objectives of a research plan change, the direction of the research would also need to be re-evaluated to ensure that the design and sampling is compatible and appropriate. Part of this process would be the development of alternative methods and providing evidence to WG-SAM as to how questions were addressed and what solutions were found.

4.55   The Working Group noted that the development of the stock hypothesis for this region was planned towards the end of the research duration, whereas in many other regions, a stock hypothesis precedes and informs the research plan, so that the research can be improved as the hypothesis is improved. The Working Group recommended that a stock hypothesis be developed to inform the research going forward.

Review of research proposals and results from Subareas 88.1 and 88.2

4.56   The Working Group considered WG-SAM-17/23 which reported on a preliminary analysis of variability in catch rates of target and by-catch species of different longline gear types within selected SSRUs within Subareas 88.1 and 88.2. CPUE data (kg/1 000 hooks) were used to examine spatial and temporal variability in catch and by-catch rates by looking at residual deviations from the long-term average and cluster analysis on spatial heterogeneity with the Coniss method. The analysis indicated:

(i)   spatial–temporal variability in, and mean estimates of, CPUE by SSRU and season

(ii)   differences in toothfish length distributions (arising from small and large fish in the catches), as well as in the mean length of toothfish in the catch

(iii)   catches are characterised by a wider species composition of by-catch when using the autoline system.

4.57   The Working Group noted the necessity to provide additional analysis of differences between the CPUE and length- or species compositions of catch obtained from different gear types based on the analyses presented in WG-SAM-17/23.

4.58   The Working Group recalled that during WG-SAM-16 it was noted that there was a range of additional variables that were likely to influence catch rates of target and non-target species, including depth and bait type. The Working Group noted that WG-SAM-16 and WG-FSA-16 had recommended the use of multivariate methods such as GLMMs and GAMs for the analysis of catch data in order to address this issue and recommended exploration using these statistical methods (SC-CAMLR-XXXV, Annex 7, paragraph 3.57).

4.59   The Working Group discussed the difficulty in using the number of hooks to standardise CPUE on trotlines making comparison with Spanish and autoline systems problematic. It remains uncertain as to how the unit of effort for a trotline should best be defined. The Working Group also noted that considerable differences in the reporting rate of by-catch between vessels had been highlighted during the 2016 meeting of the Scientific Committee and the influence of this on the analysis of by-catch CPUE should be considered in future GLM and GLMM analyses.

4.60   The Working Group noted that it should consider how the results of analyses of spatial, temporal and gear-specific differences in CPUE are incorporated into calculating the toothfish density used in the first stages of the development of research plans. However, it was also noted that differences in the gear type of vessels operating within fisheries as in Division 58.5.2 and Subarea 88.1 have not been a barrier to the development of integrated stock assessments for toothfish. Dr Kasatkina indicated that the results of further analyses would be reported to WG-FSA-17.

Tagging using pop-up satellite archival tags

4.61   WG-SAM-17/33 reported on the preliminary results of the use of PSATs deployed on *D. mawsoni* on the southern shelf (SSRUs 881M, J, L) and northern seamount (SSRUs 881B, C) areas of the Ross Sea region in 2016. The objectives were to characterise movement and habitat preferences, compare two different commercially available types of PSATs, and to develop methods to support research and monitoring of the Ross Sea region MPA.

4.62   Of the 15 tags deployed, 13 were scheduled to pop-up and transmit data on 1 February 2017, and two on 1 February 2018. Data were recovered from four tags, although two of these tags only provided partial data. The limited amount of data recovery may have been a result of a variety of reasons, including depth limitation to 1 800 m for one of the tag types as evidenced by diagnostics from two of these tags.

4.63   The Working Group discussed the experiences of other deep-sea tagging programs, noting that tags on toothfish are likely to be the deepest tags currently deployed. Further development of the devices and methods for deployment is required if they are to be successfully deployed on toothfish within the Convention Area. The Working Group noted that PSAT technology was developing rapidly and models were now available that were depth rated to 8 000 m that would overcome the issue of depth damage observed during the study.

4.64   Considering the cost and early stage development of deep-sea PSATs, the Working Group also considered whether the use of other data storage tags could provide some movement and environmental data given the apparent site fidelity observed in toothfish, acknowledging the trade-off between cost consideration, longer collection duration and loss in location accuracy.

4.65   The Working Group discussed the paper's recommendation that a two-day workshop involving scientists with an interest in archival tagging and PSAT manufacturers would be a useful way of advancing the use of PSATs for toothfish studies. It was agreed that such an approach could be beneficial, although concerns were raised about the additional time and financial cost associated with another intersessional meeting. To reduce costs, such a workshop could be run in conjunction with scheduled CCAMLR meetings in 2018 or in conjunction with the proposed Subarea 48.6 stock hypothesis and tagging workshop proposed by Germany for early 2018.

Ross Sea shelf survey

4.66   WG-SAM-17/01 presented the results of the sixth New Zealand Ross Sea shelf survey to monitor abundance of sub-adult *D. mawsoni* in the southern Ross Sea. The survey included numerous objectives as previously outlined in WG-SAM-15/45, with an additional objective of trialling the collection of tagged toothfish release data via an electronic data form application in collaboration with the CCAMLR Secretariat.

4.67   Operational and sea-ice constraints meant the survey commenced from Terra Nova Bay in the northwestern stratum of the survey area. High catch rates encountered in this region at the start of the survey led to the need to reduce station numbers in the southern strata to avoid exceeding the catch limit. This is likely to have contributed to higher overall variance within the survey results compared with previous years. Results suggest the Ross Sea shelf survey series is providing a reliable means of monitoring recruitment, estimating recruitment availability and year-class strength, which was not evident in the data collected from fishery operations in the wider Ross Sea region fishery.

4.68   The Working Group noted high levels of spatial variability in toothfish depredation by amphipods. Where high scavenging rates occur, it was noted that total removals might be underestimated. This issue should be referred to WG-FSA for consideration across all toothfish fisheries where scavenging by amphipods occurs.

4.69   The Working Group considered the proposal by New Zealand to continue the Ross Sea shelf survey for a further five years from 2018. It noted that the core strata would be sampled every year with the McMurdo and Terra Nova strata sampled in alternate years. Although an effort-limited survey, the different maximum catches observed in these strata would give rise to a total catch limit of 43 tonnes in 2018, 2020, 2022, and 65 tonnes in 2019 and 2021.

4.70   The Working Group noted that, to date, the survey has taken place following the commercial fishing season in areas where commercial fishing occurs. Following the adoption of CM 91-05 (Ross Sea region MPA), from 2017/18 surveys will take place within a region of the MPA where fishing activities will be otherwise prohibited. Changes to fish density in the region resulting from a reduction in fishing effort may result in higher survey catch rates in the future and the current survey catch limit may need to be reviewed.

4.71   The Working Group noted that the proposed research was for an annual survey for the next five years. However, it was recalled that unlike other toothfish research, outputs from the Ross Sea shelf survey provide direct input into the Ross Sea region integrated stock assessment and the objectives of the research are not to derive a local biomass estimate. In addition, catch limits are deducted from, and not additional to, the Ross Sea region catch limit.

4.72   Dr Kasatkina noted that it was important to determine how data on the abundance of sub-adult *D. mawsoni* obtained from previous time-series surveys are reflected in the subsequent fish length frequency in catch data in order to track strong cohorts into the adult population. This analysis will provide information on fish movement as well as on the efficacy of surveys to monitor abundance of sub-adult *D. mawsoni* in the southern Ross Sea.

Special research zone

4.73   The Working Group considered two proposals by Members to conduct toothfish research in the newly created Ross Sea region MPA special research zone (SRZ) submitted by Russia (WG-SAM-17/21) and Ukraine (WG-SAM-17/29).

4.74   The Russian proposal for research in Subarea 88.2 followed on from research that had been carried out between 2010 and 2012 and described a 10-year program of proposed research within the eastern part of the Ross Sea region over the shelf and continental slope within the SRZ would focus on providing data on toothfish stock structure, movement and life history which links to the objectives of the research and monitoring plan for the Ross Sea region MPA. Tagging was a key component of the research with a proposed tagging rate of 5 fish per tonne within the SRZ. This program provides opportunities for collaborative investigations in the SRZ by the Russian vessel and vessels from other CCAMLR Members.

4.75   The Ukrainian proposal (WG-SAM-17/29) suggested a tagging rate of 3 fish per tonne for the first 30 tonnes of catch and 1 fish per tonne thereafter and included a program of plankton sampling and the collection of acoustic and temperature data.

4.76   The Working Group noted that very little detail on the research and analysis to be conducted by Ukraine was provided in WG-SAM-17/29, which made scientific evaluation of the proposal difficult. The Working Group requested that Ukraine outline in more detail the scientific rationale for the research, the research capacity that it was intending to utilise and the

types of analysis it will be conducting within the proposal and submit a revision for consideration by WG-FSA. Similar concerns were noted for research proposals by Ukraine in other regions (paragraphs 4.34 to 4.36, 4.87 and 4.88, 4.101 to 4.106).

4.77　The Working Group noted that there is no requirement within CM 91-05 for Members to submit proposals for conducting research within the SRZ. It also noted that under CM 91-05 a requirement to tag toothfish at a rate of 3 fish per tonne would not be introduced until the start of the 2020/21 season. The Working Group recalled that the overall catch limit for the SRZ has been set at 15% of the catch limit for the Ross Sea region assessment.

4.78　The Working Group noted that careful consideration should be given to the potential impact of research conducted within the SRZ upon the Ross Sea region stock assessment. As the SRZ is open to all vessels notified to fish in the Ross Sea region fishery, concern was raised that prior to the introduction of a 3 fish per tonne requirement in 2020/21, different tagging rates as indicated in the research proposals could introduce bias into the stock assessment.

4.79　The Working Group recommended that proponents of research within the SRZ should consider the impact of non-research fishing within the SRZ on their ability to conduct research. Coordination of research activities with other Members may reduce these impacts.

4.80　The Working Group noted that CM 91-05 does not prescribe how catch limits for research within the SRZ are to be allocated. The Working Group recommended that this issue should be considered by WG-FSA and the Scientific Committee. It was noted that research catches within the SRZ could be allocated from the overall Ross Sea region catch limit in an analogous manner to the Ross Sea shelf survey of sub-adult toothfish.

4.81　The Working Group agreed that there is a need to demonstrate how research conducted within the SRZ would link to the Ross Sea region MPA research and monitoring plan.

Review of research proposals and results from Subarea 88.3

4.82　The progress report for the Korean research fishing in Subarea 88.3 in 2016/17 (WG-SAM-17/28) noted that fishing commenced on 11 January 2017 and ended on 7 March 2017 with a total of 95 longlines being set and hauled. Research blocks 883_2 to 883_5 were surveyed with a total catch of 118.2 tonnes and 4 132 individual *D. mawsoni* being removed. The survey had a mean CPUE of 0.21 kg/hook and 597 individuals of *D. mawsoni* were tagged and released and the by-catch was approximately 6.2% of the total catch by weight across all research blocks. The tagging rate and tag-overlap statistics were 5.04 and 88% respectively. The length frequency of *D. mawsoni* had a single mode of 150 cm and the maturity of both male and female *D. mawsoni* were predominantly in stage 2. Biological information of *D. mawsoni*, including otolith, stomach contents, gonad and muscle were collected. Temperature and salinity data was also recorded using a conductivity temperature depth probe (CTD) at 12 stations.

4.83　In discussing the 2016/17 progress report, the Working Group noted that none of the tagged fish releases from the survey in the previous year had been recaptured. To assist with understanding why this had occurred, the Working Group recommended the proponents include a table of the number of tagged fish releases and the estimated number of tagged fish available for recapture in each research block and year in future progress reports and a plot of spatial overlap in fishing from previous seasons.

4.84   The Working Group considered the proposals from the Republic of Korea (WG-SAM-17/43), New Zealand (WG-SAM-17/38) and Ukraine (WG-SAM-17/16 and 17/19) to conduct research in Subarea 88.3 in 2017/18.

4.85   The Working Group noted that the Korean proposal would implement the third year of research fishing in the 2017/18 season with the same survey design to previous years, while New Zealand and Ukraine were proposing to initiate new surveys in the area with a number of new research blocks (Figure 1).

4.86   The Working Group noted differences in the scientific objectives between the proposals, but emphasised that when the objective was to provide robust estimates of *D. mawsoni* abundance, recapturing tagged fish was the highest priority. The Working Group noted the highest number of tagged fish releases had been in research blocks 883_3, 883_4 and 883_5. It was also noted that these research blocks were more likely to be ice free and, therefore, accessible during the proposed survey period.

4.87   The Working Group discussed the rationale behind creating new research blocks in some of the proposals in Subarea 88.3 and noted that research objectives for the purpose of estimating abundance were more likely to be achieved if a coordinated research effort was focused in the existing research blocks.

4.88   The Working Group noted that data collected from historical surveys in this area could be presented in descriptive summaries to better characterise the area and information available in future proposals. The Working Group also noted that the justification for the proposed sample size and design in WG-SAM-17/19 was unclear. Additionally, it was noted that the intention to acquire fish age data and develop an assessment model were stated, but there was no specification of how and when this would be achieved.

4.89   The Working Group recommended that the proponents collaborate to provide a single multi-Member coordinated research proposal for presentation at WG-FSA-17.

Review of research proposals and results from Subareas 48.1, 48.2 and 48.5

Subarea 48.5

4.90   WG-SAM-17/22 presented an updated proposal for the third stage of the Russian research program in the Weddell Sea. A five-year longline survey is proposed in the eastern region of the Weddell Sea, with the objectives to estimate fish distribution and abundance and assess biological parameters related to productivity in Subarea 48.5.

4.91   The Working Group noted that the situation with this survey proposal in Subarea 48.5 has not changed since 2014 (SC-CAMLR-XXXIII, paragraphs 3.230 to 3.233). The Working Group recalled that, as in previous years, the submitted proposal was based on assumptions and results of previous work carried out by Russia in Subarea 48.5 from 2012 to 2014, and that data from these activities have been quarantined by CCAMLR since 2014 (SC-CAMLR-XXXIII, paragraph 3.232).

4.92   The Working Group recalled that in 2015 the Scientific Committee had requested an update on the analyses on catch rates in Subarea 48.5 (SC-CAMLR-XXXIV, paragraphs 3.271 to 3.275), and that such an update had not been provided to WG-SAM-16 (SC-CAMLR-XXXV, Annex 5, paragraph 4.71).

4.93   A background paper on previous Russian survey activities undertaken in Subarea 48.5 was subsequently submitted to the Commission in 2016 (CCAMLR-XXXV/BG/29 Rev. 1), but the Scientific Committee noted that this report had not been presented to the Scientific Committee for consideration (SC-CAMLR-XXXV, paragraph 3.237).

4.94   Without completion of the analysis requested by WG-SAM, WG-FSA and the Scientific Committee, and therefore to be consistent with its previous advice, the Working Group was not able to evaluate the approach and proposed research in WG-SAM-17/22 (SC-CAMLR-XXXV, Annex 5, paragraph 4.71).

Subareas 48.1, 48.2 and 48.4

4.95   In WG-SAM-17/18, Chile proposed a research plan for a three-year project to study the distribution, abundance and biological characteristics of Antarctic demersal fish communities around the continental shelf of Elephant Island (Subarea 48.1) and the South Orkney Islands (Subarea 48.2). Based on the experience gained in the first phase of research in 2016 and recommendations made by WG-SAM-16 and WG-FSA-16 (SC-CAMLR-XXXV, Annex 5, paragraphs 4.62 to 4.67; SC-CAMLR-XXXV, Annex 7, paragraphs 4.149 to 4.155), a revised proposal for a random, stratified trawl survey in accordance with CM 24-01 was provided. The proposed survey will be conducted in six depth strata between 100 and 500 m using bottom trawl nets, with stations in the same approximate geographic coordinates as those used by Germany on the RV *Polarstern* around Elephant Island in 2012 and by the USA on the RV *Yuzhmorgeologiya* around the South Orkney Islands in 2009. The proposed catch limits for this research is 50 tonnes in Subarea 48.1 and 50 tonnes in Subarea 48.2.

4.96   The Working Group agreed that repeating historic surveys in the area will provide insights into the potential recovery of mackerel icefish (*Champsocephalus gunnari*) and marbled rockcod (*Notothenia rossii*). The Working Group noted that while individual hauls may return large catches, the survey was not planning to repeatedly haul the same stations, and the overall catch should thus not exceed the catch limit. The maximum catch limit proposed was similar to that of the previous survey.

4.97   The Working Group noted that the bottom net used in the 2009 survey will be on board the fishing vessel and, if possible, used for this survey to maintain consistency in gear type.

4.98   The Working Group noted that the proposed locations for sampling stations are similar to the ones from the German and US surveys, with the exceptions of those that had previously encountered vulnerable marine ecosystems (VMEs). These locations will be replaced with stations from within the same stratum. The Working Group agreed that VMEs which have been reported frequently in the survey areas require careful consideration in the choice of alternative sampling locations, as spreading effort could spread impacts to other VMEs versus limiting impact to just those areas already impacted to some degree. The Working Group also noted that

cameras, similarly, for example to the ones used in Divisions 58.4.1 and 58.4.2, attached to the trawl net can record the seafloor habitat and should be considered for this survey if feasible.

4.99   The Working Group recommended that the survey include hydro-acoustic sampling as during the first survey, since this remote sensing method could provide important estimates of the distribution and abundance of pelagic and demersal organisms.

4.100   Prof. P. Arana (Chile) confirmed that, as chief scientist of the research proposal, he will be on board the fishing vessel to ensure that the survey will be conducted as planned.

4.101   In WG-SAM-17/15 and 17/17, Ukraine proposed research fishing in accordance with CM 24-01 in a study area within the eastern part of Subarea 48.1 and the western parts of Subareas 48.2 and 48.5. Research fishing is proposed to be conducted over three years, with a possible two-year extension, with 36 hauls using Spanish longline and a total catch limit of 40 tonnes. No haul locations were specified, but hauls would be set in the first year in the depth range between 600 and 2 200 m. The main result from this initial prospecting phase would be the mapping of the spatial distribution and relative abundance of toothfish in the research area. Research blocks would then be proposed and subsequent fishing would be depth-stratified with spatial consistency in every subsequent year. The research aims to provide an estimate of the stock abundance using standard assessment methods that have been tested in other areas which have a robust stock assessment.

4.102   The Working Group noted that while the research proposal description indicated that it would be conducting research in Subarea 48.5, no fishable depths were indicated on the maps presented and the research area outlined in the presentation did not extend to Subarea 48.5. Consequently, the Working Group recommended that this area be removed from the proposal and, if subsequently agreed, the proposal concentrate on the fishable depths in Subarea 48.1.

4.103   The Working Group noted the lack of key information in this proposal, including a stock hypothesis, the locations of the proposed haul stations, a sea-ice analysis, details on biological sampling and statistical analyses, and details about how the research would contribute to the stated objectives and the management of toothfish in this area.

4.104   Given that no research fishing has occurred in this area so far, the Working Group recommended random haul locations be specified for the initial survey, rather than research blocks within which the research fishing activities would occur. Research would then be determined based on the outcomes of the initial effort-limited survey.

4.105   The Working Group noted that the area is known for heavy ice concentrations even in summer, and that it is likely to be inaccessible for many fishing seasons. A sea-ice analysis is, therefore, crucial to evaluate the ability to revisit research locations on a regular basis.

4.106   With existing research proposals by Ukraine in other parts of Subarea 48.2 and new research proposals in Subareas 88.1 and 88.3 and Division 58.4.2, the Working Group asked whether Ukraine would be able to conduct all research activities as required, including field work, laboratory analyses of biological samples such as otoliths for ageing and gonads for maturity estimation, and statistical analyses of the data in order to develop an integrated population model.

4.107 WG-SAM-17/25 provided a preliminary report of the third year of research fishing by Ukraine in Subarea 48.2. In the 2016/17 season, Ukraine fished all proposed 48 stations in the research block on the northern plateau and the four southern research blocks. Catch rates were higher in the southern research blocks, but they were found to be highly variable between fishing seasons. The effort-limited survey was completed with a total catch of 62 tonnes out of a 75 tonne catch limit. A total of 318 fish were tagged and six *D. mawsoni* were recaptured.

4.108 In WG-SAM-17/26, Ukraine proposed to continue research fishing in Subarea 48.2 in accordance with CM 24-01 for another two seasons (2017/18 and 2018/19), with the same research design for all haul locations, a 75 tonne catch limit, and tagging rate of 5 fish per tonne. The motivation for the continuation of this research was the highly variable catch rate data which prevented an estimation of *Dissostichus* spp. biomass in the area.

4.109 In WG-SAM-17/24, Chile proposed to continue its research fishing in Subarea 48.2 in accordance with CM 24-01. The survey for 2017/18 would use similar methodology and objectives as agreed in WG-FSA-16/34. During the 2015/16 season, Chile conducted the first stage of its multiannual research program (WG-FSA-15/10), but it did not fish in the 2016/17 season because of the performance of the research program in the 2015/16 season (SC-CAMLR-XXXV, Annex 7, paragraph 4.44).

4.110 The Working Group noted the commitment by Chile to improve the performance of the research program. It requested that Ukraine and Chile, with the support of the Secretariat, coordinate their fishing activities with the aim to achieve the objectives of their research, for example by fishing the same research strata with two vessels to enable a comparison of catch rates and catch composition by gear type. It also noted that the collection of oceanographic data, especially of bottom temperature, in an area where the two species of *Dissostichus* overlap, could assist in understanding the habitat preferences for biogeographic models.

4.111 The Working Group highlighted the contribution that Chilean research could make to the identification of natal origin through the microchemistry of otoliths. It looked forward to the presentation of results of such analyses at WG-FSA-17, based on samples collected in the survey of the 2015/16 season.

4.112 The Working Group noted that *D. mawsoni* constituted most of the catch and considered that future research fishing should focus on this species.

4.113 The Working Group also noted that the research has been conducted for three years by Ukraine as an effort-limited survey with an overall catch limit. Given the availability of data on catch rates and recaptures from these surveys, the Working Group recommended that the proposal be updated and that biomass could be estimated with the CPUE by seabed area method and the Chapman estimator, with the choice of reference area following that for other research blocks in which *D. mawsoni* is targeted.

4.114 The Working Group requested that an updated survey design be presented to WG-FSA, with information on how the research design accounts for the distribution of the two toothfish species. It also requested that Ukraine present further research results in the area, such as *D. mawsoni* ageing and spatial by-catch distribution, as well as to update the stock structure hypothesis and outline the development of a population assessment as indicated in the research objectives.

4.115 WG-SAM-17/34 presented preliminary results from the first year of a three-year survey into the connectivity of toothfish species in Subareas 48.2 and 48.4. The survey is located in an area where both species are caught simultaneously between predominantly single-species catches of *D. eleginoides* and *D. mawsoni* to the north and south respectively. On the 18 stations of this effort-limited survey, 12 tonnes of *Dissostichus* spp. were caught in Subarea 48.2 and 17 tonnes were caught in Subarea 48.4, both below the set catch limits of 23 tonnes and 18 tonnes respectively. A total of 151 *D. mawsoni* and one *D. eleginoides* were tagged and released, and seven tagged *D. mawsoni* were recovered in Subarea 48.4.

4.116 The Working Group noted that VME indicator taxa were reported mainly from Subarea 48.4 and discussed whether this pattern was driven by reporting differences between vessels or the volcanic geology of the habitat in Subarea 48.4.

4.117 The Working Group also noted that tissue samples were collected from this area which will be used in genetics studies on stock connectivity of toothfish. Dr Choi indicated that the Republic of Korea was conducting research fishing outside the CAMLR Convention Area to the west of Subarea 48.3 to further understand stock structure and movement of toothfish in the area outside the CAMLR Convention Area.

Future work

5.1 The Working Group considered the proposed five-year work plan for the Scientific Committee presented by its Chair in WG-EMM-17/02. The paper advances the recommendations of the Scientific Committee which were discussed and put forward by the Scientific Committee Symposium in October 2016. The paper outlined the work in themes and it also indicated a timeline by which each topic should be addressed.

5.2 The Working Group welcomed and thanked the Chair for bringing forward the work and also the conveners of the working groups for working with the Chair. The Working Group noted that a week had been set aside between the meetings of WG-SAM-18 and WG-EMM-18 in order to address some of the overlapping/common topics that are in the five-year priority list of the two working groups, as was the case with WS-SISO-17. In 2018, a spatial planning data management workshop was scheduled for this week. It was also suggested this could offer an opportunity to review and develop implementation for the Ross Sea region MPA research and monitoring plan.

5.3 The Working Group further noted that the scientific topics that are a priority will inevitably grow in number and scope as the work is being carried out in the next five years. The Scientific Committee will need to continuously reprioritise and streamline the scientific topics in order to balance the workload of the working groups. A number of strategies, such as conducting some priority tasks/topics less frequently, might be explored in order to free up time to streamline the work of the working groups.

5.4 The Working Group encouraged its participants to focus on priority topics when submitting their scientific work to be considered by WG-SAM meetings and the Working Group Convener will allocate meeting time mainly to the discussions of priority topics. The Working Group noted that the priority topics tasked by the Scientific Committee can arise quickly and displace other previous high-priority topics. Further, it noted that some topics will not be addressed in a single meeting and may require a specific workplan and contributions from Members over several years.

Other business

Ross Sea region marine protected area (MPA) research and monitoring plan

6.1   The Working Group discussed the draft Ross Sea region MPA research and monitoring plan (RMP) (WG-SAM-17/42) and noted the impressive breadth of information and research topics contained in the plan. In particular, the Working Group noted that the Co-conveners of the Ross Sea region MPA Research and Monitoring Plan Workshop (WS-RMP-17) had undertaken to seek recommendations from all of the working groups in order to provide a revised RMP to the Scientific Committee for consideration.

6.2   The Working Group noted that the draft RMP contained a description of the research requirements associated with the SRZ, but that some clarity of the requirements in the short and longer term would be desirable.

6.3   The Working Group noted that the RMP did not seek to prioritise the areas of research that had been identified but that it is advantageous to allow national Antarctic programs to select the work that they would undertake rather than for CCAMLR to seek to agree on a priority for the list of important research areas. The Working Group noted that the first five-year review would reveal gaps in the delivery to the RMP and that this would be likely to require a prioritisation to address identified gaps.

6.4   The authors of the RMP encouraged contributions and proposed revisions to the RMP via the e-group that had been established at the Workshop (WS-RMP-17).

6.5   Dr T. Ichii (Japan) suggested that although there is evidence that toothfish are prey for a number of air-breathing predator species, the current stock assessment does not take account of ecosystem impacts on dependent species and this may require further consideration.

6.6   The Working Group noted that the CCAMLR decision rules and conservation measures that mitigate against incidental mortality of seabirds and impacts on VME taxa, all contribute to CCAMLR's ecosystem approach. Furthermore, the adoption of CM 91-05, the Ross Sea region MPA, provides additional mitigation against irreversible impacts of fishing on the Ross Sea region ecosystem through spatial management.

6.7   Mr Dunn informed the Working Group that New Zealand planned a considerable amount of future research related to the ecosystem impacts of the toothfish fishery on dependent and related species in the region. The Ross Sea region MPA RMP will have a key role in driving the requirements of this research.

Weddell Sea MPA

6.8   The Working Group discussed WG-SAM-17/30 on the Weddell Sea MPA and noted the:

(i)   desire for increased clarity on the interaction between the CCAMLR decision rules and the 60% protection targets for toothfish in the Weddell Sea proposal

(ii) importance of determining toothfish life-history and stock dynamics of the region, including the offer from Germany to host a workshop in early 2018 to examine toothfish dynamics and movement in the region in order to inform a working stock structure hypothesis

(iii) desirability for the authors of WG-SAM-17/30 to be present at the meeting in order to facilitate discussion of their paper.

Advice to the Scientific Committee

7.1 The Working Group's advice to the Scientific Committee and its working groups is summarised below; the body of the report leading to these paragraphs should also be considered:

(i) Development and progress of integrated assessments –

(a) Subarea 88.1 (paragraphs 2.16 and 2.18).

(ii) Review of research plan proposals and results –

(a) harmonising conservation measures related to conducting research on toothfish (paragraph 4.2)

(b) special research zone (paragraph 4.80).

Close of the meeting

8.1 In closing the meeting, Dr Parker thanked all the participants for their cooperation and productivity during the meeting.

8.2 Dr Parker noted that Dr Kenji Taki has taken a new assignment and will no longer participate in CCAMLR working groups. On behalf of the Working Group, he expressed sincere thanks for all the hard work and diligence that Dr Taki contributed to CCAMLR and its working groups and wishes him the best in his future work.

8.3 On behalf of the Working Group, Dr Belchier thanked Dr Parker for conducting the meeting in an efficient and friendly atmosphere that had allowed the efficient and effective outcomes of the meeting.

References

Hillary, R.M., C.T.T. Edwards, R.E. Mitchell and D.J. Agnew. 2010. Length-based assessment for mackerel icefish (*Champsocephalus gunnari*) at South Georgia. *CCAMLR Science*, 17: 129–137.

Welsford, D.C. 2011. Evaluating the impact of multi-year research catch limits on overfished toothfish populations. *CCAMLR Science*, 18: 47–55.
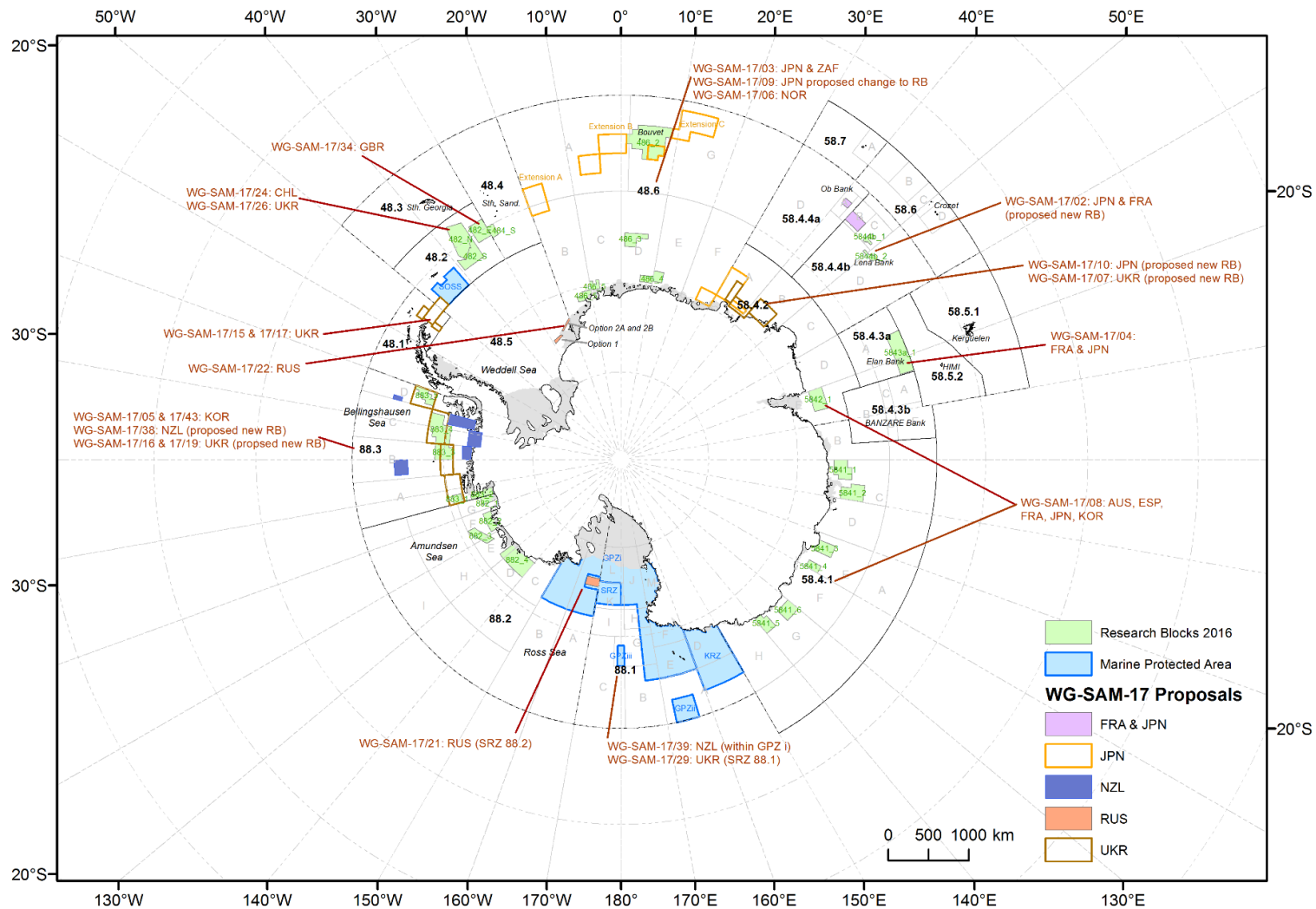
Figure 1:   Map of existing and proposed research blocks for activities involving toothfish considered at WG-SAM-17. AUS – Australia, CHL – Chile, ESP – Spain, FRA – France, GBR – United Kingdom, JPN – Japan, KOR – Republic of Korea, NZL – New Zealand, NOR – Norway, RUS – Russia, UKR – Ukraine; ZAF – South Africa. RB – research block, GPZ – general protection zone, SRZ – special research zone.

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(Buenos Aires, Argentina, 26 to 30 June 2017)

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Agenda

Working Group on Statistics, Assessments and Modelling
(Buenos Aires, Argentina, 26 to 30 June 2017)

1.   Introduction

   1.1   Opening of the meeting
   1.2   Adoption of the agenda and organisation of the meeting

2.   Development and progress of integrated assessments

   2.1   Krill
   2.2   Toothfish
   2.3   Icefish

3.   Biomass estimation, including estimation of uncertainty

4.   Review of research plan proposals and results

   4.1   Proposals and research results from Subarea 48.6

   4.2   Proposals and research results from Subarea 58.4

      4.2.1   Proposals and research results from Divisions 58.4.1 and 58.4.2
      4.2.2   Proposals and research results from Divisions 58.4.3 and 58.4.4

   4.3   Review of research proposals and results for other areas

      4.3.1   Review of research proposals and results from Subarea 88.1
      4.3.2   Review of research proposals and results from Subarea 88.3
      4.3.3   Review of research proposals and results from Subareas 48.1, 48.2
               and 48.5

5.   Future work

6.   Other business

7.   Advice to the Scientific Committee

8.   Adoption of report and close of meeting.

List of Documents

Working Group on Statistics, Assessments and Modelling
(Buenos Aires, Argentina, 26 to 30 June 2017)

WG-SAM-17/01	Results of the sixth Ross Sea shelf survey to monitor abundance of sub-adult Antarctic toothfish in the southern Ross Sea, January 2017 K. Large, L. Robinson and S. Parker
WG-SAM-17/02 Rev. 1	Research plan for the 2017/18 toothfish fishery in Division 58.4.4b by Japan and France Delegations of Japan and France
WG-SAM-17/03	Research plan for the 2017/18 exploratory longline fishery of *D. mawsoni* in Subarea 48.6 by South Africa and Japan Delegations of Japan and South Africa
WG-SAM-17/04	Continuation of multi-Member research on the *Dissostichus* spp. exploratory fishery in 2017/18 in Division 58.4.3a by France and Japan Delegations of France and Japan
WG-SAM-17/05	Vacant
WG-SAM-17/06	Proposal for a longline survey on toothfish in Statistical Subarea 48.6 in 2017/18 Delegation of Norway
WG-SAM-17/07	Research plan for the 2017/18 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.2 Delegation of Ukraine
WG-SAM-17/08	Continuation of multi-Member research on the *Dissostichus* spp. exploratory fishery in East Antarctica (Divisions 58.4.1 and 58.4.2) by Australia (notification ID 98422, 98423), France (94903, 94904), Japan (94886, 94887), Republic of Korea (94889, 94890) and Spain (94835) Delegations of Australia, France, Japan, Republic of Korea and Spain
WG-SAM-17/09	Proposal for the extension of research block 48.6_2 T. Namba, T. Ichii and T. Okuda

WG-SAM-17/10	Update of analysis on sea-ice concentration of southern part of 48.6 and 58.4.2 for the new research block on expected spawning ground of TOA T. Namba, T. Ichii and T. Okuda
WG-SAM-17/11	Estimation and correction of migration-related bias in the tag-based stock assessment of Patagonian toothfish in Division 58.5.2 P. Burch, P. Ziegler, D. Welsford and C. Péron
WG-SAM-17/12	Estimating uncertainty in local biomass estimates of toothfish in CCAMLR in Subareas 58.4 and 48.6 research blocks L. Robinson, P. Burch and K. Reid
WG-SAM-17/13	Assessing data requirements for tag-based estimates of local biomass in data-poor and exploratory fisheries L. Robinson, P. Burch and K. Reid
WG-SAM-17/14	Vacant
WG-SAM-17/15	Format for reporting finfish research proposals of the Ukraine in Subarea 48.1 in 2018 (CM 24-01, para 3) Delegation of Ukraine
WG-SAM-17/16	Format for reporting finfish research proposals of the Ukraine in Subarea 88.3 in 2018 (CM 24-01, para 3) Delegation of Ukraine
WG-SAM-17/17	Plan of research program of the Ukraine in Subarea 48.1 in 2018 Delegation of Ukraine
WG-SAM-17/18	Demersal finfish distribution, abundance and their biological characteristics in Statistical Subareas 48.1 (northern part) and 48.2 (2018–2020) Delegation of Chile
WG-SAM-17/19	Plan of research program of Ukraine in Subarea 88.3 in 2018 Delegation of Ukraine
WG-SAM-17/20	Characterisation of the exploratory fishery on *Dissostichus* spp. between the 2004/05 and 2016/17 fishing seasons in Division 58.4.3.a J.-B. Lecomte, R. Sinegre, A. Rigaud and T. Okuda
WG-SAM-17/21	Research program to examine the life cycle and resource potential of *Dissostichus* species in the Special Research Zone within the Ross Sea region marine protected area (RSRMPA) in 2017–2027 Delegation of the Russian Federation

WG-SAM-17/22	Plan of the research program of Russian Federation in Subarea 48.5 (Weddell Sea) in season 2017/18 Delegation of the Russian Federation
WG-SAM-17/23	Analysis of the toothfish fishery indices in Subareas 88.1 and 88.2 when using different types of longline gears S. Kasatkina
WG-SAM-17/24	Research longline fishing proposal for *Dissostichus* spp. in Subarea 48.2 Delegation of Chile
WG-SAM-17/25	The preliminary report on the survey in Subarea 48.2 in 2017 (the third year of the planned 3-year-old investigations) Delegation of Ukraine
WG-SAM-17/26	Proposal for continuation of the Ukrainian research survey in Subarea 48.2 in 2017/18 and 2018/19 seasons Delegation of Ukraine
WG-SAM-17/27	Progress report on the Korean exploratory longline fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 in 2016/17 season S.-G. Choi, J. Lee, J. Lee and D. An
WG-SAM-17/28	Progress report on the Korean research fishing by longline fishery for *Dissostichus* spp. in Subarea 88.3 in 2016/17 season S.-G. Choi, J. Lee, J. Lee and D. An
WG-SAM-17/29	Ukrainian research proposal for the 2017/18 season in Subarea 88.1 Delegation of Ukraine
WG-SAM-17/30	Scientific background document in support of the development of a CCAMLR MPA in the Weddell Sea (Antarctica) – Version 2017 – Reflection of the recommendations by WG-EMM-16 and SC-CAMLR-XXXV K. Teschke, H. Pehlke and T. Brey on behalf of the German Weddell Sea MPA (WSMPA) project team
WG-SAM-17/31	Phase-randomisation in an integrated assessment model for Antarctic krill D. Kinzey, G.M. Watters and C.S. Reiss
WG-SAM-17/32	Incorporation of science advice from the CCAMLR working groups and Scientific Committee into the krill assessment model for Subarea 48.1 D. Kinzey, G.M. Watters and C.S. Reiss

WG-SAM-17/33	Results of 2016 pop-off satellite archival tagging of Antarctic toothfish in the Ross Sea region C.D. Jones and S.J. Parker
WG-SAM-17/34	Preliminary results from the first year of a three-year survey into the connectivity of toothfish species in Subareas 48.2 and 48.4 K. Olsson, M. Belchier and M. Söffker
WG-SAM-17/35	Sensitivities in the assessment of the Patagonian toothfish (*D. eleginoides*) in Subareas 48.3 and 48.4 to truncation of tagging data T. Earl
WG-SAM-17/36	Comparison of bootstrap methods for assessment of mackerel icefish (*Champsocephalus gunnari*) in CCAMLR Statistical Subarea 48.3 based on the ground fish survey T. Earl and N. Fallon
WG-SAM-17/37	Developing robust biomass estimates and advice on catch limits in research blocks S.J. Parker, S. Mormede, A. Dunn, S.M. Hanchet and C. Marsh
WG-SAM-17/38	Notification for scientific research in 2017/18: proposal to participate in research plan for Antarctic toothfish in Subarea 88.3 Delegation of New Zealand
WG-SAM-17/39	Proposal to continue the time series of research surveys to monitor abundance of Antarctic toothfish in the southern Ross Sea, 2018−2022 S.M. Hanchet, K. Large, S.J. Parker, S. Mormede and A. Dunn
WG-SAM-17/40	Simulations to evaluate model performance for Antarctic toothfish stock assessment in the Amundsen Sea region S. Mormede and S. Parker
WG-SAM-17/41	Updating the 2017 stock assessment of Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea region S. Mormede and S. Parker
WG-SAM-17/42	The Ross Sea region Marine Protected Area Research and Monitoring Plan (WG-SAM 2017) A. Dunn, M. Vacchi and G. Watters
WG-SAM-17/43	Research plan for the exploratory longline fishery for *Dissostichus* spp. in Subarea 88.3 in 2017/18 Delegation of the Republic of Korea

WG-SAM-17/44	By-catch analysis as a part of progress report for the research fishery of *Dissostichus* spp. in Subarea 48.6 by Japan and South Africa during 2012/13–2016/17 T. Okuda, S. Somhlaba and T. Ichii
WG-SAM-17/45	By-catch analysis as a part of progress report for the research fishery of *Dissostichus* spp. in Divisions 58.4.3a and 58.4.4b by Japan and France during 2012/13–2016/17 T. Okuda, A. Rigaud, R. Sinegre and T. Ichii
WG-SAM-17/46	Preliminary investigation of fish movement in Subarea 48.6 S. Somhlaba, R. Leslie, T. Okuda, T. Ichii and D. Yemane
WG-SAM-17/47	An update on using the CCAMLRGIS R package to create polygon data and access data on the CCAMLR online GIS Secretariat

Other Documents

WG-EMM-17/02	Development of a five-year work plan for the CCAMLR Scientific Committee M. Belchier (Chair of SC-CAMLR)