SC-CAMLR-XXXII

SCIENTIFIC COMMITTEE FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

REPORT OF THE THIRTY-SECOND MEETING OF THE SCIENTIFIC COMMITTEE

HOBART, AUSTRALIA
21–25 OCTOBER 2013

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Abstract

This document presents the adopted report of the Thirty-second Meeting of the Scientific Committee for the Conservation of Antarctic Marine Living Resources held in Hobart, Australia, from 21 to 25 October 2013. Reports of meetings and intersessional activities of subsidiary bodies of the Scientific Committee, including the Working Groups on Statistics, Assessments and Modelling, Ecosystem Monitoring and Management and Fish Stock Assessment, are appended.

1031-2889

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REPORT OF THE THIRTY-SECOND MEETING OF THE SCIENTIFIC COMMITTEE

(Hobart, Australia, 21 to 25 October 2013

OPENING OF MEETING

1.1 The Scientific Committee for the Conservation of Antarctic Marine Living Resources met from 21 to 25 October 2013 at the CCAMLR Headquarters in Hobart, Tasmania, Australia. The meeting was chaired by Dr C. Jones (USA).

1.2 The Chair welcomed to the meeting representatives from Argentina, Australia, Belgium, Brazil, Chile, People's Republic of China, European Union, France, Germany, India, Italy, Japan, Republic of Korea, Namibia, New Zealand, Norway, Poland, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America and Uruguay.

1.3 The Chair also welcomed to the meeting observers from ACAP, ARK, ASOC, CEP, COLTO, SCAR (including SCOR) and SEAFO and encouraged them to participate in the meeting to the extent possible.

1.4 The List of Participants is given in Annex 1. The List of Documents considered during the meeting is given in Annex 2.

1.5 The report of the Scientific Committee was prepared by Drs J. Arata (Chile), A. Constable (Australia), C. Darby (UK), Mr N. Gasco (France), Drs O.R. Godø (Norway), S. Hain (Germany), S. Hanchet (New Zealand), K.-H. Kock (Germany), Prof. K. Kovacs (Norway), Drs R. Leslie (South Africa), J. Melbourne-Thomas (Australia), Mr A. Miller (Secretariat), Drs S. Mormede (New Zealand), P. Penhale (USA), D. Ramm, K. Reid (Secretariat), Mr R. Scott (UK), Drs B. Sharp (New Zealand), S. Thanassekos (Secretariat), P. Trathan (UK), G. Watters (USA) and D. Welsford (Australia).

1.6 While all parts of this report provide important information for the Commission, paragraphs of the report summarising the Scientific Committee's advice to the Commission have been highlighted.

Adoption of agenda

1.7 The Scientific Committee discussed the Provisional Agenda which had been circulated prior to the meeting (15 July 2013). The agenda was adopted (Annex 3) with two minor changes (inclusion of subitem 3.2.3 'Advice to Commission' and expansion of item 15 to include election of the Chair).

1.8 The Scientific Committee noted that discussion of the main issues of the agenda should only take place with interpretation into the official languages of the Commission in accordance with the rules of procedure, considering that the work of the working groups takes place in English only.

Chair's report

1.9 Dr Jones reflected on the Scientific Committee's work in the 2012/13 intersessional period. The following meetings had taken place:

(i) the meeting of WG-SAM was held from 24 to 28 June 2013 in Bremerhaven, Germany (Annex 4), and was convened by Dr Hanchet; 23 participants from 11 Members attended

(ii) the meeting of WG-EMM was held from 1 to 10 July 2013 in Bremerhaven, Germany (Annex 5), and was convened by Dr S. Kawaguchi (Australia); 48 participants from 18 Members attended

(iii) the Intersessional Meeting of the Scientific Committee (SC-CAMLR-IM-I) was held from 11 to 13 July 2013 in Bremerhaven, Germany; 90 participants from 23 Members and 29 Observers attended

(iv) the meeting of WG-FSA was held from 7 to 18 October 2013 at the CCAMLR Headquarters (Annex 6) and was convened by Dr M. Belchier (UK); 40 participants from 14 Members attended

(v) the meeting of the CCAMLR Scheme of International Scientific Observation review panel was held from 26 to 30 October 2013 at the CCAMLR Headquarters.

1.10 Dr Jones, on behalf of the Scientific Committee, thanked all chairs, conveners and coordinators of intersessional meetings, and Germany for hosting the meetings of WG-SAM, WG-EMM and SC-CAMLR-IM-I in 2013.

ADVANCES IN STATISTICS, ASSESSMENTS, MODELLING, ACOUSTICS AND SURVEY METHODS

Statistics, assessment and modelling

2.1 The Scientific Committee reviewed advice from WG-SAM and noted, in particular, advice pertaining to the following items:

(i) research in data-poor fisheries (Annex 4, paragraphs 2.1 to 2.37), particularly advice on submission of research plans (Annex 4, paragraph 2.3)

(ii) review of scientific research proposals for other areas, e.g. closed areas, areas with zero catch limits, and Subareas 88.1 and 88.2 (Annex 4, paragraphs 3.1 to 3.28), particularly advice on proposals for research in Subarea 88.1 (Annex 4, paragraphs 3.25 and 3.26) and in Divisions 58.4.4a and 58.4.4b (Annex 4, paragraph 3.28)

(iii) methods for assessing finfish stocks in established fisheries, notably *Dissostichus* spp. (Annex 4, paragraphs 4.1 to 4.36), particularly advice on routine collection of gonad weights (Annex 4, paragraph 4.13)

(iv) other matters (Annex 4, paragraphs 5.1 to 5.11), particularly papers on toothfish biology referred to WG-FSA for consideration (Annex 4, paragraph 1.3).

2.2 The Scientific Committee noted that most of the advice of WG-SAM (Annex 4) directly informed the work of WG-FSA and is, therefore, considered under the relevant agenda items. It agreed that:

(i) in the future, research plans, which are currently included as part of a fishery notification for a data-poor fishery, should be submitted as separate stand-alone papers and that the final research plan endorsed by the Scientific Committee and the Commission should be fully documented (Annex 4, paragraph 2.3). The process for doing this, such as using the CCAMLR website in the Members Only section, was considered under future work

(ii) the 10 points in Annex 4, paragraph 2.7, could be used as a basis to develop research plans in a developing exploratory fishery. This was considered further under exploratory fisheries (paragraph 3.170)

(iii) the key points and recommendations from WG-SAM for future work to examine factors that might produce observed anomalous patterns of CPUE on three Insung vessels (Annex 4, paragraphs 4.17 to 4.24)

(iv) the ChartMaster GIS software developed by Russia (Annex 4, paragraphs 4.25 to 4.27) could be used to provide a preliminary estimate of biomass in data-poor regions based on CPUE and seabed area, but that such estimates should not be based on extrapolations beyond the spatial bounds of the sampled data.

2.3 The Scientific Committee congratulated and thanked Dr Hanchet for his leadership in WG-SAM in delivering a useful process for developing research plans in data-poor fisheries. It noted the importance of having processes to guide decision-making in difficult situations.

2.4 Prof. P. Koubbi (France) indicated that, unfortunately, France had been unable to attend the meeting of WG-SAM and will endeavour to accompany its proposals for exploratory fishing in future.

2.5 Dr A. Petrov (Russia) noted that consideration by WG-SAM of WG-SAM-13/34 on tag-detection performance (Annex 4, paragraphs 4.5 to 4.8) should be considered when discussing the assessment in Subarea 88.2 (paragraphs 3.162 to 3.168).

2.6 The Scientific Committee noted that the only toothfish assessments reviewed by WG-SAM were for Subarea 48.4 and Division 58.4.4.

2.7 The Scientific Committee noted that it had been requested by WG-SAM to discuss potential mechanisms by which a catch limit should be applied to the sub-adult survey of *Dissostichus* spp. in Subarea 88.1, which will include SSRU M (which has a catch limit of 0 tonnes). This was discussed and resolved at WG-FSA (Annex 6, paragraph 4.71) and was considered by the Scientific Committee in discussions under exploratory fisheries (paragraph 3.149).

2.8 The Scientific Committee agreed to consider how assessments should be processed and reviewed in the intersessional period (paragraph 13.1), noting the roles of WG-SAM and WG-FSA according to their current terms of reference, which are:

(i) WG-SAM (SC-CAMLR-XXVI (2007), Annex 7, paragraphs 8.18 and 8.19):

'to provide advice to the Scientific Committee and its working groups on:

(i) quantitative assessment methods, statistical procedures, and modelling approaches for the conservation of Antarctic marine living resources

(ii) the implementation and data requirements of such methods, procedures and approaches.'

It was agreed in SC-CAMLR-XXVI, Annex 7, paragraph 8.19, that one of the roles of WG-SAM 'was to provide expert review of methods and procedures that leads to advice, such as estimates of yield, to the Scientific Committee … Not all methods, procedures and approaches would need to be reviewed by WG-SAM. The Working Group agreed that where a working group is not able to judge the utility or the implementation of a method, procedure or approach, the following process should be followed (SC-CAMLR-XXVI, Annex 7, paragraph 6.3):

(i) the method, procedure or approach be submitted to WG-SAM with sufficient information to enable replication of the model. This includes, but is not limited to, the software package or code and the input data

(ii) the method, procedure or approach be tested against previously documented and appropriate scenarios, simulated data or other ecological models

(iii) the realism and suitability of the method, procedure or approach be reviewed by the relevant working group (WG-EMM, WG-FSA or ad hoc WG-IMAF).'

(ii) WG-FSA (SC-CAMLR-III (1984), paragraph 7.54):

'1. To assess the status of fish stocks in the Convention Area, including South Georgia, other areas in the South Atlantic within the Convention Area, and Kerguelen.

2. To advise on the management measures needed to achieve the Commission's objectives taking account of any requests made to the Scientific Committee by the Commission.

3. To identify further research studies and data collections which would be required for improved fish stock assessment.

4. To submit a report to the Scientific Committee which would inter alia assist the Committee in considering any management measure that might appear necessary.'

2.9 A number of Members recalled that the remit of WG-SAM was to review new methods and software, but not necessarily review previously approved stock assessments themselves unless they are in the development stage, have been changed substantially from the last model brought to WG-SAM (e.g. inclusion of new datasets or structural changes) or are cause for specific concern as flagged by WG-FSA.

Acoustic survey and analysis methods (SG-ASAM)

2.10 In the absence of any representatives from the SG-ASAM Correspondence Group, the WG-EMM Convener, Dr Kawaguchi, reported on activities in relation to SG-ASAM that occurred during the 2012/13 intersessional period, as well as on discussions that took place at the WG-EMM meeting in Bremerhaven, Germany, during July 2013 (Annex 5, paragraphs 2.136 to 2.142).

2.11 The Scientific Committee endorsed the agreement by WG-EMM regarding the two-staged work plan of the proof-of-concept program for acoustic data collection by fishing vessels (Annex 5, paragraphs 2.137 and 2.138). Stage 1 is being implemented in 2013 to evaluate the current setup of acoustic equipment on participating vessels. Stage 2 will consist of acoustic data collected during a range of vessel activities, speeds and weather conditions to assess more fully the quality and utility of acoustic data from commercial fishing vessels.

2.12 The first step of this process was carried out in 2013. Several Members have submitted their data as part of this work program. These data are now under evaluation by SG-ASAM, working through the intersessional correspondence group.

2.13 Dr Godø reported that Norway was not on the list of Members as having contributed data, as Norwegian krill fishing vessels have already collected acoustic survey data for scientific use which are already in use by CCAMLR.

2.14 The Scientific Committee discussed whether there was a need for SG-ASAM to be convened in the 2013/14 intersessional period to determine protocols for collection and analysis of acoustic data collected on board fishing vessels (as outlined in Annex 5, paragraphs 2.140 and 2.142). The Secretariat indicated that a number of vessels have already implemented stage 1 and that the web-based subgroup is currently drafting protocols for stage 2. Based on this, and advice received from the SG-ASAM Correspondence Group Convener, Dr J. Watkins (UK), that there was good momentum for ongoing work, the Scientific Committee agreed that a 2013/14 intersessional meeting of SG-ASAM would be very useful.

HARVESTED SPECIES

Krill resources

Catch in the current fishing season, 2012/13

3.1 The Scientific Committee noted that the 2012/13 fishing season for krill is still under way and that the final figures for the season are not yet available. However, 12 vessels from

five Members have fished for krill, and as of 20 September 2013, approximately 154 000 tonnes were taken from Subarea 48.1, 30 000 tonnes from Subarea 48.2, and 28 000 tonnes from Subarea 48.3. The total catch to date is 212 000 tonnes, which compares to 161 085 tonnes from 2011/12 (Tables 1 and 2). Pursuant to CM 51-07, the fishery was closed in Subarea 48.1 on 14 June 2013.

3.2 The Scientific Committee endorsed recommendations from WG-EMM that information related to the krill fishery should be summarised in a format similar to the Fishery Reports for finfish fisheries, and that this new report should be published in the four official languages of CCAMLR. The Secretariat agreed to coordinate the preparation of a draft Krill Fishery Report for consideration by WG-EMM in 2014.

Notifications for the next fishing season, 2013/14

3.3 Six Members submitted notifications for 19 vessels intending to fish for krill in 2013/14. The notified catch for Subareas 48.1 to 48.4 is 545 000 tonnes and all notifications provided the information required by CM 21-03. Clarification on specific elements within each notification (Annex 5, Table 1) and additional information on the makes, types and frequencies of the echo sounders used on each vessel was requested by WG-EMM, and all of the notifications were revised accordingly (CCAMLR-XXXII/05 Rev. 1, XXXII/06 Rev. 1, XXXII/07 Rev. 1, XXXII/08 Rev. 1, XXXII/09 Rev. 1 and XXXII/10 Rev. 1).

3.4 The Scientific Committee noted that WG-EMM reviewed the information requirements for krill fishery notifications. These requirements are listed in CM 21-03 (Annexes A and B).

3.5 The Scientific Committee endorsed the recommendations that:

(i) information requirements related to the configuration of nets and seal exclusion devices should be strengthened and submitted to WG-EMM for review and subsequent inclusion in the CCAMLR Fishing Gear Library so that future notifications may simply refer to relevant documents in that library

(ii) information on the relative amounts of product, notified fishing months, expected proportion of time for each fishing technique and the simple check-box to indicate the presence of mammal exclusion devices should be removed from the list of notification requirements.

3.6 The Scientific Committee also advised that Annex A of CM 21-03 should include detailed guidelines for the provision of net diagrams and descriptive information, such as length and height of each trawl panel, mesh size, shape and material, and mesh construction, to be included in the net diagram. It further advised that any changes made to net configuration must be submitted to WG-EMM for consideration.

3.7 Revised guidelines for notifying how the green weight of krill will be estimated by each vessel intending to participate in the krill fishery were agreed by WG-EMM (Annex 5, Appendix D) and endorsed by the Scientific Committee. The Commission is requested to update Annex 21-03/B using these revised guidelines, and the Secretariat should update the

C1 data form for use in 2013/14. The Secretariat was also requested to include examples of how to enter the green-weight estimation parameters in the C1 form, and to place these examples on the CCAMLR website to assist Members with completion of the form.

Krill abundance and distribution, krill biology, net selectivity, CPUE and fish by-catch

3.8 Members are building new collaborations that link efforts to survey krill and study ecosystem dynamics within Subarea 48.1 during both the austral summer and the austral winter. The Scientific Committee acknowledged that this work is important to better understand the seasonal dynamics of krill production as well as ecosystem structure and function. Members were encouraged to continue such collaboration, especially now that the krill fishery has an increased focus on winter operations. It was recognised that surveying krill in the sea-ice is difficult, and it would be useful if Members also collaborated to find new ways of collecting and analysing survey data that are collected in ice-covered areas.

3.9 The Scientific Committee acknowledged that Members had submitted useful papers to WG-EMM on krill biology, net selectivity and CPUE. These contributions are ultimately valuable for understanding the dynamics of krill in a changing environment and improving the management of the krill fishery. There continues to be a need to understand vessel behaviour and how such behaviour affects both CPUE and the spatial distribution of fishing effort, and Members were encouraged to conduct further analyses of fishery operations and the factors determining fishing strategy and efficiency.

3.10 The volume and quality of data on the by-catch of fishes in the krill fishery are increasing, and increased collaboration between WG-EMM and WG-FSA to consider these data may lead to new insights on the degree to which the by-catches of the krill fishery impact fish stocks, including recovery of depleted stocks, and the predators that eat these fishes (e.g. some seabirds and seals). There is concern that increased krill fishing in coastal areas may undermine other conservation measures intended to protect or facilitate the recovery of important fish stocks (e.g. CM 32-02) by adversely impacting fishes that use coastal areas as juvenile rearing habitat. By-catch data from the krill fishery may also increase understanding of the stock structure of fishes, including patterns of larval dispersal. The Scientific Committee agreed that work to address these topics is important and needs to be prioritised.

Feedback management

3.11 To improve understanding of feedback management, several points should be communicated more broadly within CCAMLR. The Scientific Committee therefore agreed that:

(i) advice relevant to feedback management will include advice on the overall catch limit for the krill fishery and on its spatial distribution

(ii) while the work plan to develop a feedback management strategy has been noted by the Commission, general guidance on desirable elements of a feedback management strategy is not available

(iii) CEMP and other observations can provide important data for formulating advice on fishery catch limits and the spatial distribution of these limits

(iv) decision rules on how to respond to indicators from the CEMP or other observations would help specify the measures to be taken to achieve the objectives in Article II

(v) indicators that reflect processes at different time- and space scales might be used in different decision rules to adjust fishing over a range of time- and space scales.

3.12 Although some of the points listed in the preceding paragraph have been made previously, the Scientific Committee acknowledged that its previous communication on the issue of feedback management with the Commission may have been unclear. A new strategy to regularly communicate with the Commission on complex emerging issues such as feedback management may be needed. The Scientific Committee thus asked the Commission whether there are specific approaches that can be used to improve communication on such issues. For example, the Scientific Committee suggested that a small amount of time during each Commission meeting might be devoted to a short oral and visual presentation on an emerging issue. Such presentations could be delivered by the Chair of the Scientific Committee or a Member's representative and provide background material that aims to improve understanding of the Scientific Committee's work.

3.13 The Scientific Committee admitted that the plan to develop a feedback management strategy by 2014 no longer seems feasible. Despite efforts made by WG-EMM, experience since 2011 has demonstrated that several factors have made it difficult for all Members to develop a common understanding. For example:

(i) communication among Members on issues related to feedback management has been limited to the regular meetings of WG-EMM

(ii) the regular meetings of WG-EMM have full agendas, and there is insufficient time to work on feedback management issues during the meetings

(iii) different research groups are progressing work over different time frames and spatial scales, which makes it difficult to envision how some management procedures might be implemented

(iv) the work to advance feedback management is highly technical, and WG-EMM needs more time to evaluate and understand several details

(v) it has proven difficult to follow the six steps agreed in 2011 sequentially, and improved understanding can likely be developed by considering issues more holistically.

3.14 Despite these difficulties, the Scientific Committee agreed that staged development of a feedback management strategy remains feasible if:

(i) in the short term, work focuses on the use of existing data and monitoring efforts, such as existing CEMP data and results from acoustic surveys by fishing vessels

(ii) in the medium term, work progresses to extending data collection and monitoring efforts while also investing in the tailoring of models to available data and the development of operational ecosystem models

(iii) in the long term, ecosystem models are used to guide the establishment of a 'final' feedback management strategy.

3.15 Following advice from WG-EMM and building on the concepts in the preceding paragraph, the Scientific Committee recommended that the four stages in the development of the krill fishery could be:

stage 1 – continuation of the current trigger level and its spatial distribution among subareas

stage 2 – an increase from the trigger level to a higher interim catch limit and/or changes in the spatial distribution of catches that are adjusted based on decision rules that take account of results from the existing CEMP and other observation series

stage 3 – a further increase to a higher interim catch limit and/or changes in the spatial distribution of catches that take account of results from an 'enhanced' CEMP and other observation series

stage 4 – a fully developed feedback management strategy that is based on forecasts from ecosystem models, may involve structured fishing and/or reference areas, and includes catches up to the precautionary catch limit based on decision rules taking account of enhanced CEMP and other observation series.

3.16 In all stages, the spatial distribution of catches might be among subareas, individual or groups of SSMUs, or other areas that are defined by considering the spatial scales over which the fishery operates and which are relevant to CEMP data and other observations.

3.17 The Scientific Committee encouraged WG-EMM to urgently continue the work on distributing the catch limit of krill among SSMUs in Area 48.

3.18 The Scientific Committee discussed whether advancement through the stages identified in paragraph 3.15 above should occur according to an agreed timeline. Some Members felt that this should not be the case and that advancement from one stage to the next should be determined by the availability and relevance of scientific information and tools. Other Members felt that development of a timeline would focus scientific work and potentially allow for more rapid advancement through the stages. In either case, it was acknowledged that advancement through the stages will become a more pressing issue since the current trigger limit and its spatial subdivision made the krill fishery more constrained. The Scientific Committee encouraged work to rapidly address the issues that could lead to stage 4 as quickly as possible.

3.19 With respect to stage 1, the Scientific Committee considered discussions by WG-EMM on whether the trigger level and its spatial subdivision are still regarded as being suitable to achieve the objectives of the Convention without further controls on the fishery. Implementation of the trigger level and its spatial distribution are predicated on three conditions:

(i) catches up to the trigger level will not compromise the ability of the Commission to achieve the objectives of the Convention

(ii) the permitted spatial pattern of fishery catches will not compromise the ability of the Commission to achieve the objectives of the Convention

(iii) long-term ecosystem change will not invalidate the first two conditions during the period over which a feedback management strategy is developed.

3.20 It was noted that the Commission will review CM 51-07 during 2014, and will expect advice on the trigger level. The Scientific Committee endorsed WG-EMM's work plan to evaluate the conditions on which stage 1 is predicated. This work plan is summarised in Annex 5, paragraph 2.69.

3.21 The Scientific Committee noted that there are several practical approaches that can be used to develop stage 2, such as:

(i) increasing the frequency of small-scale or larger-scale krill surveys, using research vessels, vessels of opportunity and specified fishery operations

(ii) expanding the number of CEMP sites or sites where predator monitoring compatible with CEMP is conducted

(iii) assessing changes in the environment that could impact on krill, predators or fishing vessels

(iv) developing data-integration models to consider time and space variations in available data.

It was agreed that the first two approaches listed above should be prioritised, and these respectively link to ongoing work discussed in paragraphs 3.24 to 3.26.

3.22 The Scientific Committee noted WG-EMM's plan to form two intersessional task groups to progress work on stage 2 and endorsed this plan. These task groups will propose feedback management strategies based on existing data for Subareas 48.1 and 48.2 during 2014 and 2015. The Scientific Committee thanked Drs Watters and J. Hinke (USA) for agreeing to co-convene the task group for Subarea 48.1 and Dr Trathan and Lic. M. Santos (Argentina) for agreeing to co-convene the task group for Subarea 48.2. Discussion related to the work of both task groups is provided in Annex 5, paragraphs 2.77 to 2.84, and the plans in these paragraphs were endorsed. The Scientific Committee requested that the Secretariat establish a web-based correspondence tool to facilitate the work of these task groups, and all Members were encouraged to participate in the work.

3.23 The Scientific Committee also welcomed the indication that it may be possible for some Members to develop a feedback management strategy for Divisions 58.4.1 and 58.4.2 in 2014 and 2015.

3.24 In considering moving beyond stage 2 of the staged approach to developing a feedback management strategy (paragraph 3.15), the Scientific Committee noted that several specific studies and field projects would be expected to provide important information, including:

(i) quantifying the krill densities and/or biomass
(ii) understanding fleet dynamics and how the fishery operates
(iii) expanding acoustic estimation using fishing vessels
(iv) establishing periodic regional predator censuses
(v) determining where new CEMP sites should be established
(vi) methods for determining the flux of krill past CEMP sites.

With respect to item (v) listed above, the Scientific Committee agreed that specifying the location of new CEMP sites is a complex issue involving practical as well as scientific considerations.

3.25 The Scientific Committee noted several other considerations with respect to the establishment of new CEMP sites and reference areas during stage 4:

(i) the power to detect changes will increase with increases in the time over which monitoring occurs, increases in the magnitude of change, increases in the number of replicate CEMP sites and reference areas

(ii) the sizes of candidate reference areas need to be considered in the context of krill flux, with increased flux expected through smaller areas and decreased flux expected through larger areas

(iii) the locations of candidate reference areas need to be considered in relation to locations of fished areas.

3.26 The Scientific Committee noted that the criteria for establishing reference areas will evolve as stages 1 and 2 are progressed. Importantly, datasets from existing sites should not be compromised through fishing activity during the time taken to develop these stages. The Scientific Committee asked WG-EMM to consider this as part of its deliberations.

3.27 The Scientific Committee agreed that advancement to stages 3 and 4 could benefit from broader collaboration with other groups such as ICED, SOOS, COMNAP and IWC for development of a feedback management strategy and further data collection in the field. It noted that climate-change effects may, under some scenarios, be so great that they dwarf any effects from fishing, and that there is a need for investigating quantitative objectives for implementing Article II in the contexts of climate change and feedback management (see also paragraphs 8.1 to 8.10).

CEMP and WG-EMM-STAPP

3.28 The Scientific Committee noted the WG-EMM discussions on CEMP and WG-EMM-STAPP (Annex 5, paragraphs 2.93 to 2.111), and in particular, updates on the progress of WG-EMM-STAPP, and discussion related to requirements for reference sites in the context of the changing spatial distribution of the fishery, which might make identifying reference sites difficult. It agreed that validation of new methods and tools was an important step toward ensuring efficient use of new monitoring methods in CEMP and WG-EMM-STAPP. The Scientific Committee encouraged engagement with the broader predator research community to work together in a collaborative manner to deliver results on predator monitoring that may be of use for CCAMLR's management procedures.

3.29 The Scientific Committee welcomed an update from Dr Trathan regarding significant support from the penguin research community for developing an international penguin tracking database following presentations made at the recent SCAR Biology Symposium in Spain and the International Penguin Conference in the UK. Such a database would support the development of feedback management strategies, as well as helping inform a variety of CCAMLR analyses on spatial planning processes.

3.30 The Scientific Committee noted the WG-EMM discussion with respect to CEMP data and CEMP site designation, particularly in relation to designation of CEMP sites under CM 91-01 for further protection of such sites (Annex 5, paragraphs 2.124 to 2.130). It congratulated Ukraine and Poland on their contributions of monitoring data to the CEMP database, and noted that Ukraine has presented a preliminary management plan, in accordance with CM 91-01, for new CEMP sites in the Argentine Islands. Based on recommendations from WG-EMM, this proposal now includes two sites and Ukraine has started providing data to the Secretariat.

3.31 The Scientific Committee also noted that the procedure for establishing a CEMP site and new time series of data for CEMP is not easily understood and welcomed news from the Secretariat that specific guidelines are now being developed and will soon be available.

Integrated assessment

3.32 The Scientific Committee noted that an update on the integrated assessment model for krill will be submitted to WG-SAM or WG-EMM in 2014 (Annex 5, paragraph 2.131).

Subarea 48.2

3.33 The Scientific Committee considered those aspects of SC-CAMLR-XXXII/08 that related to the development of a feedback management strategy for the commercial fishery for krill in Subarea 48.2. The South Orkney Islands are one of the important areas used by the krill fishery. The islands also lie in a part of the Southern Ocean where some of the strongest regional expressions of climate change have occurred during the past decades. In this context, the data available to managers are currently inadequate for developing appropriate tools for managing the precautionary catch limit for Antarctic krill (*Euphausia superba*) over a range of spatial and temporal scales. Recently, however, there has been a considerable amount of new research initiated around the South Orkney Islands that has the potential to facilitate the development of management processes in Subarea 48.2. These include recent penguin foraging studies; recent oceanographic moorings; and recent krill distribution and abundance information from the regular Norwegian acoustic surveys. SC-CAMLR-XXXII/08 suggested that these field campaigns might contribute to the development of candidate approaches for feedback management. The paper also suggested that an experimental structured approach to harvesting (fished areas and contrasting unfished areas) would further the potential for providing considerable management advice.

3.34 The Scientific Committee welcomed the contribution from Norway and the UK (SC-CAMLR-XXXII/08), and noted their invitation for expert input, data or other contributions from other Members with an interest in the South Orkney Islands. The Scientific

Committee congratulated the authors of the paper for initiating a partnership between a number of Members, industry and science which offered a new and novel collaborative approach that has the potential to address some of the large-scale problems associated with spatial management.

3.35 The Scientific Committee recognised that data from fishing vessels provides an important contribution for helping to increase understanding of Antarctic ecosystems and for informing spatial management, particularly when used in conjunction with other research that is taking place. The Scientific Committee therefore thanked Dr E. Barrera-Oro (Argentina) and Dr V. Bizikov (Russia) for their offers of data and expert input to the collaborative studies.

Contributions from ASOC and ARK

3.36 Dr R. Werner, ASOC Observer to SC-CAMLR, introduced CCAMLR-XXXII/BG/17 Rev. 1 in which ASOC suggested that, as the krill fishery has become increasingly spatially concentrated in Subarea 48.1 over the past several years, and the fact that fishing is likely occurring very close to threatened populations of Adélie and chinstrap penguins, ASOC would have significant reservations about any lifting of the trigger level until stage 4 of the development of a feedback management strategy (including testing of models of feedback management, reference areas and an appropriate CEMP). Following the proposal made by Ukraine in 2009 (CCAMLR-XXVIII/48), ASOC also proposed that some fishing effort should be moved to pelagic areas using the proportions of 27% and 73% that correspond to the average of krill biomass distribution between coastal and pelagic areas based on the estimates of the CCAMLR-2000 Survey.

3.37 ASOC also indicated that it would be key for fishing nations to contribute financially to the CEMP fund to facilitate the development of the envisioned feedback management of the krill fishery. They also noted that although some Members have been reporting direct measurements of green weight and the methods used to estimate green weight to the Secretariat, other Members still do not provide descriptions and analyses on how they estimate green weight. Therefore, ASOC proposed that CCAMLR should make this reporting a mandatory part of the krill fishing notification requirements. Furthermore, ASOC considered that although the current level of coverage exceeds the minimum requirements in CM 51-06, ASOC continues to promote the need for 100% observers on board krill fishing vessels.

3.38 The Scientific Committee noted that CCAMLR-XXXII/BG/17 Rev. 1 provided constructive comments with important points for discussion. In particular, the percentage-based redistribution of fishing effort in coastal versus pelagic areas might help to protect both early stages of fish taken as by-catch and krill-dependent predators. However, no conservation measures currently exist which provide a definition of the depth ranges for coastal and pelagic zones. The Scientific Committee agreed that these concepts could be addressed when the spatial allocation for Area 48 is reviewed.

3.39 The ARK Observer to SC-CAMLR, Dr S. Nicol, introduced CCAMLR-XXXII/BG/25 and noted that the closure of the krill fishery when the trigger level in Subarea 48.1 was reached during 2012/13 was evidence that CCAMLR's management procedures were

working efficiently. ARK also noted that no krill fishing occurred in ASMAs or ASPAs during 2012/13 (paragraph 5.41) following the provision of clear information on the location of these areas by ARK in 2012, including ARK making maps available through its website.

3.40 ARK noted the discussions on the use of fishing vessels for the collection of scientific data. Although the emphasis to date has been on the collection of acoustic data, ARK would like to encourage proposals for the use of its members' vessels for the collection of a range of biological data, as well as acoustic data for determining krill distribution and abundance.

3.41 Given WG-EMM's priority on understanding how the fishery operates and the discussion at the Scientific Committee on the utility of sourcing data from the fishing fleet, ARK proposed holding a one-day workshop in conjunction with WG-EMM in 2014 to bring together the masters from fishing vessels with krill scientists working within CCAMLR. The meeting could be a useful forum for exchange of information between fishery operators and scientists on issues such as krill management, krill biology, fleet behaviour, estimation of green weight, escapement mortality, the efficient use of observers and future developments in fishing technology and management.

3.42 The Scientific Committee welcomed the initiative from ARK to promote interactions between science and industry, and considered that the opportunity for WG-EMM scientists to meet with vessel operators for the purpose of information exchange was an important one. It agreed that Chile would assess the logistical requirement for hosting a joint meeting between ARK and WG-EMM in Punta Arenas, Chile, in 2014, and that the WG-EMM Convener would also assess whether such a meeting could be accommodated in the schedule for the Working Group.

Fish resources

Status and trends

3.43 The Scientific Committee noted that the following finfish fisheries operated in the Convention Area in 2012/13:

(i) fisheries for *Champsocephalus gunnari* (icefish)

  (a) Subarea 48.3 (CM 42-01)
  (b) Division 58.5.2 (CM 42-02)

(ii) fisheries for *Dissostichus eleginoides* and/or *D. mawsoni* (toothfish)

  (a) Subarea 48.3 (CM 41-02)
  (b) Subarea 48.4 (CM 41-03)
  (c) Subarea 48.6 (exploratory fishery, CM 41-04)
  (d) Division 58.4.1 (exploratory fishery, CM 41-11)
  (e) Division 58.4.2 (exploratory fishery, CM 41-05)
  (f) Division 58.4.3a (exploratory fishery, CM 41-06)
  (g) Division 58.5.1 (waters adjacent to the Kerguelen Islands, French EEZ)
  (h) Division 58.5.2 (CM 41-08)

(i) Subarea 58.6 (waters adjacent to the Crozet Islands, French EEZ)
(j) Subareas 58.6 and 58.7 (waters adjacent to the Prince Edward Islands, South African EEZ)
(k) Subarea 88.1 (exploratory fishery, CM 41-09)
(l) Subarea 88.2 (exploratory fishery, CM 41-10).

3.44 Catches of *C. gunnari* and *Dissostichus* spp. taken in the Convention Area in 2012/13 to 20 September 2013 are summarised in Table 1 (see also SC-CAMLR-XXXII/BG/01). Catches taken in 2011/12 are summarised in Table 2. These catches include by-catch, and catches taken during research fishing in areas closed to fishing (Subarea 48.5 and Divisions 58.4.4a and 58.4.4b).

3.45 For *Dissostichus* spp., research fishing was carried out in the closed areas, namely Subarea 48.5 (50 tonnes) and Division 58.4.4b (31 tonnes). The Secretariat also closed three fisheries this season for *Dissostichus* spp.: Subarea 48.4N on 4 April (at 98% of catch limit), Subarea 88.1 on 25 January (at 96% of catch limit) and Subarea 88.2 on 3 February (at 90% of catch limit). There were also closures at SSRU level in Subareas 88.1 and 88.2 (see also CCAMLR-XXXII/BG/06 Rev. 1, paragraph 7).

3.46 There are two main fisheries targeting *C. gunnari*, in Subarea 48.3 and Division 58.5.2; fishing is continuing in Subarea 48.3. In Subareas 48.1, 48.2 and 48.3 there have been small catches of *C. gunnari* as by-catch to the krill fishery; and in Subarea 48.3 there was also a survey by Argentina (<1 tonne).

3.47 The Scientific Committee requested that the Secretariat provide summaries by Flag States of catches of *D. eleginoides* from outside the Convention Area through the CDS, including regions outside EEZs (Table 3).

Fishery reports

3.48 The Scientific Committee noted that WG-FSA had discussed the procedure for updating and publishing the Report on Bottom Fisheries and VMEs and the Fishery Reports.

3.49 It was noted that there was no intention to change the structure of the VME reports, but that publication had been delayed until 2014 to allow the assessments to be conducted and Fishery Reports finalised as soon as practicable.

3.50 In the past, Fishery Reports had been appended to the WG-FSA report. WG-FSA suggested a revision to this procedure, such that the reports would be updated during the meeting, and then finalised and published by the Secretariat as separate reports which would include the management advice and conservation measures agreed by the Commission. WG-FSA recommended that edits to the Fishery Reports should be supplied to the Secretariat by 10 December 2013, the interim versions should be made available on the CCAMLR website by 20 January 2014 (but only viewable by accredited users), and the final versions made publically available by 20 February 2014.

3.51 The Scientific Committee noted that there was a strong rationale for not having a final completed version of the Fishery Reports available from WG-FSA due to its increasing meeting workload. Until four to five years ago, the Fishery Reports were formally adopted

within WG-FSA, but the adoption of large volumes of tables had not been practical in the time available. In addition, the final reporting on catch levels required in the report is not available until after the Commission meeting.

3.52 The Scientific Committee agreed that there was a need for WG-FSA to complete a report which provided detailed information on past history, fishery data, population and exploitation trends, by-catch trigger levels and catch limit spatial allocations, which would be useful to the Scientific Committee in the provision of advice to the Commission during its meetings.

3.53 It was suggested that the Secretariat provide updates automatically each year and a section of the WG-FSA report detailing data revisions and additions. More detailed changes to the assessment model structure would require rapporteured text added during the WG-FSA meeting of that year. Following the WG-FSA, Scientific Committee and Commission meetings, the reports need a review and formal adoption process, and one option comprised a web-based review and adoption (paragraph 3.50).

3.54 The Scientific Committee discussed developments to the Fishery Reports that would aid the work of WG-SAM, WG-FSA and the Scientific Committee in providing advice to the Commission. The reports would benefit not only from the standardisation of data formats but also standard assessment diagnostics and stock summaries. It was considered WG-SAM and WG-FSA could develop the first set of edits of a Fishery Report next year and WG-FSA would then complete the task in an assessment year. The Scientific Committee agreed that the Secretariat should review the information and data that can be routinely provided and coordinate the review and revision of the reports.

3.55 The Scientific Committee noted that it had endorsed the preparation and translation of a Krill Fishery Report (paragraph 3.2). It was considered that the Fishery Reports should also be translated as they formed an important component of the CCAMLR documentation. Translation costs would need to be brought to the attention of the Commission, but they would reduce in time, as the reports became standardised.

Response to WG-FSA-13/P02

3.56 The Scientific Committee considered the WG-FSA discussions (Annex 6, paragraphs 12.3 to 12.6) on WG-FSA-13/P02 which raised a number of concerns with CCAMLR data collection, assessment modelling and harvest control rules.

3.57 WG-FSA had discussed the paper and members of the Working Group and other scientists, with experience of CCAMLR science, were collating a reply to be placed, if possible, in the same journal in order to address some of the misconceptions and inconsistencies within the paper.

3.58 The Scientific Committee noted that papers such as WG-FSA-13/P02 in which misconceptions arise, may reflect a general lack of understanding of CCAMLR science, its data collection schemes, observer, assessment and management approaches. The Scientific Committee agreed the need to accurately represent to a wider audience CCAMLR's precautionary system of management, and that individual scientists with knowledge of

CCAMLR could respond to inaccuracies presented in this paper. The Scientific Committee also agreed that CCAMLR should also respond by developing research and addressing issues where it was considered there was scientific justification.

3.59 The Scientific Committee reiterated that the CCAMLR management procedure and its implementation should be able to identify whether concerns, internally or externally, are genuine and that they are addressed in reasonable time, before problems arise. Scientific concerns need to be placed into context and evaluated in a considered and reliable manner with implementation of a suitable strategy for recalling, and making information available when an issue has been addressed (see also SC-CAMLR-XXXII/10).

3.60 CCAMLR has long advocated and enshrined ecosystem-based fishery management in its Convention as early as 1982, when CCAMLR came into force. In addition, CCAMLR's management procedures explicitly recognise that knowledge about the target species, related species and ecosystem is not, and never can be, perfect. These rules acknowledge that increased understanding is required, and puts requirements in place to improve that understanding, while also explicitly limiting the scale of the fishery throughout its development and management to be precautionary at existing levels of understanding and knowledge.

3.61 The main criticisms from WG-FSA-13/P02 were whether CCAMLR is achieving and likely to continue to achieve, the objectives in Article II. The central criticism raised, concerned management of toothfish in the Ross Sea.

3.62 The Scientific Committee noted that the CCAMLR management procedure, which is applied in the Ross Sea, comprises operational objectives, data collection and validation, decision rules (harvest control rules), compliance and enforcement along with regular updating in a feedback management system. A key issue is whether the process (the overall management strategy over many years) has been evaluated to achieve the objectives despite uncertainties in knowledge of the stocks or future scenarios or potential biases and precision in the assessments. Such reviews are ongoing within CCAMLR. Nevertheless, there is a need to provide materials to the wider international scientific and interested community to show how the systems are sufficient to achieve the CCAMLR objectives.

3.63 COLTO noted that within SC-CAMLR-XXXII/BG/09 it had provided a review conducted by the Marine Stewardship Council (MSC) and a second by the Monterey Bay Aquarium Seafood Watch Program. COLTO also noted, however, while debates on the scientific basis for CCAMLR's management procedure were important, there would always be polarised values concerning Antarctic fisheries and extensive review procedures would be unlikely to resolve all criticism.

3.64 The Scientific Committee discussed whether increased transparency would be achieved and enhanced by initiating a process of benchmark reviews of stock assessments and management procedures. Benchmark reviews are used by ICES to provide peer review of data collection and analysis procedures, assessment models (including alternatives) and management procedures. The reviews are conducted for an individual stock every 3–5 years on a rotating basis. Between benchmark reviews, the model structure, data time series to which the model is fitted and harvest control rule are held constant, apart from addition of new years of data, until the next benchmark.

3.65 The Scientific Committee noted that the benchmark reviews conducted by ICES are monitored and reported by a panel of externally appointed scientific experts who report on the science and process and provide feedback to managers, similar to the review recently conducted for the CCAMLR system of observers.

3.66 The Scientific Committee agreed that independent and in-depth reviews of CCAMLR stock assessments should be facilitated. These could potentially provide benchmark reviews that are similar to those conducted by ICES. Referees for these reviews should be individuals who do not participate in the work of the Scientific Committee and its working groups, and these reviews should, at a minimum, consider:

(i) the data that are used in an assessment (including the process of data selection)

(ii) the population model that is used to retrospectively estimate biomass and stock status (including the assumptions in the model and how it is fitted to the data)

(iii) the approach used to project how the modelled stock might change in response to future management (e.g. changes that might result from future catch limits)

(iv) how results from the projection are used to implement CCAMLR decision rules that are relevant to the stock.

3.67 Because criticism in papers such as WG-FSA-13/P02 has been directed at the stock assessment for *Dissostichus* spp. in the Ross Sea region, the Scientific Committee agreed that the stock assessment for the Ross Sea region should undergo independent review within the context noted in the preceding paragraph. It was suggested that this review should occur as soon as possible and that the process for inviting individual referees to participate in the review should be different than the usual rules of procedure for inviting experts to meetings of the Scientific Committee and its working groups.

3.68 The Scientific Committee noted that a symposium on the management of the Ross Sea system, similar to that held for the Kerguelen Plateau region (Duhamel and Welsford, 2011), could be held and a document produced that would allow external scientists access to CCAMLR science for an area.

3.69 The Scientific Committee agreed that it should develop a process to facilitate independent reviews of CCAMLR stock assessments, potentially using information from symposia like those described in the preceding paragraph. Dr Darby agreed to develop a proposal for such a process, using the benchmark reviews within ICES as a possible model. Dr Darby will present a paper to WG-SAM-14 that can subsequently be reviewed by WG-FSA and the Scientific Committee. The paper will include a suggested process for identifying and contracting referees, terms of reference for stock assessment reviews, and suggestions for how the Scientific Committee and its working groups will respond to the comments of referees. The Scientific Committee thanked Dr Darby for offering to undertake this work in the intersessional period.

CASAL version control

3.70 The Scientific Committee noted the WG-FSA discussions on CASAL version control (Annex 6, paragraphs 4.93 to 4.98) and the problems that this had caused for the group. WG-FSA had noted that the issues fell into two categories:

(i) failure to find a unique converged solution when fitting the population and fishery model to the stock data (Annex 6, Table 4)

(ii) different estimated parameter values resulted from using the same input files but different versions of CASAL (Annex 6, Table 6).

WG-FSA had concluded that further investigation of the problems should be conducted with information provided to WG-SAM.

3.71 The Scientific Committee noted that there was a need for version control for software such as CASAL within CCAMLR. The Scientific Committee noted that WG-FSA made specific recommendations as to how this could be conducted within the Secretariat (Annex 6, paragraph 4.97). It also noted that simulated datasets generated externally of the software, and datasets from existing stock assessments, should be used by the Secretariat to check software version changes (Annex 6, paragraph 4.98). The Scientific Committee agreed that WG-SAM should provide advice as to which version to apply in CCAMLR working groups.

3.72 The Scientific Committee noted that WG-FSA had failed to establish the cause of the differences in some models between the converged parameter estimates resulting from the different CASAL versions. Although the differences between CASAL versions were explained by the authors, in the CASAL manual, these did not seem to account for the differences noted by WG-FSA.

3.73 Dr Mormede noted that new versions of the CASAL software were always first trialled on a simulated dataset by the developers in New Zealand to ensure consistency in the results.

3.74 The Scientific Committee recommended that the developers of the program should be provided with feedback in order that WG-SAM and WG-FSA could be given the information that they required to resolve issues that WG-FSA assessments had raised. It also suggested that future models present a sensitivity run using the version of CASAL used in the previous assessment, particularly for models where the CASAL version might be an issue.

3.75 The Scientific Committee considered that it would review the individual assessments conducted by WG-FSA and evaluate the CASAL version issues and note the caveats in its advice to the Commission.

Other generic issues raised by WG-FSA

3.76 The Scientific Committee endorsed the following general recommendations made by WG-FSA that should apply to all stock assessments (detailed in Annex 6, paragraphs 4.99 to 4.103). These can be summarised as:

(i) Information be provided to WG-SAM on areas with potential *Dissostichus* spp. stock linkages, in particular Subareas 48.3 and 48.4; 58.6 and 58.7; 88.1, 88.2 and 88.3; and Divisions 58.5.1 and 58.5.2. This information will allow WG-FSA to review the current structure of the stocks for which it is providing management advice.

(ii) A review of weighting and screening of assessment data be considered as a special topic for WG-SAM, and for WG-SAM to provide guidance on appropriate approaches. It would also be useful to combine such a review with a comparison of MCMC and covariance resampling projection methods used in generating uncertainty when determining catch levels consistent with the CCAMLR decision rules.

(iii) WG-SAM should evaluate (a) appropriate methods for the estimation of cryptic biomass, and (b) its consequences on stock assessment results and decision rules. The use of simulated data was considered a useful method.

(iv) The Scientific Committee endorsed the importance of the research priorities for the Ross Sea region outlined by WG-FSA (Annex 6, paragraphs 4.106 to 4.107) and requested research proposals be developed by Members for consideration by the Scientific Committee. These research priorities are:

(a) research fishing in the northern Ross Sea region during winter to address current uncertainties in toothfish life-cycle movements and spawning dynamics

(b) research in the south of SSRU 882A (on the slope) to better understand toothfish distribution and movements on the Ross Sea slope and potential implications for stock structure and potential bias in the stock assessment

(c) spatially stratified longline surveys in previously unfished SSRUs (e.g. 882A–B north, 881D and 881F) to inform the parameterisation of the SPM and reduce potential bias in the stock assessment.

Icefish assessments

Champsocephalus gunnari South Georgia (Subarea 48.3)

3.77 The Fishery Report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in www.ccamlr.org/node/75667, and discussion by WG-FSA is in Annex 6, paragraphs 3.29 and 4.3 to 4.5.

3.78 In 2012/13, the catch limit for *C. gunnari* was 2 933 tonnes. Fishing early in the season was conducted by two vessels using midwater trawls and the total reported catch was 1 354 tonnes as of 20 September 2013. The fishery was active at the time of the WG-FSA meeting.

3.79 The Scientific Committee noted the results of the 2013 demersal fish survey conducted in Subarea 48.3. Notably, the biomass for *C. gunnari* was the highest since 1990, with large

aggregations observed to the northwest of South Georgia. It also noted that there was no evidence of strong recruitment of 1+ or 2+ toothfish observed in the survey. These data were included in the preliminary assessments for *C. gunnari* and *D. eleginoides* in Subarea 48.3.

Management advice

3.80 The Scientific Committee recommended that the catch limit for *C. gunnari* in Subarea 48.3 should be set at 4 635 tonnes for 2013/14 and 2 659 tonnes for 2014/15 based on the outcome of the short-term assessment and forecast.

Champsocephalus gunnari Heard Island (Division 58.5.2)

3.81 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in www.ccamlr.org/node/75667, and discussion by WG-FSA is in Annex 6, paragraphs 3.30 and 4.8 to 4.16.

3.82 In 2012/13, the catch limit for *C. gunnari* was 679 tonnes. Fishing was conducted by one vessel using a semipelagic trawl and the total reported catch up to 20 September 2013 was 644 tonnes.

3.83 The Scientific Committee noted that Australia had undertaken a random stratified trawl survey in Division 58.5.2 during April–May 2013, using a demersal trawl. It also noted that total catches of most finfish species were within 95% confidence intervals derived from the seven equivalent surveys undertaken between 2006 and 2012, with the exception of *C. gunnari*, which was seven times more abundant than the long-term mean. These data were included in the preliminary assessments for *C. gunnari* and *D. eleginoides* in Division 58.5.2.

Management advice

3.84 The Scientific Committee recommended that the catch limit for *C. gunnari* in Division 58.5.2 should be set at 1 267 tonnes for 2013/14 and a 30-tonne research and by-catch limit in 2014/15 based on the outcome of the short-term assessment and forecast; unless revised advice from WG-FSA following the 2014 survey indicates that a fishery is viable.

Toothfish assessments

Dissostichus eleginoides South Georgia (Subarea 48.3)

3.85 The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in www.ccamlr.org/node/75667, and discussion by WG-FSA is in Annex 6, paragraphs 4.17 to 4.24 and 9.9.

3.86 In 2012/13, the catch limit for *D. eleginoides* was 2 600 tonnes. Fishing was conducted by six vessels using longlines and the total reported catch up to 20 September 2013 was 2 098 tonnes.

Management advice

3.87 The Scientific Committee recommended that the catch limit for *D. eleginoides* in Subarea 48.3 should be set at 2 400 tonnes for 2013/14 and 2014/15 based on the outcome of this assessment. Following previous management agreements, the catch limit would be further subdivided among Management Areas A–C: Management Area A: 0 tonnes; Management Area B: 720 tonnes in each season; Management Area C: 1 680 tonnes in each season.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

3.88 The Fishery Report for *Dissostichus* spp. in Subarea 48.4 is contained in www.ccamlr.org/node/75667, and the discussion by WG-FSA is in Annex 6, paragraphs 4.25 to 4.37.

3.89 In 2012/13, fishing was conducted by two vessels using longlines. In the Northern Area, the catch limit for *D. eleginoides* was 63 tonnes and the management area was closed on 4 April 2013; the total reported catch of *D. eleginoides* was 62 tonnes. In the Southern Area, the catch limit for *Dissostichus* spp. was 52 tonnes and the total reported catch up to 20 September 2013 was 50 tonnes.

3.90 The Scientific Committee noted that the assessment and management of *Dissostichus* spp. fisheries in Subarea 48.4 had, to date, been based on separate assessments for the north and south of the management area, but that this year a separate assessment was made for each *Dissostichus* species rather than by area. The Scientific Committee commended WG-FSA for moving to species-specific assessments.

Dissostichus eleginoides South Sandwich Islands (Subarea 48.4)

3.91 The Scientific Committee noted that a preliminary CASAL assessment for *D. eleginoides* was updated with data for 2013 and further developed to incorporate the recommendations of WG-SAM-13. It also noted that additional analyses were conducted during the meeting of WG-FSA.

3.92 The Scientific Committee noted that *D. eleginoides* biomass estimates using CASAL and the Petersen method were compared, and highlighted the similarities in the results from both these methods. The application of CASAL estimated a total biomass of 1 600 tonnes while the Petersen method estimated 1 400 tonnes.

3.93 The Scientific Committee endorsed the recommendations for further work identified by WG-FSA (Annex 6, paragraphs 4.32 and 4.33).

Management advice

3.94 The Scientific Committee recommended that the catch limit for *D. eleginoides* in Subarea 48.4 should be set at 45 tonnes for 2013/14 based on the outcome of this assessment.

Dissostichus mawsoni South Sandwich Islands (Subarea 48.4)

3.95 The Scientific Committee noted that a tag-based Petersen estimator was implemented to provide the first species-specific biomass estimates for *D. mawsoni* in Subarea 48.4. The catch limit for 2013/14 was estimated by applying the same catch rate as in previous years, which is based on the harvest rate of *D. eleginoides* in Subarea 48.3 ($\gamma = 0.038$). It also noted that additional analyses were conducted during the meeting.

3.96 The Scientific Committee recommended that some high within-season recaptures should be considered further and that γ be estimated using biological parameters for *D. mawsoni* from this area in the future (Annex 6, paragraph 4.36). It also recommended that WG-FSA works towards a full stock assessment for this fishery.

Management advice

3.97 The Scientific Committee recommended that the catch limit for *D. mawsoni* in Subarea 48.4 should be set at 24 tonnes for 2013/14 based on the outcome of this assessment.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

3.98 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in www.ccamlr.org/node/75667, and the discussion by WG-FSA is in Annex 6, paragraphs 4.57 to 4.61.

3.99 The fishery for *D. eleginoides* in Division 58.5.1 is conducted in the French EEZ. In 2012/13, the catch limit for *D. eleginoides* was 5 100 tonnes. Fishing was conducted by seven vessels using longlines and the total reported catch up to 20 September 2013 was 3 239 tonnes.

3.100 The Scientific Committee noted that although there were no papers submitted to WG-FSA this year on the stock assessment of *D. eleginoides* at Kerguelen (national EEZ in Division 58.5.1), France has just finished the POKER 3 survey, and is in the process of updating the stock assessment in the coming year, which was presented at WG-FSA.

3.101 The Scientific Committee recommended that the updated stock assessment be presented at WG-SAM-14, as well as the detailed results of the POKER 3 survey. It also endorsed the recommendations for further work identified by WG-FSA (Annex 6, paragraph 4.59).

Management advice

3.102 In the absence of a new stock assessment, the Scientific Committee recalled last year's advice: 'The Scientific Committee agreed that the current catch limit of 5 100 tonnes for *D. eleginoides* in the French EEZ in Division 58.5.1 could be used as management advice for 2012/13. It also agreed that a more robust stock assessment was required to provide advice on catch limits beyond 2012/13.'

3.103 Mr R. Sinegre (France) noted that France intends to progress the work plan outlined by WG-FSA during the intersessional period and to present a more robust stock assessment model to the 2014 meeting of WG-FSA.

3.104 No new information was available on the state of fish stocks in Division 58.5.1 outside areas of national jurisdiction. The Scientific Committee therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-02, remain in force.

Dissostichus eleginoides Heard Island (Division 58.5.2)

3.105 The fishery report for *D. eleginoides* at Heard Island (Division 58.5.2) is contained in www.ccamlr.org/node/75667, and the discussion by WG-FSA is in Annex 6, paragraphs 4.38 to 4.56.

3.106 In 2012/13, the catch limit for *D. eleginoides* was 2 730 tonnes. Fishing was conducted by four vessels using bottom trawls, longlines and pots, and the total reported catch up to 20 September 2013 was 2 413 tonnes.

3.107 Dr Bizikov drew the attention of the Scientific Committee to the fact that a catch limit of 3 005 tonnes, suggested as one of the options of WG-FSA for Division 58.5.2 for the 2013/14 season, may cause a decline of the SSB below 50% B_0 by 2017 and that the median SSB in this scenario is projected to be around 40% of B_0 for approximately 10 years – between 2020 and 2030 (Annex 6, paragraph 4.42). Dr Bizikov went on to question the notion of increasing the catch limit while a stock status is in decline. He noted that, in spite of the recommendations of WG-FSA in 2009 and 2011 (SC-CAMLR-XXVIII, Annex 5, paragraph 5.151 and SC-CAMLR-XXX, Annex 7, paragraph 6.4), the current stock assessment for *D. eleginoides* for Division 58.5.2 was made without tag-recapture data being incorporated into the model and thus there is greater uncertainty in the resultant estimates. He also noted that the toothfish fishery in the Heard Island area is still carried out, in part, using bottom trawls which are banned elsewhere in the CAMLR Convention Area according to CMs 22-05 and 22-06.

3.108 The Scientific Committee noted the WG-FSA concerns that, while the catch advice in excess of around 2 500 tonnes was consistent with the CCAMLR decision rules, SSB is projected to drop below 50% B_0 and remain below that level for the majority of the projection period before increasing to above the target reference point of 50% SSB_0 in the latter years of the projection. The Scientific Committee noted that maintaining a catch level in the long term that results in this pattern may be less precautionary than a catch level that results in a less steep decline. The Scientific Committee considered that a review of how the CCAMLR decision rule is implemented should be conducted by WG-SAM in order to provide advice to WG-FSA and the Scientific Committee.

3.109 Advised catches and biomass status of the stock were conditional on the CASAL assessment version in which the model was fitted and the model structure and model fitting will be reviewed by WG-SAM-14 (paragraphs 3.70 to 3.75).

3.110 Dr Constable noted the following regarding comments on the Heard Island fisheries and stock assessment:

(i) Bottom fishing at Heard Island has been the subject of a six-year study funded by Australia's Fishery Research Development Council and undertaken in collaboration with industry. The report is in the process of being finalised but key conclusions include that the Heard Island Marine Reserve, which excludes commercial fisheries, plays an important role in protecting benthic habitats and biodiversity in the region. Also, bottom trawl fisheries outside the marine reserve have been concentrated in a few small areas, limiting their impact on the seafloor outside of the Marine Reserve. The report will be published by the end of 2013, and currently intended to be submitted for consideration by the Scientific Committee and its working groups next year.

(ii) Tagging data has been included in assessment scenarios in the past but this was found to have problems because of the small-scale areas in which the tags were deployed (WG-FSA-06/64; WG-FSA-SAM-06/14; WG-FSA-07/48 Rev. 1; Candy and Constable, 2008). It has also been found that the inclusion of tagging data will require consideration of the dynamics and spatial structure of the stock, including the interaction of tagged fish within the wider Kerguelen Plateau area. This is being investigated at present. In 2011, WG-FSA advised that it would be important to be including tag data before it is forecast that stock trajectory of SSB reaches the target level (SC-CAMLR-XXX, Annex 7, paragraph 6.41). At present, the stock is around 60%.

(iii) With respect to the question as to whether the catch limit can go up from one assessment to another when the stock status is descending towards the target, this is one of the positive outcomes of doing regular research which can result in increased certainty in estimates of vital rates such as growth, mortality and maturation. As the uncertainties are reduced, then the usual outcome from the decision rules is for the stock projections to be more certain, which can result in catches increasing, particularly when the stock is above the target level.

(iv) With respect to the stock projections showing a decline in the stock below the target level and whether there are grounds for concern about such a scenario, there are two issues:

(a) The first issue relates to the current decision rules. The decision rules are a means of finding a catch limit for a given assessment. There is an expectation that when this is considered as part of a feedback management procedure, the catches will be adjusted in order to keep the stock moving toward the target level. The estimated stock status may fluctuate around the target level but there is an expectation that if it goes below the target level, the catch will be adjusted downwards in a subsequent assessment. When the stock goes up above the target level, there is an expectation that the catch will likely be increased in a subsequent assessment. Importantly,

the assessment needs to be undertaken at regular intervals in order to continue to make these adjustments. In this management strategy, changes in the catch are expected to be only small when the assessments are undertaken regularly. Also, the actual stock trajectory is not expected to be as variable as might be seen in the individual trials of an assessment.

(b) The second issue is whether 50% of the pre-exploitation median spawning biomass should be regarded as a target or a limit. This is a question that can only be addressed by looking at the decision rules. In the current situation, the 50% level is a target, thereby allowing fluctuations above and below this level. The management strategy aims to avoid the stock going below the limit reference point of 20% of the pre-exploitation median spawning stock.

3.111 The Scientific Committee noted that WG-FSA had considered several scenarios on which to base management advice but had insufficient time to conclude the assessment that took account of assessment scenarios raised at the meeting, notably the inclusion of a stock-recruitment relationship, removal of the influence of two of the trawl fisheries and exclusion of the estimate of year-class strength in 2009 (Annex 6, paragraphs 4.47 to 4.53).

3.112 The Scientific Committee noted that this is an established fishery with a long history of assessments and that substantial progress has been made to address requests made in 2011 for further work as requested by WG-FSA in 2009 and 2011. It also noted that tagging data was not included in the current assessment work, which needs to be included before the stock reaches the target level of 50% (SC-CAMLR-XXX, Annex 7, paragraph 6.41). The Scientific Committee agreed it was important to consider the following work during the intersessional period and present a report on progress at WG-SAM-14 (Annex 6, paragraph 4.53):

(i) update the age data used in the assessment to include all recent years for which the information is available

(ii) review the tagging data available for inclusion in the assessment, including:

(a) an analysis of the spatial and temporal patterns of releases and recaptures, including linkage with other stocks

(b) localised and stock-based estimates of abundance using Petersen estimators

(c) sensitivity tests when including tag-recapture information in the CASAL stock assessment

(iii) compare MCMC runs with covariance matrix resampling for stock projections for this stock

(iv) evaluate the consequences, including information from ALKs and externally estimated growth functions, that account for length-based selectivity in the model.

3.113 The Scientific Committee recalled that results from the assessment in 2011 were that the stock would now be around 58% (with the 5 and 95 percentiles of 56 and 60 respectively)

of the median pre-exploitation spawning biomass. From the scenarios worked on by WG-FSA, the stock is likely to have a status this year in the range of 58–63% (Annex 6, Table 4). The analyses conducted in 2011 and 2013 indicated that the stock is likely to reach the target in 2017 if current catch levels are maintained.

3.114 The Scientific Committee noted the status of the stock, previously successful assessments and the time still available to refine the assessment before the stock is likely to reach the target level of $B_{50\%}$. It further noted that the regular assessments in this division and the application of the CCAMLR decision rules will provide for corrections before problems will arise for the status of the stock (SC-CAMLR-XXVI, paragraph 2.11).

Management advice

3.115 Noting the issues raised in paragraphs 3.111 to 3.114, the Scientific Committee agreed that, in this instance, the maintenance of the current catch limit of 2 730 tonnes for a further year would be appropriate while the issues raised by WG-FSA-13 are considered by WG-SAM-14 and WG-FSA-14.

3.116 The Scientific Committee also agreed that this should not be viewed as a precedent, noting that uncertainty in current status will increase as the interval between assessments increases.

3.117 WG-SAM was requested to consider the items in Annex 6, paragraph 4.53 (see paragraph 3.108), as well as the application of a stock recruitment relationship in the assessment.

3.118 Some Members recognised that bottom trawling constitutes the most damaging method of fishing benthic habitats and recommended that bottom trawl be excluded from practice within CCAMLR fisheries as soon as possible.

3.119 Dr Constable recalled the UNGA Resolution 61/105 (2006), Article 80, with respect to bottom fisheries:

> ‘Calls upon States to take action immediately, individually and through regional fisheries management organizations and arrangements, and consistent with the precautionary approach and ecosystem approaches, to sustainably manage fish stocks and protect vulnerable marine ecosystems, including seamounts, hydrothermal vents and cold water corals, from destructive fishing practices, recognizing the immense importance and value of deep sea ecosystems and the biodiversity they contain.’

3.120 He noted that Australia has been implementing this resolution in Division 58.5.2. He also noted that Australia intended to present to the Scientific Committee and its working groups next year a comprehensive overview of its precautionary ecosystem-based approach to management of the marine environment at Heard Island and the McDonald Islands, which includes assessing ecological risks of fisheries (Hobday et al., 2011).

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

3.121 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in www.ccamlr.org/node/75667, and the discussion by WG-FSA is in Annex 6, paragraphs 4.62 to 4.65.

3.122 The fishery for *D. eleginoides* at Crozet Islands is conducted in the French EEZ, which includes parts of Subarea 58.6 and Area 51 outside the Convention Area. In 2012/13 the catch limit for *D. eleginoides* was 700 tonnes. Fishing was conducted by six vessels using longlines and the total reported catch up to 20 September 2013 was 504 tonnes.

3.123 The Scientific Committee noted that a first stock assessment of *D. eleginoides* at Crozet Islands (Subarea 58.6 inside the French EEZ) was carried out. The Scientific Committee thanked France for providing this first stock assessment, which the Scientific Committee has requested for many years, and is looking forward to seeing this model being considered by WG-SAM-14.

3.124 The Scientific Committee noted that MCMCs were carried out and the potential yield that would satisfy the CCAMLR decision rules was calculated as 2 500 tonnes (including 10% killer whale (*Orcinus orca*) depredation).

3.125 The Scientific Committee endorsed the recommendations for further work identified by WG-FSA (Annex 6, paragraphs 4.63 and 4.64), in particular comparing the results from the model with a calculation of biomass by CPUE analogy method and including annual ALKs in the model.

3.126 The Scientific Committee recommended that this stock assessment be progressed and brought back to WG-FSA. It also recommended that a description of the killer whale depredation through time be undertaken, including whether or not it is increasing and if it might have an impact on fisheries operations and advice in the future.

3.127 Mr Sinegre confirmed France's intention to present this model at WG-SAM-14 and WG-FSA-14, as well as further details of the depredation analysis that is currently being conducted.

Management advice

3.128 No new information was available on the state of fish stocks in Subarea 58.6 outside areas of national jurisdiction. The Scientific Committee therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-02, remain in force.

Dissostichus eleginoides Prince Edward and Marion Islands (Subareas 58.6 and 58.7) and Area 51 inside the South African EEZ

3.129 The Fishery Report for *D. eleginoides* in Subareas 58.6 and 58.7 and Area 51 inside the South African EEZ is contained in www.ccamlr.org/node/75667, and the discussion by WG-FSA is in Annex 6, paragraph 4.66.

3.130 Dr Leslie informed the Scientific Committee that a revised operational management procedure to form the basis for management advice is under development by South African scientists and will be brought to WG-SAM when available. An interim catch limit of 320 tonnes of *D. eleginoides* was applied for the South African EEZ for 2011/12 and retained for 2012/13, of which 200 tonnes was set aside to conduct an experiment to calibrate CPUE between Spanish and trotlines in each of these seasons. This experiment has now been concluded. The catch limit for 2013/14 has not yet been determined but is likely to be higher than 400 tonnes.

3.131 The total reported catch of *D. eleginoides* was 234 tonnes up to 15 October 2013; two vessels are currently still active in this fishery.

Management advice for *D. eleginoides* at Prince Edward and Marion Islands (Subareas 58.6 and 58.7) inside the EEZ

3.132 The Scientific Committee was unable to provide management advice for the fishery in the South African EEZ at the Prince Edward Islands.

Management advice for *D. eleginoides* at Prince Edward Islands (Subareas 58.6 and 58.7 and Division 58.4.4) outside the EEZ

3.133 No new information was available on the state of fish stocks in Subareas 58.6 and 58.7 and Division 58.4.4 outside areas of national jurisdiction. The Scientific Committee therefore advised that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-02, remain in force.

Fish and invertebrate by-catch

3.134 The Scientific Committee noted the discussion by WG-FSA on data related to biological parameters and tag-recapture data for skates (Rajiformes) (Annex 6, paragraphs 9.1 to 9.4). It endorsed the following recommendations that:

(i) spatially explicit ecological risk assessments and productivity susceptibility analyses could be usefully investigated for species groups such as skates, in the absence of sufficient data for reliable stock assessments

(ii) tag-recapture data be summarised across the Convention Area, to evaluate patterns in tag shedding

(iii) measuring skates accurately would be enhanced by measuring multiple dimensions of skates (e.g. disc width, pelvic length, total length)

(iv) further studies be undertaken to estimate post-tagging survival and tag-retention with different tag types.

3.135 Dr Barrera-Oro drew the attention of the Scientific Committee to the catches of *C. gunnari* of 4.6 tonnes and 0.4 tonnes, taken as by-catch by a krill vessel operating off the northwest slope of the South Orkney Islands (Subarea 48.2) (Annex 6, paragraph 9.5). In addition, WG-EMM-13/38 contained a detailed summary of observer data on the by-catch of fish larvae in the krill fishery. He noted that the consolidation of identification guides at the species level of fish larvae in the krill catches has been made possible by recent improvements in the knowledge of their systematics.

3.136 The Scientific Committee noted that as datasets on the levels of interaction between the krill fishery and finfish species grow in spatial and temporal coverage, it is important that both WG-EMM and WG-FSA consider the impact that such interactions, especially by-catches of fish larvae, may be having on depleted and/or recovering finfish species such as *Notothenia rossii*.

3.137 It further noted that a body of research and literature existed on the inshore habitats that species such as *N. rossii* use during the early stages of their life cycle, and noted that this information should be considered alongside krill vessel catch and effort and by-catch observations, suggesting that krill catches close to the coast and/or at shallower depths have the potential to interfere with critical phases of the life cycle of inshore species. Thus, krill fishing depths might be a factor to be taken into account in the formulation of measures for the protection of fish at their early stages. It also encouraged Members to continue to undertake research on early life stages of marine organisms in the Southern Ocean that would assist CCAMLR to achieve its objectives.

3.138 Dr Barrera-Oro noted the agreement from both, the Argentine and the UK survey in Subarea 48.3, on the slow recovery of the population of the species *N. rossii*, which was the first overexploited Antarctic finfish in the onset of the 1970s. The same situation has been reported for this species in Subarea 48.1, as observed from the historical offshore surveys carried out by the USA and Germany, and by the long-term monitoring program developed by Argentina in inshore waters of the South Shetland Islands.

3.139 He also noted that the time required for the recovery of *N. rossii* after the overfishing event, and probably the case for other Antarctic fish species, largely exceeds the limit of two or three decades established in Article II of the Convention, indicating that a precautionary approach should be applied in order not to hamper these processes.

3.140 Dr Kock agreed that a detailed analysis of the distribution and abundance of early life stages of fish is desirable. However, he reminded the Scientific Committee that data on fish by-catch has been collected for 20 years without any detailed analysis of the data being conducted.

3.141 Dr Kock questioned that many of the available data on fish might be detailed enough to withstand a rigorous statistical analysis in relation to the small-scale geographical distribution of the krill fishery. In order to make progress in resolving a long-standing question in CCAMLR's work, he suggested an experimental phase in the krill fishery of two or three years in which all krill vessels need to carry two scientific observers, one specifically tasked with the collection of the required detailed data on fish by-catch.

3.142 The Scientific Committee noted CCAMLR-XXXII/33 which presented a proposal to ban the finning of sharks caught in the Convention Area. The Scientific Committee requested that in its considerations of this proposal, the Commission note that:

(i) the proposal applies to sharks only, and excludes skates and rays

(ii) all by-catches of sharks are required to be reported by vessels and that statistics on shark by-catch are summarised in the *Statistical Bulletin* each year

(iii) several conservation measures require that by-caught elasmobranchs, including sharks, skates and rays, are required to be released where they have a good chance of survival.

3.143 Mr H. Moronuki (Japan) pointed out that the amount of by-catches of sharks is relatively small and not identified to species, and therefore the compilation and analyses of data are necessary before examining whether CCAMLR should discuss the proposal on shark finning.

3.144 Given that the by-catch of sharks is relatively small and not well recognised, the Scientific Committee recommended, where possible, to have sharks transported to the shore when they are not suitable for live release.

New and exploratory fisheries

3.145 Seven Members have submitted notifications for exploratory fisheries under CM 21-02 for Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a, and in Subareas 88.1 and 88.2. Four Members have submitted notifications to conduct research fishing for the closed areas Divisions 58.4.4a and 58.4.4b, and Subareas 48.1, 48.2 and 48.5 (CCAMLR-XXXII/BG/06 Rev. 1). In total, 26 vessels have notified to conduct exploratory fisheries. No notifications have been submitted for new fisheries in 2013/14.

3.146 No notification was received for Division 58.4.3b for which there is currently a zero catch limit. The Scientific Committee recalled its advice to the Commission in 2012 (SC-CAMLR-XXXI, paragraph 3.150), that it was unable to approve research fishing in this area until the analyses noted in SC-CAMLR-XXX, paragraphs 9.34 and 9.36, had been provided. The Scientific Committee discussed a change in the classification of Division 58.4.3b in CM 41-07 to reflect the cessation of fishing activity in this area. Japan informed the Scientific Committee that it may continue research fishing in this area in the future and requested that CM 41-07 remain unchanged.

Dissostichus spp. Subareas 88.1 and 88.2 SSRUs A and B

3.147 Seven Members and 18 vessels fished in the exploratory fishery in Subarea 88.1 between December 2012 and January 2013. The fishery was closed on 25 January 2013 and the total reported catch of *Dissostichus* spp. was 3 155 tonnes (96% of the catch limit). The following SSRUs were closed during the course of fishing (CCAMLR-XXXII/BG/06 Rev. 1):

- SSRUs B, C and G closed on 11 December 2012 with a total catch of 411 tonnes (96% of the catch limit)

- SSRUs H, I and K closed on 25 January 2013 with a total catch of 2 388 tonnes (99% of the catch limit)

- SSRUs J and L closed on 25 January 2013 with a total catch of 356 tonnes (93% of the catch limit).

3.148 The stock of toothfish in Subarea 88.1 and SSRUs 882A–B was assessed using a revised CASAL assessment as described by WG-FSA-13 (Annex 6, paragraph 4.68). The assessment incorporated a revised maturity ogive for males and revised data-weighting procedures. In addition, an alternative data selection method had been employed.

3.149 The Scientific Committee supported the advice of WG-SAM-13 (Annex 4, paragraphs 3.25 and 3.26) that the sub-adult survey be continued with a catch limit of 43 tonnes allocated from the Ross Sea shelf catch limit in 2013/14. The Scientific Committee further recommended that the depth shift parameters should be omitted from future assessments as described in Annex 6, paragraph 4.71, and that length-based tag mortality, as applied for *D. eleginoides* in Subarea 48.3, be investigated as a sensitivity.

3.150 The Scientific Committee recommended that the catch limit for *Dissostichus* spp. in Subarea 88.1 should be set at 3 044 tonnes for 2013/14 and 2014/15, based on the outcome of the assessment.

D. mawsoni in SSRUs 882A–B

3.151 The Scientific Committee recalled the agreement in 2012 that SSRU 882A could potentially be opened and managed as part of the Ross Sea fishery (SC-CAMLR-XXXI, paragraph 9.30), and the advice of WG-FSA to provide a mechanism by which this advice could be implemented (Annex 6, paragraphs 4.74 to 4.81).

3.152 The Scientific Committee recalled that because toothfish in SSRU 882A are considered part of the larger Ross Sea region stock, the objectives for this research are not the same as would be the case for design of research fishing in a data-poor area lacking a robust stock assessment. Tag releases and recaptures remain central to the success of this research, but the primary aim is to better understand toothfish movement and distribution relative to the remainder of the Ross Sea stock, rather than to simply estimate local abundance (Annex 6, paragraphs 4.77 and 4.78). Nonetheless, WG-FSA felt that the design for research fishing in this SSRU could productively follow the example of the framework for designing research in the data-poor fisheries. To this end, a research block was defined around the area in which 146 tags were released during research fishing in 2011 and 2012, of which 95 were estimated to be still available for recapture in 2014. Applying the CPUE analogy method results in an estimated local biomass of 1 410 tonnes within the research block; a catch limit of 60 tonnes inside the block corresponds to a local exploitation rate of 4.3%.

3.153 Outside the research block, the CPUE analogy method results in a local biomass estimate of 10 286 tonnes at the scale of the entire SSRU. Applying the SPM (as in SC-CAMLR-XXXI, paragraph 9.31), the CPUE-derived estimate was discounted by 17% (the

proportion of the biomass in this SSRU estimated to occur in the north) resulting in an estimate of 7 117 tonnes in SSRU 882A south (i.e. on the shelf and slope, south of 73°S). The catch limit proposed in WG-FSA-13/13 was 286 tonnes, corresponding to an exploitation rate of 4.0% at the scale of the SSRU 882A south, which was judged to be appropriate by WG-FSA-13.

3.154 Drs L. Pshenichnov (Ukraine) and Petrov welcomed this as the first step in many years to re-open SSRUs that had previously been closed. Dr Petrov further noted the constructive efforts of all of the participants of WG-FSA on this issue and considered this to be a very positive development for the future of the Ross Sea fishery.

3.155 The Scientific Committee recommended the following as an appropriate basis for research fishing in SSRU 882A:

(i) A maximum catch of 60 tonnes would apply inside a research block (76.647S to 75.790S, and 169.660W to 166.967W) that bounds an area in which around 146 tagged fish were released during research in 2010/11 and 2011/12. Fish should be tagged at a rate of three fish per tonne. No limit on the spatial separation of sets would apply.

(ii) A maximum catch of 226 tonnes could be taken from the remaining area of SSRU 882A south (i.e. south of 73°S). All lines should be separated by a minimum of 5 n miles (for each individual vessel) and fish should be tagged at a rate of three fish per tonne.

(iii) All catches taken both inside and outside the research block are part of the Ross Sea slope catch limit (SSRUs 881H, I, K). Uncaught portions of catch limits in SSRU 882A south can be taken from elsewhere in SSRUs 881H, I, K.

(iv) The research design and associated maximum catches should apply for two years. The results will be evaluated and further research will be conditional on the results of the evaluation and on the suitability of the data for inclusion in the 2015 stock assessment and management advice.

3.156 The Scientific Committee noted the potential that opening SSRU 882A could change the spatial distribution of fishing in the Ross Sea and that this could have consequences for the proposed MPA in this region.

3.157 The Scientific Committee noted the primary aim of fishing within the research block is to recapture tagged fish that were released in 2010/11 and 2011/12, as well as other tags potentially indicative of fish movements from other areas.

3.158 The Scientific Committee noted the primary aim of fishing outside of the research block is to provide information on the distribution and movement of fish in the Ross Sea region, in particular the movement from SSRU 881K where more than 6 500 fish have been tagged since 2001.

3.159 The Scientific Committee noted that the stated objective of research in this area was to provide additional data to improve stock assessment and management and emphasised the importance of achieving a high tag overlap and conducting the tagging of fish in accordance with the guidelines described in WG-FSA-13/49. The Scientific Committee also encouraged

all Members to undertake biological sampling at a higher frequency in these areas, including toothfish otoliths and to contribute to the development of annual ALKs and to ensure that data are of the highest quality.

3.160 The Scientific Committee noted that catch limits for the Ross Sea region are managed under two conservation measures (CMs 41-09 and 41-10) and recommended that the boundary between Subareas 88.1 and 88.2 be revised or that the scope of CMs 41-09 and 41-10 be revised such that the Ross Sea Region (Subarea 88.1 and SSRU 882A–B) is managed within a single conservation measure.

Dissostichus spp. in Subarea 88.2

3.161 Six Members and 12 vessels fished in the exploratory fishery in Subarea 88.2 between December 2012 and February 2013. In 2012/13, the catch limit for *Dissostichus* spp. was 530 tonnes. The fishery was closed on 13 February and the total reported catch of *Dissostichus* spp. was 476 tonnes (90% of the catch limit). The following SSRUs were closed during the course of fishing (CCAMLR-XXXII/BG/06 Rev. 1):

- SSRUs C, D, E, F and G closed on 13 February 2013 with a total catch of 118 tonnes (95% of the catch limit)
- SSRU H closed on 2 February 2013 with a total catch of 358 tonnes (88% of the catch limit).

3.162 The CASAL assessment model used to assess the stock is described by WG-FSA-13 (Annex 6, paragraphs 4.84 to 4.86). The data selection method described in WG-SAM-13/34 was used to select data for inclusion in the model. The Scientific Committee noted that in 2012 it endorsed advice that this method was a powerful and useful analytical approach and should be used to develop a data-quality selection algorithm to select trips for use in the Ross Sea assessments, with the actual selection criteria to be developed for discussion at WG-SAM-13 (SC-CAMLR-XXXI, paragraph 3.167 and Annex 7, paragraph 5.165). WG-SAM-13 recognised that because the vessel selection imposes a binary distinction (inclusion or exclusion of the vessel data) based on a continuous index, the particular choice of the selection criteria is subjective, and recommended further development to estimate the relationship between the tagging mortality and tag detection indices (Annex 4, paragraph 4.6). However, the Scientific Committee further noted that WG-SAM had been unable to reach agreement on the mechanism or threshold to be applied in the implementation of that method (Annex 4, paragraph 4.8).

3.163 The Scientific Committee noted that WG-FSA had been unable to reach agreement on management advice for catch limits in Subarea 88.2 but had provided three options (Annex 6, paragraph 4.89).

3.164 At the time of text adoption, Dr Pshenichnov requested that catch limits for Subarea 88.1 be reviewed in 2014.

3.165 The Scientific Committee noted that all of the tag data included in the assessment (WG-FSA-13/52) came from the north and that exploitation of the stock in this region has been concentrated around specific seamounts. As a consequence, recent changes in biomass,

as estimated in the model, may represent only the localised biomass and dynamics of the stock at these locations in the northern area (SSRU 882H) and may not be representative of the population over the whole region (SSRUs 882C–H) (Annex 6, paragraph 4.87).

3.166 The recent increase of between-season tag recaptures from SSRU 882H, and reduced weighting given to the catch-at-age data in the model, resulted in a lower estimate of yield (266 tonnes) compared to the estimate of yield from the 2011 assessment (530 tonnes). The high incidences of within-season recaptures for this SSRU (not currently used in the assessment model), the decline in standardised CPUE and truncation in the age structure all provide further evidence that there has been some level of localised depletion in this SSRU.

3.167 The Scientific Committee also noted that few tags had been recaptured from the southern area (SSRUs 882C–G) and that fishing there has been conducted on an intermittent basis and not in spatially consistent locations. It requested WG-SAM to consider how an assessment of stock abundance can be developed for this southern area.

3.168 The Scientific Committee identified three options for management advice but was unable to achieve consensus:

Option 1 – To apply a catch limit of 266 tonnes across all SSRUs (882C–H)

Option 2 – To apply a catch limit of 266 tonnes to the northern area (SSRU 882H) and, as in 2012/13, to apply a catch limit of 124 tonnes for the southern area (SSRUs 882C–G)

Option 3 – To apply the management measures that had applied in 2012/13 – which equalled a catch limit of 406 tonnes in the northern area (SSRU 882H) and a catch limit of 124 tonnes for the southern area (SSRUs 882C–G).

3.169 The Scientific Committee recommended that this assessment be reconsidered by WG-SAM-14 with specific consideration of the potential for localised depletion and tag mixing and stock identity. The Scientific Committee also recommended that all Members contribute, where possible, to the development of annual ALKs. In particular, Norway, Russia and the UK were identified as nations that may have historic otolith samples that could be aged. The Scientific Committee recalled the recommendation of the Ageing Workshop for *D. eleginoides* and *D. mawsoni* (SC-CAMLR-XXXI, Annex 7, paragraph 10.13) that intercalibration of otolith readings should be conducted.

Data-poor fisheries

Progress in developing assessments in data-poor exploratory fisheries

3.170 The Scientific Committee considered general progress on research in data-poor exploratory fisheries reported by WG-SAM (Annex 4, paragraphs 2.1 to 2.8) and WG-FSA (Annex 6, paragraphs 6.1 to 6.28). The Scientific Committee endorsed the specific advice in Annex 4, paragraph 2.7, and agreed that the accompanying diagram in Figure 1 usefully summarises advice to date. The Scientific Committee agreed that this advice describes an excellent process to guide research to achieve stock assessments in data-poor areas.

3.171 The Scientific Committee noted that development of the framework for data-poor fisheries has been a very labour-intensive process within WG-SAM and WG-FSA since 2011 when CCAMLR first undertook to provide scientific advice to guide research in data-poor fisheries (SC-CAMLR-XXX, Annex 5, paragraphs 2.1 to 2.44). The Scientific Committee agreed that this process now provides a rigorous and transparent roadmap by which proposals for research fishing may be developed, evaluated and annually updated, subject to the advice of CCAMLR's scientific working groups, to ensure that catch limits are precautionary while providing sufficient information to develop stock assessments in a reasonable time period. The Scientific Committee recognised that in some data-poor areas, research plans developed under this process had already yielded substantial progress toward the development of stock assessments, and that the advice this year was sufficiently developed that in future the evaluation of research plans in data-poor fisheries would likely constitute a much smaller workload within the working groups, requiring only minor adjustments on an annual basis consistent with the process already developed, at least until substantially more data is available to inform modification or expansion of the research designs.

3.172 The Scientific Committee discussed the application of by-catch move-on rules and line separation rules in the context of research plans (SC-CAMLR-XXXII/07 Rev. 1, paragraphs 6.7 to 6.10). The Scientific Committee agreed that by-catch should not unduly impede research implementation in the short term but that cumulative impacts on by-catch species should also be considered in the longer term as research proceeds toward the development of assessed fisheries.

3.173 The Scientific Committee recommended that paragraph 5 from CM 33-03 should continue to apply to research in data-poor fisheries with a 1 tonne threshold except where another threshold had already been agreed.

3.174 The Scientific Committee noted that WG-FSA had recommended that paragraph 6 from CM 33-03 should no longer apply to research and data-poor fisheries. However, Dr Watters could not support the recommendation because more research on the cumulative impacts of *Macrourus* by-catch in data-poor fisheries is needed. Therefore, the Scientific Committee did not endorse this recommendation.

3.175 The Scientific Committee endorsed the advice of WG-FSA that current line-separation rules in CM 41-01 should continue to apply and should apply separately per vessel and per season.

3.176 The Scientific Committee noted advice regarding appropriate application of biomass estimation methods, appropriate reference areas for use in CPUE analogy method, and estimating 'effective' tags available for recapture for use in Petersen estimators (Annex 6, paragraphs 6.11 to 6.18). The Scientific Committee recommended that Members further develop these methods to more explicitly represent uncertainty regarding estimated biomass and expected numbers of tag recaptures.

3.177 The Scientific Committee noted that several Members requested flexibility in their research for situations when ice restricted access to research blocks, and agreed that research in Antarctic waters was always challenging and that contingencies for bad ice years are a

necessary part of any research plan. However, it also noted that ice charts included in the research proposals indicated that the research blocks were ice free in most years, and that there were several research blocks in each of the areas where research was being proposed which should allow for some variation in ice conditions between years.

3.178 The Scientific Committee suggested that research fishing could be extended to include those fine-scale rectangles immediately adjacent to the existing research block if the research block was partially covered by ice (Annex 6, paragraphs 6.19 to 6.21).

3.179 While recognising that the ability to extend fishing to adjacent fine-scale blocks does provide some flexibility, some Members noted that during 2012/13 vessels from Japan and the Republic of Korea were able to occupy only one of the research blocks in SSRUs 5841C, 5841E and 5842E due to adverse ice conditions (Annex 6, paragraph 6.53) and that these vessels thereby incurred substantial costs.

3.180 Flexibility in fishing location (i.e. fishing outside the specified research blocks) in years of severe ice conditions was requested by some Members. The Scientific Committee noted that the following three points are relevant to this request:

(i) the primary objective of research in data-poor areas is to collect data that will lead towards a stock assessment

(ii) fishing outside the research blocks would provide very little useful additional information on stock abundance for the targeted blocks, but could provide additional information on stock structure and biological parameters, which are also required for a stock assessment in the short to medium term (SC-CAMLR-XXX, Annex 5, paragraphs 2.27 to 2.29)

(iii) additional flexibility in fishing outside the specified research blocks is being requested for mainly operational reasons.

3.181 Given the three points listed in the preceding paragraph, the Scientific Committee concluded that the request for additional flexibility is a matter for the Commission.

3.182 The Scientific Committee noted that Annex 6, paragraphs 6.19 to 6.21 and 6.53, are also relevant to this topic.

Advice on catch limits

3.183 The Scientific Committee discussed the process by which advice on precautionary catch limits was developed within research blocks, consistent with the framework for data-poor fisheries, including the use of alternate plausible biomass estimates to represent uncertainty, and evaluation of appropriate catch limits with reference to precautionary local exploitation rates, expected tag recaptures and the proportion of fishable area over which research fishing is occurring at the scale of each SSRU (Table 4; Annex 6, paragraphs 6.23 to 6.27). The Scientific Committee agreed that the process summarised in Table 4 provided a transparent and objective basis by which to evaluate the appropriateness of different catch limits despite uncertainty, and should be updated on an annual basis as biomass estimates improve.

3.184 The Scientific Committee discussed the extent to which advice on catch limits was affected by the 'status quo', i.e. catch limits in place in the previous season. The Scientific Committee recalled that while there may be operational benefits to achieving consistency between years, status quo catch limits were sometimes agreed in the absence of scientific advice. The Scientific Committee noted that, where consistency with previous catch limits was considered in catch-limit discussions at WG-FSA, these catch limits were evaluated scientifically to ensure that they were within the appropriate range as described in Annex 6, paragraphs 6.23 to 6.27.

3.185 The Scientific Committee endorsed the research catch limits in Tables 4 and 5 as management advice for research fishing in data-poor fisheries in the 2014 season. Research block boundaries and locations are shown in Figure 2. Discussions pertaining to individual subareas or divisions are described below.

Subarea 48.6

3.186 Notifications were received from Japan, South Africa and Ukraine for research in Subarea 48.6. Japan and South Africa had conducted research in 2013 based on a similar design. The notification from Ukraine was not accompanied by a research plan.

3.187 The Scientific Committee congratulated Japan and South Africa for successfully collaborating to carry out research in Subarea 48.6, and encouraged Members to consider developing multi-Member research plans in other data-poor fisheries.

3.188 The Scientific Committee discussed appropriate mechanisms to manage catches of *D. eleginoides* in the north of Subarea 48.6 (research blocks a and b) where they are mainly caught as a by-catch species of *D. mawsoni*, recalling Annex 6, paragraph 6.48, regarding management of mixed-species toothfish fisheries more generally. Members recalled the development of stock assessments for mixed toothfish species in Subarea 48.4 (paragraph 3.90).

3.189 The Scientific Committee noted that WG-FSA-13 had not achieved consensus regarding catch limits for *D. eleginoides* in these research blocks, suggesting a range of 14 to 28 tonnes depending on which biomass estimate was used.

3.190 Dr K. Taki (Japan) stated that he believed that the biomass estimate for *D. eleginoides* in this area derived from the CPUE analogy method (using CPUE in which the catch intention of the vessel was considered rather than when *D. eleginoides* was caught as by-catch; see WG-FSA-13/63) was the more accurate estimate of biomass. He felt that the biomass obtained by the Petersen estimator was likely to be biased low, because it was applied across both research blocks (a and b) despite six of seven tag recaptures having occurred in research block b where *D. eleginoides* is primarily caught as a by-catch species (see also Annex 6, paragraphs 6.41 to 6.43). On this basis Dr Taki suggested a catch limit of 28 tonnes for *D. eleginoides* in research blocks a and b.

3.191 The Scientific Committee suggested that to aid WG-FSA in evaluating the potential for such bias in future years, Japan and South Africa could submit a characterisation of spatial and temporal patterns of tagged *D. eleginoides* releases and recaptures in Subarea 48.6.

3.192 The Scientific Committee endorsed 28 tonnes as a catch limit for *D. eleginoides* in Subarea 48.6 research blocks a and b.

3.193 The Scientific Committee did not achieve consensus regarding a catch limit for *D. mawsoni* in research block d. Some Members suggested 100 tonnes based on application of the method described in Annex 6, paragraphs 6.24 to 6.27, corresponding to an estimated local exploitation rate of 4%. Other Members recommended the status quo catch limit of 150 tonnes. These Members felt that the fact that no tags were recaptured in the 2013 season, despite the expectation of approximately 15 recaptures using the biomass estimated in Table 4, suggested that either the actual biomass was much higher or that fish in this area were highly mobile, and therefore the actual exploitation rate would be lower.

3.194 The Scientific Committee discussed the potential use of electronic pop-up tags in toothfish research, to address hypotheses regarding toothfish movement, recalling WG-FSA-11/49.

3.195 The Scientific Committee recommended that the catch limit for *D. mawsoni* in research block 48.6d should be either 100 or 150 tonnes (Annex 6, paragraphs 6.45 to 6.47).

3.196 The Scientific Committee endorsed the following catch limits for *D. mawsoni* in research blocks in Subarea 48.6:

48.6b:	170 tonnes
48.6c:	50 tonnes
48.6e:	190 tonnes.

3.197 The Scientific Committee recalled that estimates of biomass, exploitation rates and expected tag recaptures arising from the CPUE analogy method are highly uncertain but that statistical estimates of variance are currently not available, because much of that uncertainty arises from structural assumptions regarding the choice of appropriate reference area rather than simply statistical uncertainty (Annex 6, paragraph 6.18). It was important to remember that estimates derived from these methods are indicative only, and that precaution is maintained by considering multiple plausible biomass estimates where more than one method is available, by applying precautionary exploitation rates, and/or by applying these methods only over a portion of the fishable area at the scale of a stock or SSRU (Annex 6, paragraphs 6.23 to 6.28).

Divisions 58.4.1 and 58.4.2

3.198 A notification was received from Spain for research in Division 58.4.1. Research was conducted in 2013 under a similar design.

3.199 The Scientific Committee supported the continuation of research by Spain utilising a combined depletion experiment and tag recapture approach in Division 58.4.1. The Scientific Committee endorsed the following catch limits to be set aside for this research in 2013/14:

5841C: 42 tonnes
5841D: 42 tonnes
5841G: 42 tonnes
5841H: 42 tonnes.

3.200 Research notifications were also received from Japan and the Republic of Korea for Divisions 58.4.1 and 58.4.2. Both Members had conducted research in 2013 based on a similar design, with useful supplemental information provided in the updated proposals (Annex 6, paragraphs 6.53 and 6.55).

3.201 The Scientific Committee noted that interpretation of data in these areas was potentially affected by assumptions regarding the explanation for anomalous CPUE data (paragraphs 3.226 and 3.227) and that Members using data in this area should be explicit regarding how this data is used.

3.202 The Scientific Committee endorsed the continuation of this research with the following catch limits assigned to individual research blocks:

58.4.1C-a: 125 tonnes
58.4.1C-b: 90 tonnes
58.4.1E-a: 280 tonnes
58.4.1E-b: 35 tonnes
58.4.1G: 26 tonnes
58.4.2E: 35 tonnes.

3.203 The Scientific Committee noted that research catch limits for the depletion experiment by Spain are independent of those assigned to research blocks, but that in SSRU 5841G both types of research are potentially occurring in the same area. The Scientific Committee noted that the review of the results next year will be important for evaluating the estimates of local biomass from tag-recapture experiments on the Antarctic continental shelf in a comparison with estimates from a Leslie depletion experiment.

Division 58.4.3a Elan Bank

3.204 Notifications were received from France and Japan for research in Division 58.4.3. Both Members conducted research in 2013 based on a similar design.

3.205 The Scientific Committee endorsed the continuation of this research consistent with the advice of WG-FSA, including a requirement that each vessel set a minimum of five research sets, separated by at least 3 n miles, east of the 70°E meridian, after which research sets, as defined in CM 41-01, can continue within the research block defined in 2012. The Scientific Committee further recommended that a minimum of 10 tonnes be made available to each vessel (Annex 6, paragraphs 6.68 and 6.69).

3.206 Recalling previous advice regarding high by-catch rates and mortality of skates in the 2012 season (SC-CAMLR-XXXI, Annex 7, paragraph 8.19 to 8.26) on board the French vessel, the Scientific Committee recommended the following measures be applied on board the French vessel: continued application of a by-catch move-on rule, requirement to release alive all skates with a high likelihood of survival and restrictions on maximum soak time

(Annex 6, paragraphs 6.63 to 6.65). The Scientific Committee requested that, to provide a basis for evaluating the effect of soak time on skate condition, France consider conducting an experiment to collect data on the condition of skates across a range of depths and soak times in an analogous area such as in Subarea 58.6, and provide an analysis to the next meeting of WG-FSA.

3.207 The Scientific Committee recommended that an updated biomass estimation and integrated assessment be prepared and presented at WG-FSA-14 by the research proponents.

3.208 The Scientific Committee endorsed the continuation of this research with a catch limit of 32 tonnes.

Subarea 48.2

3.209 A notification was submitted by Ukraine for research in Subarea 48.2.

3.210 The Scientific Committee recalled discussions at WG-FSA that the notification was not accompanied by a fully developed research plan corresponding to the recommended format and content as described in paragraphs 3.170 and 3.171, and had not fully taken into account all the concerns raised by WG-SAM (Annex 6, paragraphs 6.70 to 6.79).

3.211 The Scientific Committee recalled that tagging performance is very important for research in data-poor areas, and that research proponents are encouraged to achieve tag-overlap statistics as high as possible, not merely in excess of the 60% minimum statistic required under CM 41-01, noting that in 2013 most vessels had achieved overlap statistics in the range of 70–90% (Annex 6, Table 8). The Scientific Committee expressed concern at the low tag-overlap statistic (43%) of the Ukrainian vessel *Simeiz* in the Ross Sea fishery last year (Annex 6, Figures 8 and 9).

3.212 The Scientific Committee noted that a tag-overlap statistic of 43% is also a matter for SCIC.

3.213 Dr Pshenichnov made the following statement:

> ‘We have noted the unsatisfactory results achieved for tag overlap by fish size on the *Simeiz* last season and the errors made in the approach to this matter. The captain of the vessel will be replaced next season. The crew and the national observer were given special training with an emphasis on the correct technique for bringing undamaged, large fish on board for tagging. In the upcoming season we intend to significantly exceed the requirements for tag overlap by fish size.’

3.214 Some Members felt that the proposal had been filled out in the proper format, had contained sufficiently detailed content, and had followed the approved research design and process for research in the prospecting phase. These Members felt that evaluation of research proposals submitted under CM 24-01 should not be used to deny research notifications, because this could generate a risk that research would become limited to only a subset of CCAMLR Members.

3.215 Other Members felt that the research proposal was insufficiently developed and should be further developed and resubmitted next year. Recalling several years in which no progress had been made toward stock assessments in data-poor areas when research plans were not required and tagging performance was poor, these Members felt that the research design described in this proposal and using this vessel was unlikely to produce information leading to an assessment. These Members recalled that during the WG-SAM and WG-FSA meetings, many Members had worked collaboratively together to improve the standard of all research proposals, and this process did not constitute a risk that research would become exclusive to only some Members.

Subarea 48.5 Weddell Sea

3.216 A notification was received from Russia for three different options for research in Subarea 48.5. Russia conducted research in 2013 in the areas described under option 1.

3.217 The Scientific Committee noted that the research design in option 1 was modified in response to advice from WG-SAM and during the course of WG-FSA to include both a research block in previously fished locations in option 1, and additional prospecting phase sets under all three options.

3.218 The Scientific Committee endorsed this research to continue in 2014 as described in Annex 6, paragraphs 6.86 to 6.88, with catch and effort limits as follows:

Option 1 inside research block: 60 tonnes, with 50% of lines separated by a minimum of 3 n miles.

Option 1 outside research block: a maximum of 40 longline sets of not more than 3 600 hooks per set, and each set separated by a minimum of 5 n miles. In addition, a maximum catch of limit of 213 tonnes shall apply.

Option 2: a maximum of 40 longline sets of not more than 3 600 hooks per set, and each set separated by a minimum of 5 n miles. In addition, a maximum catch of limit of 48 tonnes shall apply.

Option 3: a maximum of 80 longline sets of not more than 3 600 hooks per set, and each set separated by a minimum of 5 n miles. In addition, a maximum catch of limit of 112 tonnes shall apply.

3.219 The Scientific Committee noted that there was some discussion on the suitability of the survey area specified in option 3 due to concerns of vessel safety and the perceived limited opportunity to undertake multi-year research. The Scientific Committee recalled advice with respect of ice conditions contained in the report of WG-FSA-12 (SC-CAMLR-XXXI, Annex 7, paragraphs 5.105 and 5.106).

3.220 The Scientific Committee noted that the implementation of the three options was not guaranteed in any particular year due to unpredictable ice. The Scientific Committee agreed that the order of priority for completion of this research in 2014 was first the research block in option 1, then the prospecting sets in option 1, and last the completion of options 2 and 3. The Scientific Committee agreed that if ice conditions were favourable, then all three options

could be completed in a single year. It also agreed that should sea-ice be unfavourable in option 1, then the sequence of research could be changed with the intention that option 1 would be completed before the end of the season if possible.

Divisions 58.4.4a and 58.4.4b Ob and Lena Banks

3.221 A notification was received from Japan for research in Divisions 58.4.4a and 58.4.4b SSRUs C and D. Japan has conducted research in this area since 2008.

3.222 The Scientific Committee agreed that Japan's research on Ob and Lena Banks provides a very positive example of how research can be planned and conducted successfully under the agreed framework for research plans in data-poor fisheries. The Scientific Committee recalled that this framework was developed and refined in large part by adopting and refining practices and methods first employed by the proponents of this research, in particular the use of a rigorous mechanism by which fishing effort is spread throughout the area of the research block to avoid spatial bias in tag recaptures. The Scientific Committee agreed that this research provides a clear example for others to follow of the progression of research in data-poor fisheries through the stages of the flowchart in Figure 1, and may soon make the transition to exploratory fishery with a robust stock assessment. The Scientific Committee discussed mechanisms by which this might happen in the near future, recalling the example of the regulatory framework (SC-CAMLR-XVIII, paragraphs 7.1 and 7.11 to 7.23).

3.223 The Scientific Committee encouraged Japan to note the advice of WG-FSA-13 (Annex 6, paragraph 6.93) to improve its stock assessment for this area to facilitate this process.

3.224 The Scientific Committee endorsed this research to continue in the 2014 season with a catch limit of 25 tonnes in SSRU C and 35 tonnes in SSRU D. Accordingly, the total catch limit for combined SSRUs C and D is 60 tonnes. The Scientific Committee also agreed that in 2013/14, the *Shinsei Maru No. 3* would first complete research sets in each grid square as in 2012/13, and then be able to fish anywhere within the research block until the research catch limit is reached.

Division 58.4.3b BANZARE Bank

3.225 The Scientific Committee discussed the status of Division 58.4.3b which under CM 41-07 has had a catch limit of 0 tonnes for several years with no research having been conducted since 2012. Some Members felt that the area could be declared a closed fishery. Other Members felt that future research in this area was a high priority and the current status should be maintained (see also paragraph 3.146).

Anomalous catch data

3.226 The Scientific Committee noted the discussion by WG-SAM-13 on potential hypotheses to account for the anomalous pattern in observed catch data provided from three

Insung Corporation vessels fishing in Divisions 58.4.1 and 58.4.2 and Subarea 48.6 from 2009 to 2011, including the results of a Korean Government workshop held in Busan, Republic of Korea (Annex 4, paragraphs 4.17 to 4.24). In particular, it noted the request by WG-SAM-13 for Members to consider ways to evaluate hypotheses or propose alternative hypotheses to help understand the patterns of catch and effort reported.

3.227 The Scientific Committee recalled the advice of WG-FSA-12 (SC-CAMLR-XXXI, Annex 7, paragraph 5.11) that it was not possible to explain the anomalous characteristics of the CPUE data from the three Korean vessels at this time, and that such data collected on these vessels should not be used in stock assessments for CCAMLR. It noted that these CPUE data had been omitted from all the calculations conducted by WG-FSA-13 to determine catch limits for 2013/14 in data-poor fisheries.

3.228 The Scientific Committee noted that WG-FSA agreed that all data, including tagging data, collected on these vessels in the years with anomalous CPUE data should be flagged as not suitable for analysis and had recommended that all data collected on the *Insung No. 22* in 2009, *Insung No. 2* in 2010 and *Insung No. 7* in 2011 should be flagged accordingly (SC-CAMLR-XXXI, Annex 7, paragraph 5.11). The Scientific Committee noted that there had been no change in the advice of WG-FSA this year.

3.229 Some Members noted that both VMS and standardised catch information were useful and that further analysis of these data should be encouraged. They recalled the analyses presented in WG-FSA-13/57 Rev. 1 in which two additional hypotheses (area misreporting and catch misreporting) were identified to try to explain the anomalous patterns in observed CPUE.

3.230 The Scientific Committee noted Annex 6, paragraph 3.11, in which some Members had recommended that an examination of the correspondence between VMS data and reported fishing locations for the vessels in question would be useful in evaluating the patterns reported in this regard and that this should be undertaken by the Secretariat for further review by the Scientific Committee and/or by SCIC.

3.231 Mr S. Lim (Republic of Korea) made the following statement:

> ‘On this issue we would like to register a reservation regarding the appropriateness of passing the issue to SCIC. Considering that we cannot come up with any conclusion, it is expecting too much for SCIC to deal with this issue without convincing information, including scientific information, giving too much burden to SCIC.’

3.232 The Scientific Committee’s attention was drawn to Part 2(vi) of the SCIC terms of reference for open communication between the Scientific Committee and SCIC.

3.233 No consensus was achieved, but this important procedural issue was referred to the Commission.

3.234 The Scientific Committee discussed the issue of whether the data related to the anomalous CPUE events should continue to be flagged within the CCAMLR database. The Scientific Committee agreed that it was important that all data associated with anomalous CPUE continue to be made available to scientists and recommended that the data remain in

the database but should be flagged in such a way that they can be identified from other data. Flags should identify links to the relevant paragraphs of CCAMLR reports and specifically to Annex 6, paragraphs 3.9 to 3.15.

3.235 Dr I. Yeon (Republic of Korea) noted that there was no clear advice on how the CPUE data should be used and that it should be the decision of individual scientists whether the data in question are included in their analyses or not and that the consequences of omitting data should be considered.

3.236 Dr Yeon further noted that only one or two vessels had fished in the area each year and that there were insufficient data to conduct a thorough analysis.

3.237 Some Members noted that the statistical tests applied in the analysis of the anomalous CPUE data would indicate whether there was insufficient information to detect a significant difference between vessels. The significance of the difference between the CPUE data collected by the In Sung vessels and that of other fishing vessels would be even greater, if more data were available for the analysis.

INCIDENTAL MORTALITY ARISING FROM FISHING OPERATIONS

Incidental mortality of seabirds and marine mammals associated with fisheries

4.1 During 2012/13 the total extrapolated incidental mortality of seabirds in all longline fisheries in the Convention Area was 141 seabirds. Incidental catches of seabirds in the French EEZs have decreased by around 90% since 2007/08. There were two reported mortalities of southern elephant seals hooked/entangled in Division 58.5.2.

4.2 Prof. Koubbi advised the Scientific Committee that France is continuing its efforts to reduce bird catches by enforcing regulations in place and by increasing mitigation measures on board vessels. He proposed that ACAP reports catches from other areas to CCAMLR.

4.3 The ACAP Observer to SC-CAMLR, Mr W. Papworth, commended France for its excellent results and provided a brief report on progress in RFMOs adjacent to CCAMLR. He reported that all of these RFMOs now have seabird conservation measures that require the use of two of the three by-catch mitigation measures recommended by ACAP; the challenge now is to have these conservation measures implemented. The adoption of electronic monitoring is one way of ensuring this, particularly given the low level of 5% observer coverage in these fisheries. He encouraged Members of the Scientific Committee participating in other commissions to encourage adoption of e-monitoring on board vessels operating outside CCAMLR waters. He added that ACAP is also developing, in collaboration with the National Research Institute of Far Seas Fisheries of Japan, a seabird identification guide based on photos of dead seabirds and sought feedback from CCAMLR observer programs.

4.4 The Scientific Committee agreed that this would be useful and requested the Secretariat to circulate the guide to relevant observer programs for their input.

4.5 The Scientific Committee noted that on the basis of the low risk of seabird mortality, the season extensions in Division 58.5.2 and Subarea 48.3 should be allowed (Annex 6,

paragraphs 9.8 and 9.9) and that WG-FSA should assess the impact of these extensions during the next meeting. The extensions would have the same conditions as previous extensions, including a by-catch limit of three seabirds per vessel.

4.6 The Scientific Committee noted the report on marine debris and entanglements at Bird Island and King Edward Point, South Georgia, Signy Island, South Orkney Islands and Goudier Island submitted by the UK. Results indicate that there has been no change in the interannual trend (either up or down) and that the occurrences of debris and entanglements for the current year remain low.

4.7 Prof. O. Pin (Uruguay) informed the Scientific Committee that Uruguay has collected marine debris data over the past years on King George Island and no annual trend was observed. He noted that IUU fishing had not been detected in Subarea 48.1 in recent years. He also noted that it is difficult to extrapolate these marine debris data to other areas and encouraged Members to participate in data collection.

4.8 The Scientific Committee requested that the Secretariat continue to submit an annual report summarising the data on marine debris and entanglements held in the CCAMLR database. These data may also be displayed on the new web-based GIS.

SPATIAL MANAGEMENT OF IMPACTS ON THE ANTARCTIC ECOSYSTEM

Bottom fishing and vulnerable marine ecosystems

5.1 The Scientific Committee noted the discussions at WG-FSA-13 in relation to the relative by-catches of taxa associated with VMEs by autolines and Spanish longlines in the Ross Sea (Annex 6, paragraphs 7.1 to 7.8).

5.2 The Scientific Committee acknowledged that assessing the different risks to VME taxa associated with longlines, whether they be trotlines, autolines or Spanish longlines was complex, as the different gear types interacted with the seabed and associated benthos in different ways. The Scientific Committee also recognised that a percentage of those VME taxa that were caught on longlines may be lost as lines were hauled to the surface, thereby further complicating any assessments of longline impacts. It also noted that the manner in which different fishing captains hauled their lines, especially the lateral movement of lines, may further complicate assessments. Consequently, the Scientific Committee agreed that robust quantitative assessments of the impacts of longlines on benthic taxa would benefit from further detailed consideration.

5.3 The Scientific Committee recalled the Workshop on VMEs in 2009 (SC-CAMLR-XXVIII, Annex 10) and that the last time it had considered the impacts of longlines on VMEs was in 2010 (SC-CAMLR-XXIX, paragraphs 5.5 to 5.8). Since then, there have been important advances in technology (e.g. recent advances in video technology and in situ observation) which would merit further evaluation. The Scientific Committee noted that some elements of deliberations pertaining to longline impacts on benthic taxa were relevant for both WG-EMM and WG-FSA to consider in the future.

5.4 The Scientific Committee recalled that it adopted a standardised bottom fishing impact assessment method in 2010, and that cumulative impact assessments for all bottom longline

vessels in areas subject to CMs 22-06 and 22-07 are carried out routinely by the Secretariat using automated software (SC-CAMLR-XXX, paragraph 5.4). The Scientific Committee recalled its advice (SC-CAMLR-XXIX, paragraph 5.8) that because the impact assessment method is currently only parameterised for autoline longlines, Members should complete method assessments for Spanish longlines, trotlines, pots and trawls. For longlines and pots this will likely require direct observation of line movements, e.g. using tethered cameras (Annex 6, paragraph 7.4) but for trawls these estimates are relatively straightforward because the width of the trawl footprint is known.

5.5 The Scientific Committee recalled that bottom trawl fisheries also have the potential to have major impacts on VMEs. It recognised that modifications to different bottom trawl gear types meant that certain gear types are somewhat less destructive than other types of bottom trawling gear, but that, in general, this type of fishing gear represents a risk to VMEs. The Scientific Committee noted that it was important to develop and follow 'best practice' methods throughout CCAMLR fisheries as quickly as possible so that impacts on VMEs are minimised.

5.6 Dr Bizikov recalled that the fishery for *D. eleginoides* in Division 58.5.2 is still carried out using bottom trawls, which are banned elsewhere in the CAMLR Convention Area according to CMs 22-05 and 22-06.

5.7 Some Members emphasised that CMs 22-05 and 22-06 should be valid in any CCAMLR fishery.

5.8 Dr Constable noted that the discussions of CMs 22-05, 22-06 and 22-07 made it clear as to their application within the Convention Area. However, he noted that this did not mean that precautionary ecosystem-based management in Division 58.5.2 did not take account of bottom fishing. He noted that the marine reserve in Division 58.5.2, which excludes commercial fishing, provides representative protection of benthic habitats as part of an integrated approach to managing the marine environment in Division 58.5.2 (Constable and Welsford, 2011; Welsford et al., 2011). Using MPAs in ecosystem-based fisheries management is international best practice, and this was recognised by the MSC and the Monterey Bay Aquarium Seafood Watch Program[1] when they took into account the environmental impacts of bottom fishing in their certification of the toothfish fishery in Division 58.5.2.

5.9 Dr Constable further noted that the marine reserve in Division 58.5.2 was established in 2003, and covers 39% of all benthic habitats in waters shallower than 1 000 m. This reserve has been recently extended to include more habitat types that have been identified through a research and management process that were previously not represented in the MPA. An extensive research program, including participation by fishing industry representatives and the Australian Government, assessing the effects of bottom fishing on benthic habitats is in the final stages and its results will be presented to CCAMLR next year. This research has investigated methods for using cameras attached to fishing gear to estimate the direct effects of bottom fishing gears on benthic habitats, and developed analytical methods to evaluate the current and likely future effects of bottom fishing on benthic habitats. These methods have been applied in Division 58.5.2 and also have potential application elsewhere in the

[1] www.montereybayaquarium.org/cr/cr_seafoodwatch/content/media/MBA_SeafoodWatch_ChileanSeabassReport.pdf, www.msc.org/track-a-fishery/fisheries-search/heard-island-and-mcdonald-islands-himi-toothfish/

Convention Area. Importantly, the conclusion of this work is that bottom fishing, spatial management and marine reserves are entirely consistent with one another within a precautionary ecosystem-based management approach.

5.10 Dr Bizikov noted that protection of VMEs and the sustainability of fisheries are different matters that should not be confused; sustainability of fisheries does not imply that the fisheries are safe for bottom communities. He emphasised that it is impossible to deny the damage done by bottom fisheries on Antarctic VMEs. Damage induced in benthic environments by longlines and traps is of a totally different (smaller) magnitude. The use of bottom trawls is incompatible with the current CCAMLR ecosystem management policy. The fact that bottom trawls are being used in the area where an MPA is established compromises the very idea of MPA policy in CCAMLR's area.

5.11 Some Members expressed concern about continuing the use of bottom trawls in Division 58.5.2 and urged that all countries cease using bottom trawls in any CCAMLR fisheries.

5.12 The Scientific Committee requested that both WG-EMM and WG-FSA consider the potential impacts of bottom trawl methods on VMEs as soon as was practical.

Marine Protected Areas, ASPAs and ASMAs

Domain 1

5.13 The Scientific Committee noted the discussions held at WG-EMM-13 on the preparatory work for the spatial planning for MPAs in Domain 1 (Western Antarctic Peninsula – South Scotia Arc) (Annex 5, paragraphs 3.11 to 3.34).

5.14 The Scientific Committee congratulated Dr Arata for his continuing leadership of work related to the Western Antarctic Peninsula in Domain 1. It noted that considerable amounts of spatial data had now been collated, converted to GIS shapefiles and that appropriate metadata detailing the methods were also complete. The Scientific Committee noted that the GIS shapefiles and metadata would now be circulated to the group of scientists that had contributed the original data in order that the synthesised data could be validated and any errors corrected (Annex 5, paragraph 3.11).

5.15 The Scientific Committee recognised the need for the collated data to be made available to scientists within the CCAMLR community, noting that this was a generic issue for all planning domains (Annex 5, paragraph 3.13). It agreed that data for Domain 1 should be located within a private area of the CCAMLR website accessible only to a CCAMLR subgroup (groups.ccamlr.org).

5.16 Dr Arata informed the Scientific Committee that since WG-EMM, further progress has been made and that Argentina and Chile had undertaken a planning workshop during September 2013. He advised the Scientific Committee that contributions from other Members with data and relevant expertise would be welcomed as part of the planning process for Domain 1.

5.17 The Scientific Committee noted the discussions at WG-EMM-13 on the South Orkney Islands southern shelf MPA (Annex 5, paragraphs 3.18 to 3.32). It recognised that these discussions included consideration of a draft MPA Report for the MPA, noting that the report could subsequently contribute to the broader MPA Report for Planning Domain 1.

5.18 The Scientific Committee endorsed advice from WG-EMM that the draft MPA Report be revised to form three separate documents: a management plan, a research and monitoring plan and an MPA Report (Annex 5, paragraph 3.22), noting that the authors should prepare an SC CIRC encouraging interested individuals to contribute towards the revised version. The Scientific Committee endorsed the suggestion that revisions to the text should be located within a private area of the CCAMLR website accessible to a CCAMLR subgroup (groups.ccamlr.org) (Annex 5, paragraph 3.34).

5.19 The Scientific Committee noted SC-CAMLR-XXXII/08, which introduced a proposal from Norway and the UK outlining the potential need to harmonise the South Orkney Islands southern shelf MPA (CM 91-03) with the general framework for the establishment of CCAMLR MPAs (CM 91-04). The Scientific Committee recognised that CM 91-03 was agreed prior to CM 91-04; it also noted that the South Orkney Islands MPA was the first MPA CCAMLR designated and that such harmonisation may help improve clarity in the designation of future MPAs in the CAMLR Convention Area. It therefore requested that the Commission consider whether such a harmonisation would be of benefit, including the development of a management plan.

5.20 The Scientific Committee also noted that SC-CAMLR-XXXII/08 included a proposal to establish an international collaborative project to provide further spatial management advice for the South Orkney Islands MPA. The Scientific Committee welcomed the initiative, recognising that better understanding is needed to manage the South Orkney Islands MPA, and that such understanding can best be achieved through the implementation of combined research and monitoring across a variety of platforms, including from fishing vessels. It noted that spatial protection proposals are best developed collaboratively and encouraged expert input, data or other contributions from other Members with an interest in the South Orkney Islands MPA.

5.21 The Scientific Committee noted that the proposal in SC-CAMLR-XXXII/08 included development and review of a management plan for the South Orkney Islands southern shelf MPA. It was recognised that this work must be undertaken with the appropriate engagement of the Commission.

Domains 3 and 4

5.22 The Scientific Committee noted the discussions held at WG-EMM-13 on the preparatory work for the spatial planning process for MPAs in Domains 3 (Weddell Sea) and 4 (Bouvet–Maud) (Annex 5, paragraphs 3.4 to 3.9).

5.23 The Scientific Committee welcomed the progress report on the scientific data compilation and analyses carried out by Germany in support of the development of a CCAMLR MPA in the Weddell Sea (SC-CAMLR-XXXII/BG/07). The paper described the boundaries of the planning area, which in addition to MPA Planning Domain 3, includes the

southern parts of Planning Domain 4 to 20°E. The extension of the planning area ensures that the specific oceanographic/ecological conditions and biological communities of the Weddell Gyre system as a whole can be considered as one entity in the data compilation and analyses. The paper reported details of a national German workshop held from 11 to 13 September 2013 which identified the work plan/schedule and the datasets collated so far, including identification of major gaps where further georeferenced data are being sought. The paper also provided details of a planned international workshop, which will be held in April 2014 in Bremerhaven, Germany (the exact date will be communicated in an SC CIRC to be issued in due course), to which scientists and experts from all CCAMLR Members will be invited. The main objectives of this international workshop are to actively engage CCAMLR scientists and experts in the discussions of the science and the data for the work to be carried out (inter alia to ensure that relevant data from other CCAMLR Members are being taken into account in the planning process) and to jointly evaluate any preliminary results of the analyses undertaken.

5.24 The Scientific Committee noted that Japan had a concern about the feasibility of research and monitoring in the area of Planning Domain 4. Japan indicated that the scientific and spatial analyses for the Weddell Sea MPA should be carried out in accordance with CM 91-04 and be based on the best available data, including data from the research fisheries carried out by Japan and other CCAMLR Members in the southern research blocks of Subarea 48.6.

5.25 The Scientific Committee welcomed the offer of Russia to support and collaborate with Germany in the future Weddell Sea MPA planning process. Russia indicated that it can contribute important historic and recent research data which complement the datasets already collated by Germany.

5.26 The Scientific Committee also welcomed reports from Norway which had undertaken preliminary discussions about the potential for an MPA planning process around Bouvet Island, that would augment the work carried out in the southern part of Domain 4. The Scientific Committee recognised that no MPA planning activities were yet under way for the eastern part of Planning Domain 4.

5.27 The Scientific Committee noted that the spatial planning software used in the development and evaluation of MPA scenarios in Domain 8 (WG-EMM-12/56) had been updated to allow its use in all CCAMLR MPA domains and was available on the CCAMLR website (www.ccamlr.org/node/76195). The software automates the spatial conversion of data layers to a common format with boundaries corresponding to the chosen MPA planning domain, and could be updated to accommodate alternate domain boundaries in Domains 3 and 4 if these should change (as proposed in SC-CAMLR-XXXII/BG/07).

5.28 Dr Constable thanked New Zealand for providing its planning software. However, he noted that Australia had experienced some problems with the use of the software and requested that the Secretariat update the input files and become familiar with the software in order to assist Members with its use.

Domain 5

5.29 Prof. Koubbi reported that the collation of data is progressing for Domain 5 (del Cano – Crozet) (Annex 5, paragraph 3.35), and noted that the proponents plan to provide a comprehensive report for WG-EMM-14.

5.30 Cooperative research between South Africa and France has been planned to collate geographic layers and address data gaps in some areas. Spatial planning will begin on the basis of the available data in this domain.

5.31 The Scientific Committee noted that advice on data formats and handling of metadata would be helpful to the proponents and requested the Secretariat to liaise with Prof. Koubbi during the intersessional period.

Domain 9

5.32 The Scientific Committee recalled that work is ongoing by Sweden to compile data relevant for Planning Domain 9 (Amundsen and Bellingshausen Sea) (SC-CAMLR-XXXI, paragraph 5.29). This includes data from cruises by the vessel *Oden* and work being undertaken by the Republic of Korea and the USA.

General considerations of research and spatial planning

5.33 The Scientific Committee noted SC-CAMLR-IM-I/05 Rev. 1 and IM-I/07, which had been resubmitted by Russia as background information to the present meeting.

5.34 Dr Petrov introduced SC-CAMLR-XXXII/06, which expressed the views of Russia regarding the opening of SSRUs that had been closed for fishing since 2005, and the suggestion that the opening of these SSRUs would improve the availability of research data coming forward from these areas. He indicated that collaborative research and monitoring in currently closed SSRUs was required in order to ensure that data would become available for assessment and to identify which, if any, areas needed to be protected.

5.35 The Scientific Committee recalled that CMs 21-02 and 24-01 allow for the development and implementation of fisheries research proposals in all parts of the Convention Area, independent of the existence of SSRUs, or whether they are open or closed. The Scientific Committee recalled that SSRUs had been established in the context of the development of exploratory fisheries for toothfish, including appropriate conservation measures, and that the opening or closing of SSRUs for fishing was a matter for the Commission to address. The Scientific Committee further noted that the SSRUs had been very valuable for managing fishing and tagging effort so that data for managing the exploratory fisheries was collected effectively and in a manner that helped address important issues related to stock assessment.

5.36 The Scientific Committee agreed that a structured approach to research under CMs 21-02 and 24-01 was very valuable. Proposals that clearly articulated the reasons for research (CM 21-02, paragraph 1) and the sorts of data needed (CM 21-02, paragraph 3) were particularly valuable.

5.37 Prof. Koubbi indicated that the *SCAR Biogeographic Atlas of the Southern Ocean* (de Broyer and Koubbi) is in its final stage of editing. The atlas combines contributions of international experts and will be relevant to CCAMLR for spatial management. An electronic version will be developed which should be of interest to CCAMLR (http://atlas.biodiversity.aq/index.html).

ASMAs and ASPAs

5.38 The Scientific Committee noted the discussions on fishing within ASPAs and ASMAs at WG-EMM-13 (Annex 5, paragraphs 3.38 to 3.40).

5.39 The Scientific Committee noted that, consistent with the procedure established in ATCM XXVIII Decision 9 (2005), any proposal to undertake commercial harvesting within an ASMA should be submitted to CCAMLR for its consideration and that the activities outlined in that proposal should only be undertaken with the prior approval of CCAMLR. The Scientific Committee agreed that the provision of advice from CCAMLR to the ATCM in order that such advice could be included in decision-making, was consistent with the spirit of cooperation and harmonisation between CCAMLR and the ATCM.

5.40 The Scientific Committee noted that CM 91-02 had been adopted last year to raise awareness of the geographic location and the management plans of ASMAs and ASPAs with marine components and requested that the Secretariat include a report of any fishing that occurs in ASMAs and ASPAs in its regular report on the krill fishery to the Scientific Committee.

5.41 The Secretariat has plotted krill harvesting activities in the 2012/13 period (see CCAMLR-XXXII/BG/06 Rev. 1, Figure 1) and confirmed that no such krill fishing operations had taken place in ASMAs or ASPAs during the most recent krill fishing season.

Revised proposal for the establishment of a Ross Sea
and East Antarctic Representative System of MPAs

5.42 The Commission had requested the Scientific Committee to examine revised proposals under consideration at the present meeting of the Commission:

(i) a draft conservation measure establishing an East Antarctic Representative System of Marine Protected Areas (CCAMLR-XXXII/34 and XXXII/34 Rev. 1)

(ii) a draft conservation measure for the establishment of a Ross Sea Region Marine Protected Area (CCAMLR-XXXII/27).

5.43 The Scientific Committee was asked to comment on how recommendations made at the First Intersessional Meeting of the Scientific Committee (SC-CAMLR-IM-I) held in Bremerhaven, Germany, from 11 to 13 July 2013, had been incorporated by the proponents.

5.44 The discussion of these proposals took place in subgroups and these outcomes were presented at the plenary session of the Scientific Committee. The discussion of the meeting in a subgroup which took place outside the meeting of the plenary of the Scientific Committee is reflected in paragraphs 5.45 to 5.55.

Proposal for the establishment of a Ross Sea Region MPA

5.45 Discussions focused on the following six concerns:

(i) The northern seamounts were designated in the original proposal to provide toothfish spawning ground protection; this had been removed in the revised proposal because of a lack of scientific data supporting the conservation objective. However, one seamount area 'ii' in this northwestern region had been retained. Members asked why this was the case as the reasons were unclear.

(a) The proponents clarified that this area was retained because it contained unique benthic bioregions within the broader Ross Sea area. These bioregions experience oceanographic regimes that are very different from those of similar seamount features further south, and this may be linked to the presence of different fish and invertebrate species assemblages.

(b) There was general support for the need to retain the modified northern seamount area based on this additional information. But there was some discussion regarding the size of the area compared with the conservation values. The unique benthic bioregions are fixed spatially and concentrated in the eastern portion of the area proposed for protection. It was therefore suggested that it might be more appropriate to protect only the eastern part of the proposed area, which contains the largest gradients and unique habitats. It was recognised that environmental variability would mean that the area should be greater than the minimum size required to capture these features, based on the precautionary principle.

(c) The subgroup recognised that it is a Commission matter to decide how precautionary the boundaries for this area should be.

(ii) The size and placement of the Special Research Zone as well as the science plan for the area and the catch limit and fishing regime within the Special Research Zone were questioned.

(a) The proponents clarified that their rationale for the placement and size of the Special Research Zone was based on the need to have two ecologically comparable areas: one that was fished as part of the normal fishery, and another (Olympic style) fishery with reduced fishing effort. This contrast was designed to detect possible effects of fishing. The banks to the northwest of the Special Research Zone are a major fishing area, so the

placement of the Special Research Zone was designed to have two similarly sized focal areas along the shelf slope to provide for a good comparison – while minimising the impact on the fishery.

(b) The proponents reported that there was a very complex mix of bioregions in this area, and the contrasting areas successfully captured these. They reported that the Special Research Zone was also intentionally placed so that it was upstream of the main fishing area.

(c) The proponents reported that the proposed catch limit for the Special Research Zone was 10% of the total catch limit for the Ross Sea region. This level of fishing was designed to maintain the existing toothfish tagging program (with an increased tagging rate of three toothfish per tonne) and to generate sufficient contrast in local exploitation rates between the Special Research Zone and main fishing grounds to allow research to understand the ecosystem effects of fishing.

(d) The subgroup considered whether this catch allocation (10% in the Special Research Zone) did indeed provide sufficient contrast. Some Members suggested that adjustment might be necessary to achieve the desired experimental design. The subgroup noted that WG-FSA could be consulted to provide additional advice to assure a functional design of catches on a broader spatial basis, or adjust catch rates within the Special Research Zone.

(iii) The need for some fishing in component D (the southeastern continental slope area identified in Figure 1 of SC-CAMLR-IM-I) was identified, which should be designed in concert with the plan for the Special Research Zone, in order to allow for structured experiments across the slope. A better justification for area E (eastern Ross Sea persistent pack-ice area identified in Figure 1 of SC-CAMLR-IM-I) was also requested.

(a) The subgroup noted that sufficient catch must be available in the combined research fishing areas within the MPA in order to provide a sufficient flow of scientific data for managing the fishery and for advancing knowledge of toothfish distribution and movement. Increased tagging effort (3 toothfish per tonne) for these areas was strongly supported; it was felt that use of pop-up tags should also be incorporated into fishing-vessel tagging operations.

(b) Discussion focused on the match between stated conservation values for areas D and E and the actual area included in the MPA, particularly with respect to the northern extent. The northeastern boundary of the general protection zone (i.e. the northern boundary of area E) is based on pelagic values and ice habitat for penguins and seals (particularly during their moult). The ice-associated prey for predators during their post-moult foraging are predominantly *E. superba*, which it was recognised would not be impacted by benthic fishing.

(c) The proponents provided further insight regarding the extreme depths in this area which are not currently fishable. This led to their decision not to have this part of the MPA as a separate zone. Future research might well discover other living resources at these depths that can be harvested without damage to the conservation values in this area of the MPA. If this did occur at some time in the future; the routine reviews planned for this MPA should be able to deal with this eventuality.

(d) There is existing advice from WG-FSA, including suggestions for catch levels, for the southeast slope area in the Ross Sea (Annex 6, paragraphs 4.106 and 4.107); the subgroup noted that such limited Olympic style fishing could deliver the objectives in this area, in the context of the Ross Sea MPA.

(e) It was concluded that catches in Area D of the MPA should be made with consideration of local exploitation rates in this area and adjacent areas; appropriate tools are available to finalise decisions regarding allowable catch and its distribution in this area prior to the implementation date for a Ross Sea MPA.

(iv) Scientific planning should take place prior to the opening of the areas currently closed in Subarea 88.2 to maximise the scientific knowledge that can be accrued from fishing in these areas.

(a) The subgroup noted that sufficient time is available for WG-FSA to provide appropriate advice to start the opening process upon the MPA coming into force – such that the openings of closed areas in Subarea 88.2 provide maximum potential data yield.

(v) The prioritised list of research and monitoring science is still ambitious.

(a) The proponents agreed that the plan was indeed very ambitious, but this was done in an attempt to be inclusive and so that all Members wishing to, could contribute in joint, cooperative work programs. However, concern was also expressed that research and monitoring goals needed to be achievable so that when the first review period was reached, CCAMLR would be in a position to make firm conclusions regarding any assessment of whether conservation goals within this MPA were being met.

(b) It was recognised that the establishment of the MPA may stimulate the provision of financial resources necessary to undertake sufficient research and monitoring. In addition, the science community needs improved clarity regarding research efforts to help fund ongoing research, integrate and enhance fishing-vessel-based research and stimulate investments for new projects. The subgroup also recognised the need to increase collaboration and facilitate data sharing.

(c) The proponents agreed to simplify the research and monitoring plan to highlight general matters versus area-specific matters.

(vi) Duration of the MPA.

(a) The timing of any review and the duration of the MPA is a matter for the Commission.

Conclusion

5.46 The subgroup noted the following conclusions from the deliberations on the proposal for a Ross Sea MPA:

(i) the proponents were very responsive to the scientific advice given at Bremerhaven

(ii) the few remaining scientific concerns were well received by the proponents during the Scientific Committee meeting – and where adjustments were needed there appeared to be time, the will and clear direction to address these items

(iii) there was support for the scientific elements of the Ross Sea MPA proposal.

5.47 Dr Petrov said that since the Intersessional Meetings of the Scientific Committee and the Commission in Bremerhaven, Russia had not changed its position regarding the purpose and boundaries of the MPA; these are set out in SC-CAMLR-IM-I/03, IM-I/05 Rev. 1, IM-I/06 Rev. 2, and reflected in the statements of representatives of Russia in this Scientific Committee.

5.48 Dr Petrov noted that progress has been made on some issues in the new proposal, for example:

(i) a change in the boundaries meant that the revised Ross Sea region MPA was 1.3 million km^2, which is 41% less than the proposals contained in CCAMLR-SM-II/04

(ii) changes to the boundaries of the proposed MPAs in the northern areas of seamounts and Scott seamount

(iii) change in the formula of the catch limit in the Special Research Zone

(iv) an explanation of the fact that the Commission may modify the conservation measure concerning the MPA after the expiry of a 10-year period

(v) relevant amendments to the Management Plan (Annex B) and the priority elements of a plan for research and monitoring (Annex C).

5.49 Dr Petrov outlined that the revised proposal presented by the USA and New Zealand for an MPA in the Ross Sea region could not be supported in its present form as it needs further amendments to address issues that were presented in SC-CAMLR-IM-I/03, IM-I/05 Rev. 1 and IM-I/06 Rev. 2.

Proposal for the establishment of an East Antarctic Representative System of Marine Protected Areas (EARSMPA)

5.50 On behalf of the proponents, Dr Constable introduced the proposed EARSMPA (CCAMLR-XXXII/34 Rev. 1) and how it addressed the concerns of the Scientific Committee expressed at Bremerhaven. The proposal in CCAMLR-XXXII/34 Rev. 1 is not substantially different to that submitted to the Commission in CCAMLR-XXXII/34 except it introduces a staged approach to implement the proposed system of MPAs:

(i) In developing a revised proposal, the proponents have listened to what was discussed in Bremerhaven and to the comments received through correspondence and most recently in consultations during this meeting. In revising the proposal, the proponents were seeking to achieve good conservation and scientific outcomes in the proposed system of MPAs in East Antarctica.

(ii) The proponents noted that Members of the Scientific Committee had different views about how the objectives could be met within the areas being proposed and whether fishing and research should be restricted in all the areas proposed to be covered by the system of MPAs. The proponents agree that for individual species, protection may not be needed throughout each proposed MPA in the system. However, in order to achieve the objectives for the system of MPAs and therefore encompassing the objectives, as appropriate, for all species, the proponents considered that the objectives of the system of MPAs are best served by the proposed system with a multiple-use approach to enable fisheries and research to be undertaken in areas where the objectives would not be affected.

(iii) The revision that was submitted to the Commission after the Bremerhaven meeting focused on altering the management plan so that there were no specified restrictions within the conservation measure. The proposal has been simplified so that restrictions on fisheries and research could be done through the implementation of other conservation measures, with the Scientific Committee having to provide advice on whether any proposed research activity under CM 24-01 or proposed fishing would impact on the objectives of the MPAs.

(iv) The staged approach proposes a two-step process to build the system of MPAs in East Antarctica while keeping its integrity intact. This takes account of the issues that have been raised about the number of MPAs in the initial proposal. The proposal is for four MPAs to be adopted in stage 1 and then stage 2 would comprise consideration of the other three MPAs.

5.51 Discussions focused on the following concerns:

(i) Some Members felt that there was insufficient time to understand and review the revised proposal, as the revised document had only been available for one day.

(ii) Some Members reiterated concerns they had raised during discussions at SC-CAMLR-IM-I, specifically, understanding the scientific basis for the

(a) number of MPAs
(b) size and boundaries of MPAs.

(iii) Members wished to understand the scientific rationale for the selection of the four MPAs to be established during phase I and the three MPAs deferred to phase II.

(iv) Members expressed an interest in clarification of the proposed research and monitoring plan.

5.52 The discussion by the subgroup can be summarised as follows:

(i) The proponents indicated that the revised proposal took into account scientific advice provided at Bremerhaven as described below. The revised proposal was submitted to the Commission by the due date in CCAMLR-XXXII/34.

(a) The subsequent revision submitted during the meeting retains all the major changes presented in CCAMLR-XXXII/34 but separates the designation of MPAs within the system into two stages, with four MPAs to be included in stage 1 for consideration at this meeting; those MPAs were chosen on the basis of the discussion in the Scientific Committee in Bremerhaven. Three further MPAs are proposed to be considered for designation within a 10-year review period.

(b) A major change since Bremerhaven to account for the concerns expressed about access to the areas by fisheries and intended to reduce concerns about the number and size of areas was that no restrictions on fisheries or research are included in the MPA proposal; instead, activities are to be managed under existing or new conservation measures, in accordance with the objectives of the MPAs.

(c) In terms of representativeness, the proponents explained that the approach since 2010 has been to achieve biogeographic representation across the system, provide representation of biodiversity and key specific elements within individual MPAs, and, lastly, to achieve specific objectives, such as scientific reference areas.

(ii) The proponents believed that to achieve full representativeness in this domain, a number of individual MPAs are required. CCAMLR-XXXII/34 included seven MPAs, based on the diversity of bioregions and the differing pelagic and/or benthic communities in the entire domain and the requirements for nursery and reference areas.

(a) With regard to the size of the individual MPAs, the proponents noted that the size of the areas was based on scientific data related to bioregions and on the biological requirements of benthic and/or pelagic ecosystem processes. Size was also determined by the requirements for scientific reference areas.

(iii) With regard to the selection of the MPAs for phase I, the proponents noted that the underlying scientific objectives in the proposal remain the same as in previous versions. Based on the Scientific Committee's discussions in Bremerhaven and in response to comments received since then on each of the seven areas, four MPAs were given higher priority and will be included in phase I. Specifically, the Gunnerus MPA is representative of benthic biodiversity in the West Indian Province. The Drygalski MPA, MacRobertson MPA and D'Urville Sea – Mertz MPA were identified as important scientific reference areas and are also representative of pelagic and benthic biodiversity and of important ecosystem processes in the Central Indian Province and the East Indian Province. The importance of these MPAs was highlighted in the report from Bremerhaven.

(iv) Clarification of the research and monitoring plan was provided by the proponents. It was noted that the MPAs were not 'no take' zones, indeed it was recognised that fishery data can provide valuable scientific data. The priority elements for the research and monitoring plan aim to provide a framework for increased integrated international scientific collaboration, in which all Members can participate. Additionally, research and monitoring activities in areas where MPAs are to be proposed during Phase II, some of which are currently ongoing, and some of which are planned, will contribute to the overall understanding of the domain and will provide input to decisions related to the establishment of those MPAs.

Conclusion

5.53 The Scientific Committee expressed its appreciation for the opportunity to discuss science issues regarding the revised proposal the EARSMPA.

5.54 Dr A. Umezawa (Japan) expressed his delegation's appreciation to the proponents for their dedicated efforts to try to reflect the discussions at SC-CAMLR-IM-I held in Bremerhaven. He pointed out that while the report of this meeting (SC-CAMLR-IM-I) contained a lot of paragraphs starting with 'The Scientific Committee agreed …' in the discussion part of the Ross Sea MPA proposal, such as paragraphs 2.30 to 2.33, there is no such paragraph in the discussion part of the EARSMPA proposal, except for paragraph 2.55, which states 'The Scientific Committee agreed that the science related to objectives in the EARSMPA represented the best available science.' He also referred that at the intersessional meeting in Bremerhaven many participants had expressed their views that: (i) it was unclear if the research and monitoring would be accomplished in such huge areas; and (ii) the large-scale MPAs might develop the vast blank areas lacking scientific data. Dr Umezawa requested the proponents to clarify the scientific justification of the change in the number of MPAs from 7 to 4, as well as the two-stage plan within 10 years to achieve the objectives.

5.55 Dr D. Freeman (New Zealand) recognised the East Antarctica proposal as an example of the representativeness approach to MPA implementation and noted the significant contribution this proposal would make to marine protection in the CCAMLR area. In terms of the revisions, she supported the additional reporting requirements in the revised proposal in paragraph 8 and considered that including an assessment of the research and monitoring data

in the paragraph relating to the period of duration is a positive development. She recognised that the proponents have listened to the comments and views of other Members, including those expressed in Bremerhaven, in revising this proposal, and looked forward to working with the proponents as the system of MPAs in East Antarctica is developed.

IUU FISHING IN THE CONVENTION AREA

6.1 The Scientific Committee noted the discussion of IUU fishing undertaken by WG-FSA (Annex 6, paragraphs 3.4 to 3.8) and, in particular, noted that it remains a problem within the Convention Area and causes problems in the development of stock assessments and should be examined in sensitivity analyses.

6.2 The Scientific Committee welcomed the Secretariat presentation of the spatial and temporal distribution of IUU activity within the Convention Area in recent years (CCAMLR-XXXII/BG/09 Rev. 1) and agreed that an analysis of IUU fishing that brings together all available information, rather than relying on vessel sightings alone, was a step forward in understanding patterns of IUU activity. In particular, this analysis indicated that IUU fishing persists on the high seas in the northern part of the Indian Ocean and has also occurred in Subarea 48.6 (where there have been no IUU vessel sightings reported).

6.3 The Scientific Committee noted that IUU fishing appears to occur in both open and closed SSRUs and suggested that, in some instances, even the presence of licensed vessels in an SSRU may not deter, or result in the reporting of, unidentified vessel activity. The Scientific Committee noted that an analysis of the distances over which licensed vessels have the potential to detect other vessels may inform the likelihood of vessel sighting reports in instances where IUU vessels were known to be in the vicinity of licensed vessels. It also noted that SCIC could undertake to examine vessel reports according to CM 10-02, observer data, VMS, C2 data and the results of aerial surveillance operations (e.g. CCAMLR-XXXII/BG/20) to further clarify the potential proximity of licensed vessels with other vessels during steaming and fishing operations.

6.4 The Scientific Committee welcomed the update from the Secretariat on the development of approaches to estimate IUU removals where surveillance-based estimates cannot be effort-corrected and noted that this will include collaboration with COLTO on operational market-related issues. The Scientific Committee noted SC-CAMLR-XXXII/BG/09 from COLTO and thanked it for its continued positive contribution to the work of CCAMLR and the fight against IUU fishing.

6.5 The Scientific Committee noted that the photographs of vessels on the CCAMLR website were useful in assisting surveillance and sightings from vessels. The Scientific Committee encouraged Members to ensure that the photographs of vessels supplied by them to the CCAMLR website were of the highest quality available.

6.6 ASOC thanked the Secretariat, France and Australia for their important IUU papers and noted with concern that IUU fishing remained a problem in the Convention Area and is growing. ASOC encouraged CCAMLR and all Members to utilise the full range of tools and assets that can be directed towards its eradication, and suggested setting a target date of 2016 for accomplishing this (CCAMLR-XXXII/BG/18).

CCAMLR SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

7.1 Information collected by scientific observers for finfish on board longline and trawl cruises was summarised by the Secretariat in WG-FSA-13/68 Rev. 1, and for krill trawl cruises in WG-EMM-13/38.

7.2 The Scientific Committee acknowledged the contribution that the data collected by scientific observers has made towards an understanding of the functioning of the Southern Ocean ecosystem and noted that all vessels that participated in the krill fishery during 2012 carried observers for some, or all, of their fishing operations, resulting in scientific observer coverage of 79% of vessel months, which exceeded the minimum requirements in CM 51-06. The Scientific Committee thanked all scientific observers and technical coordinators.

7.3 The Scientific Committee considered the advice contained in the WG-EMM report (Annex 5, paragraphs 2.19 to 2.30) and the WG-FSA report (Annex 6, paragraphs 8.1 to 8.17).

7.4 Several Members proposed that observer coverage in the krill fishery be increased to 100%, noting that this is the only fishery in the CCAMLR area in which 100% observer coverage is currently not required. Other Members requested that observer data already collected be analysed to determine the optimal level of observer coverage for the krill fishery.

7.5 The Scientific Committee expressed concern over the large variability in the quality of the observer data collected on finfish by-catch (including fish larvae) in the krill fishery (Annex 5, paragraph 2.27) and recognised the need for observer training in the difficult task of identification of larval fish. The Scientific Committee noted the development of a guide for the identification of fish larvae (WG-EMM-13/07) and endorsed the request for Members to provide identification material (including photographs) of frequently reported taxa (Annex 5, paragraph 2.26).

7.6 The Scientific Committee endorsed the request from WG-EMM (Annex 5, paragraph 2.28) that the K10(ii) form be revised to require fish lengths to be recorded in millimetres.

SISO review

7.7 The Scientific Committee noted that the external peer review of the CCAMLR Scheme of International Scientific Observation that it requested last year (SC-CAMLR-XXXI, paragraph 7.3) was completed. The results of the review were presented in SC-CAMLR-XXXII/07 Rev. 1 and parts of the review were considered by WG-FSA (Annex 6, paragraphs 8.2 to 8.12).

7.8 The Scientific Committee noted that there were numerous recommendations contained in the SISO review (SC-CAMLR-XXXII/07 Rev. 1), that WG-FSA was not able to consider the review in detail (Annex 6, paragraphs 8.2 to 8.12) and WG-EMM has not yet had the opportunity to consider the SISO review.

7.9 The Scientific Committee agreed that a detailed consideration of the results of the SISO review be held over to its meeting in 2014 following further consideration as follows:

(i) a correspondence group be established to consider the recommendations and implications of the review intersessionally, as well as to review the terms of reference for ad hoc TASO; Dr Welsford agreed to lead that correspondence group

(ii) ad hoc TASO be reconstituted to consider the SISO review and other issues that may be identified by the correspondence group

(iii) the results of the SISO review and relevant outputs from ad hoc TASO and the correspondence group be considered by WG-EMM-14 and WG-FSA-14.

7.10 The Scientific Committee noted that one of the key outcomes of the SISO review was to develop a mechanism to implement COTPAS. It recognised that COTPAS was designed to improve data quality and increase engagement with SISO, not to limit the ability on Members to participate in the scheme.

7.11 The Scientific Committee acknowledged the valuable support to the Scheme of International Scientific Observation and to the SISO review made by Mr Eric Appleyard, who had now left Secretariat.

Observer sampling requirements

7.12 The Scientific Committee endorsed the adoption of an Observer Sampling Requirements Document for *Dissostichus* spp. by area to be updated annually in response to changes in scientific priorities (as outlined by the WG-FSA; see Annex 6, paragraph 8.13 and Table 15). The Scientific Committee agreed that the aim of the observer sampling requirements for *Dissostichus* document is to provide a single source of information regarding the sample size requirements for length–sex and biological sampling for each subarea/division.

7.13 The Scientific Committee recommended that CMs 41-01 and 24-01 be modified to refer to the Observer Sampling Requirements Document (Table 6). It agreed that CM 41-01, Annex 41-01/B, paragraphs 5 and 6, should be modified to require the vessel to provide enough fish for the observer to sample according to the specified sampling requirements, and that in CM 24-01, the research proposal requirements under format 2, section 3b, should reference the observer sampling requirements for the area proposed.

7.14 The Scientific Committee recommended that the Observer Sampling Requirements Document should be placed on the CCAMLR website along with the *Scientific Observers Manual* and data forms under Science/CSISO/Information for technical coordinators (www.ccamlr.org/node/77322).

Tagging training

7.15 The Scientific Committee endorsed the advice from WG-FSA in relation to the tagging training module and encouraged the distribution of this material to all technical coordinators and Scientific Committee representatives (Annex 6, paragraphs 8.15 to 8.17).

CLIMATE CHANGE

8.1 The WG-EMM Convener drew the Scientific Committee's attention to Annex 5, paragraphs 2.52 to 2.55, which highlighted effects of climate change on krill and krill-dependent predators in two contrasting regions. Krill habitat is projected to be reduced in the ACC zone by 20%, while krill stocks in areas south of the ACC currently appear to be relatively insensitive to warming. This scientific work is now in press in *PLOS ONE*. The challenge is clearly now on the Scientific Committee as to how to integrate such findings into its work.

8.2 The Chair of the Scientific Committee recommended that WG-EMM look at new SCAR ACCE report updates at its next meeting as this is insightful and includes information important to CCAMLR's work.

8.3 Dr Trathan then presented CCAMLR-XXXII/BG/11, noting that CCAMLR has already recognised the importance of climate change (see preamble to Resolution 30/XVIII, which recognises that it is one of the greatest challenges facing us today), and that increased warming and acidification are highly likely to impact marine ecosystems during the current century.

8.4 The authors of CCAMLR-XXXII/BG/11 noted that Resolution 30/XVIII urges increased consideration of climate change impacts in the Southern Ocean to better inform CCAMLR's management decisions, which requires increased awareness and understanding of climate change and continued investment in the science essential in identifying and evaluating the risks posed by climate change.

8.5 The authors of CCAMLR-XXXII/BG/11 suggested that the wider CCAMLR community has a responsibility to respond to this challenge. They suggested that the Scientific Committee could take steps to:

(i) increase awareness and understanding of the implications of climate change for the Southern Ocean throughout the CCAMLR community

(ii) provide guidance and support for science programs investigating climate change effects on Antarctic marine living resources

(iii) initiate the development of management policies that incorporate information about climate change risks

(iv) engage with bodies that produce climate change reports (e.g. SCAR, Southern Ocean Sentinel) to identify ways of ensuring that future reports give sufficient attention to the implications of climate change for CCAMLR and that the relevant findings from current and future reports are appropriately communicated to CCAMLR.

8.6 Dr Constable thanked Norway and the UK for submitting CCAMLR-XXXII/BG/11 and also highlighted the ICED program, which will undoubtedly be very important for advancing CCAMLR's work. Dr Constable also noted that there will be an IMBER meeting in Bergen, Norway, in 2014 and that the CCAMLR community could benefit greatly by having Members in attendance. He also noted that an ICED workshop is to be held at BAS in Cambridge, UK, in November 2013, that will consider future scenarios for the Southern Ocean.

8.7 Prof. Koubbi thanked the authors of both CCAMLR-XXXII/BG/11 and BG/15 (see below) and encouraged the Scientific Committee to invest more time and energy in dealing with climate change and its potential impacts on ecosystems in the CCAMLR region.

8.8 Mr F. Chemay (Belgium) emphasised the importance of this fundamental theme (climate change) and highlighted its cross-cutting, essential influences on all Southern Ocean science work and hence its vital importance to the Scientific Committee and the Commission (as well as the ATCM).

8.9 Mr R. Nicoll, ASOC Observer to SC-CAMLR, then presented CCAMLR-XXXII/BG/15 and made the following statement:

> 'As Members are aware, climate change is already affecting parts of Antarctica. The western Antarctic Peninsula is rapidly warming, with a winter temperature increase of 6°C since the 1950s, and the sea-ice season being shortened by 90 days since 1978. Rates of sea-ice loss are fastest in the southwest Atlantic, with potentially significant impacts on krill populations considered highly likely. This is of particular concern, due to the importance of krill for many Antarctic species. Furthermore, changes in sea-ice and temperature increases will facilitate the invasion of non-native species. These effects will have profound implications for the region. There is particular concern about multi-scale regime shifts, where entire biogeographical boundaries change.
>
> The Commission has important responsibilities for the conservation and management of the Southern Ocean. To meet this responsibility CCAMLR must gain an adequate understanding of climate change impacts on the Southern Ocean at both large and small scales on a timely basis and consider not only what is happening today, but the likely impacts of a changing climate. Although it is not possible for CCAMLR to halt climate change, it can take actions that will mitigate climate change impacts, and perhaps slow or stop cascading environmental effects from occurring.
>
> CCAMLR has taken an important step in adding climate change to its agenda in line with Resolution 30/XXVIII, which encourages consideration of climate change impacts when undertaking management actions. To apply the ecosystem and precautionary approaches at the heart of the Convention, consideration of climate change impacts should not just be encouraged, but must be integrated into CCAMLR's decision-making. Specific actions that CCAMLR should undertake include the

designation of MPAs that can act as climate change reference areas, and an increase in research into climate change impacts. With a more thorough consideration of this important issue, CCAMLR will be able to respond effectively to the challenges of a changing climate.'

8.10 Dr Barrera-Oro thanked the authors of the climate change papers for highlighting this important topic. The need for the Scientific Committee to develop this topic further is obvious, but climate change issues need to be prioritised in the agenda of next year's meeting because of their great diversity and complexity.

SCIENTIFIC RESEARCH EXEMPTION

Research survey in Subareas 48.1 and 48.2

9.1 The Scientific Committee reviewed WG-FSA's assessment of a proposal by Chile to conduct a survey of the finfish resources in Subareas 48.1 and 48.2 in February 2014 (Annex 6, paragraphs 11.4 to 11.6) using a pelagic trawl towed close to the bottom.

9.2 The Scientific Committee endorsed this research activity, and thanked Chile for undertaking this finfish survey.

COOPERATION WITH OTHER ORGANISATIONS

Cooperation with the Antarctic Treaty System

Committee for Environmental Protection (CEP)

10.1 Dr Penhale, CEP Observer to SC-CAMLR, reported on topics of mutual interest that were discussed during the 16th Meeting of the CEP, held in Brussels, Belgium (20 to 24 May 2013) (SC-CAMLR-XXXII/BG/04). She informed the Scientific Committee that an Intersessional Contact Group was established to review progress made against recommendations made to the CEP by the Antarctic Meeting of Experts on Climate Change (2010) and to consider how the recommendations might be addressed by developing a prioritised climate change response work program. An interim report will be submitted to the 2014 CEP meeting in Brasilia, Brasil. The CEP also noted with interest the development of the Antarctic Biodiversity Information Network (www.biodiversity.aq), which is an information portal providing access to a distributed network of databases of terrestrial and marine biodiversity.

SCAR

10.2 The SCAR Observer to SC-CAMLR, Prof. M. Hindell, presented the annual report of SCAR activities of interest to CCAMLR (SC-CAMLR-XXXII/BG/08). In particular, he noted the:

- SCAR/CCAMLR Action Group was held in May during the 2013 ATCM in Belgium

- new SCAR scientific research programs, among which those that are of most relevance to CCAMLR include the new SCAR Action Group on Remote Sensing that has been established initially for three years

- work of the SCAR EG-BAMM, including an update on the Retrospective Analysis of Antarctic Tracking Data (RAATD)

- 1st SCAR Antarctic and Southern Ocean Science Horizon Scan to which the Chair of the Scientific Committee had been invited to participate

- SOOS, including establishment of a new SOOS data portal (http://www.soos.aq/).

10.3 The Scientific Committee noted the recommendations of the SCAR/CCAMLR Action Group and welcomed the potential for increased engagement between SCAR and CCAMLR and noted that the engagement of experts and observers in the work of the Scientific Committee was considered under Item 14.

10.4 The Scientific Committee thanked SCAR for its detailed report, noting that the relationship between CCAMLR and SCAR is important as many national polar institutes are very responsive to research objectives formulated by SCAR. Therefore the Scientific Committee encouraged Members to contribute to the research objectives of SCAR which will in turn allow the inputs of academic research projects to contribute to the work of CCAMLR.

10.5 In addition to the work of SCAR with top predators, Prof. Koubbi pointed out the importance of the SCAR SO-CPR Survey that is conducted by many countries in the Southern Ocean. During previous meetings, the Scientific Committee and its working groups have recognised the importance for CCAMLR Members to contribute to this project in order to obtain information in all areas, especially in the less sampled areas of the Southern Ocean. SO-CPR is a foundation component of the larger collaborative network, GACS (Global Alliance of Continuous Plankton Recorder Surveys). The Scientific Committee encouraged the contribution of Members to this project.

Reports of observers from other international organisations

FAO

10.6 The Scientific Committee noted the joint report from the FAO and CCAMLR secretariats on the development of FAO's project on 'Sustainable Fisheries Management and Biodiversity Conservation of Deep-sea Living Marine Resources and Ecosystems in the Areas Beyond National Jurisdiction (the ABNJ Deep Seas Project)' (SC-CAMLR-XXXII/BG/10).

ACAP

10.7 Mr Papworth provided an overview of the work ACAP has undertaken with other international organisations to further the conservation of seabirds found in the CAMLR Convention Area. This work is undertaken as a component of ACAP's RFMO Engagement Strategy, which has been supported for a number of years through voluntary contributions made by the Government of France. As noted under Agenda Item 4, substantial progress has been made by the tuna RFMOs managing fisheries adjacent to the CAMLR Convention Area. In ICCAT, IOTC and the WCPFC, mandatory seabird conservation measures have been adopted requiring use of two of the three mitigation measures recommended by ACAP for pelagic longline fisheries. CCSBT requires its fishers to comply with the seabird conservation measures of ICCAT, IOTC and WCPFC, although this is a recommendation only and is not binding on them. The adoption of these conservation measures provides an effective framework with which to prevent the incidental mortality of CCAMLR seabirds in adjacent fisheries. The challenge now is to achieve the implementation of the conservation measures and this will be the focus of ACAP's work in coming years.

10.8 ACAP noted that the adoption of the abovementioned seabird conservation measures was only achieved through the active support of CCAMLR Members participating in these RFMOs and the support of CCAMLR Members will again be sought for the effective implementation of these conservation measures in the relevant RFMOs.

Reports of representatives at meetings of other international organisations

IWC

10.9 Dr Kock presented the CCAMLR Observer's report (SC-CAMLR-XXXII/BG/02) on the 65th Meeting of the Scientific Committee of the IWC, held in Jeju Island, Republic of Korea, 3 to 15 June 2013, under the chairmanship of Dr T. Kitakado (Japan). It was reported that 1 334 large whales were taken in 2012, including 103 minke whales taken under Special Scientific Permit (Japan) in the Southern Ocean. The latest revised abundance estimates of minke whales for the Circumpolar Surveys II and III were CPII: 720 000 (512 000–1 012 000) and CPIII: 515 000 (361 000–733 000). The Comprehensive Assessment (CA) for all humpback whale populations in the southern hemisphere was completed in 2013 and was the first CA which the Scientific Committee was able to complete after more than 20 years. In addition, the CA for blue whales in the Southern Ocean was continued. It was noted that the IWC is seeking close collaboration with CCAMLR with respect to krill, its abundance, and importance as a food resource for whales and other predators.

Future cooperation

ARK

10.10 Mr S. Nordrum, ARK Observer to SC-CAMLR, thanked CCAMLR for being granted the status of observer at the 2013 meetings of the Scientific Committee and the Commission. ARK reminded the Scientific Committee that the aim of ARK is to assist the krill fishing

industry to work with CCAMLR to ensure the sustainable management of the fishery (see: www.Ark-krill.org). ARK now has four companies in its membership that accounted for 64% of the krill catch in 2012/13 (SC-CAMLR-XXXII/BG/25).

10.11 In response to the discussions at WG-EMM on the use of fishing vessels for the collection of scientific data and the priority the Scientific Committee has given to understanding how the fishery operates, ARK has proposed a meeting between the fishing operators and interested krill scientists working within CCAMLR. This workshop aims to exchange information between krill fishery operators and CCAMLR scientists, and will be scheduled to be held in association with the WG-EMM meeting in 2014. The WG-EMM Convener and interested scientists will be invited to participate and the summary of the workshop will be reported back to WG-EMM. The Scientific Committee welcomed this initiative and looked forward to its contribution to the CCAMLR discussion.

COLTO

10.12 The COLTO Observer (Mr M. Exel) thanked CCAMLR for the invitation to attend CCAMLR meetings again this year. In discussing SC-CAMLR-XXXII/BG/09, COLTO highlighted the valuable, independent, scientific assessments of toothfish fisheries undertaken by both the MSC and Monterey Bay Aquarium Seafood Watch Program over the past year. Both have certified a number of COLTO toothfish fisheries as sustainable and well managed – not all toothfish fisheries, but many, which provides clear international, independent recognition that CCAMLR is doing well with conservation and management of toothfish stocks.

10.13 Following the recommendation of the Scientific Committee in 2013 (SC-CAMLR-XXXI, paragraph 7.13) and Commission (CCAMLR-XXXI, paragraph 5.23), COLTO donated A$1 000 to initiate a tag lottery to encourage tag returns in CCAMLR exploratory fisheries. Mr Exel was delighted to announce the winners of the CCAMLR tag-return lottery (drawn at random from all reports of recaptured toothfish in 2012/13) as follows:

- 1st prize (A$400): Tag number: *Viking Sur* 9622 which was recovered by Ahmad Dulkalim (crewman) on *Sunstar* (Republic of Korea) on 31 January 2013 in Subarea 88.2 having been tagged by Roberto Bello (Chile) on *Viking Sur* (Uruguay) on 13 February 2007

- 2nd prize (A$350): *San Aspiring* (New Zealand) – this tag was recovered on 23 January 2013 in Subarea 88.1 having been tagged on the *Antarctic Chieftain* (New Zealand) on 3 January 2009 in Subarea 88.1

- 3rd prize (A$250): *Palmer* (Russia) – this tag was recovered on 19 January 2013 in Subarea 88.2 having been tagged on the *Sparta* (Russia) on 22 January 2011 in Subarea 88.2.

10.14 COLTO believes this award worked well, and would appreciate any feedback that Members may have in terms of the tagging reward system, and the value of continuing it in future.

ASOC

10.15 The Scientific Committee noted the two papers submitted by ASOC, CCAMLR-XXXII/BG/15 and BG/17 Rev. 1. It thanked ASOC for these papers and its numerous valuable papers and its history of positive contributions to the work of CCAMLR.

Meetings of interest

10.16 The Scientific Committee noted the calendar of meetings of relevance to the Scientific Committee for 2013/14 (SC-CAMLR-XXXII/BG/03) and encouraged those Members who are likely to attend such meetings to inform the Secretariat and provide appropriate reports to the next meeting of the Scientific Committee.

BUDGET FOR 2013 AND FORECAST BUDGET FOR 2014

11.1 The Scientific Committee recalled that the provision of technical and logistic support for meetings of the Scientific Committee and its working groups is part of the central role of the Secretariat and, as such, is funded from the Commission's General Fund (SC-CAMLR-XXX, paragraph 12.1).

11.2 The Scientific Committee agreed to focus its budget discussion on consideration of the requirement for additional funding to support the following activities:

(i) external review of assessment of *D. mawsoni* in the Ross Sea
(ii) consideration of the costs of translation of the Fishery Reports.

11.3 The Scientific Committee also agreed to one scientific scholarship of up to A$30 000 under the General Science Capacity Fund.

ADVICE TO SCIC AND SCAF

12.1 On behalf of the Chair, the Convener of WG-FSA and the Science Manager transmitted the Scientific Committee's advice to SCIC and SCAF. The advice to SCAF is summarised in Item 11. The advice to SCIC was derived from the Scientific Committee's consideration of IUU fishing and anomalous catch data, including information provided by WG-FSA.

SCIENTIFIC COMMITTEE ACTIVITIES

Priorities for the work of the Scientific Committee and its working groups

13.1 The Scientific Committee acknowledged that it had reached the end of its substantive discussions during the meeting but there was insufficient time to fully consider the future work priorities and the progress in addressing the recommendations of the CCAMLR

Performance Review. The Chair of the Scientific Committee undertook to prepare a paper with the Vice-Chairs and the working group conveners on a process to address the longer-term priorities for the work of the Scientific Committee.

Intersessional activities and future directions

13.2 The Scientific Committee warmly welcomed the offer from Chile to host the working group meetings in 2014 and agreed to the following meetings in 2014:

(i) SG-ASAM (Qingdao, China, date to be confirmed)

(ii) WG-SAM (Punta Arenas, Chile, 30 June to 4 July 2014) (Convener: Dr Hanchet)

(iii) WG-EMM (Punta Arenas, Chile, 7 to 18 July 2014) (Convener: Dr Kawaguchi)

(iv) WG-FSA (CCAMLR Headquarters, Hobart, Australia, 6 to 17 October 2014) (Convener: Dr Belchier).

CEMP Fund Management Group

13.3 The Scientific Committee recalled the discussion last year on the management of the CEMP fund (SC-CAMLR-XXXI, paragraphs 11.16 to 11.19) and noted that SC-CAMLR-XXXII/BG/11 addressed the specific recommendations in SC-CAMLR-XXXI, paragraphs 11.19(ii) and (iii) on the establishment of a CEMP Special Fund Management Group and the development of a pro forma for applications for use of the special fund.

13.4 The Working Group welcomed the appointment of Dr Godø as Convener and Dr Arata as the Junior Vice-Chair of the CEMP Special Fund Management Group. Drs Godø and Arata undertook to seek nominations for a Senior Vice-Chair.

Invitation of Observers to the next meeting

13.5 The Scientific Committee agreed that all Observers invited to the 2013 meeting would be invited to participate in SC-CAMLR-XXXIII.

Invitation of experts to the meetings of working groups

13.6 The Scientific Committee noted that following discussion of this issue last year, the Chair had prepared SC-CAMLR-XXXII/09 regarding the invitation of both experts and Observers.

13.7 The Scientific Committee agreed that it was essential to have clarity in both terminology and procedures in respect to the meetings and the management of experts and

Observers at those meetings. In recognition of the importance of this issue, the Scientific Committee Chair prepared a discussion paper (SC-CAMLR-XXXII/09) on how to resolve this issue. However, consideration of this issue was deferred to 2014.

CCAMLR Scientific Scholarship Scheme

13.8 The Scientific Committee noted the success of the CCAMLR Scientific Scholarship Scheme, with scholarship recipients participating in, and contributing to, all working group meetings in 2013 (Annex 5, paragraphs 7.13 to 7.16; SC-CAMLR-XXXI, Annex 4, paragraph 8.3).

13.9 This year, six applications for the scholarship scheme from four Members were reviewed by a Scholarship Review Panel chaired by the Senior Vice-Chair (Dr X. Zhao) and included the Scientific Committee Vice-Chair (Dr Arata), conveners of the working groups (Drs Kawaguchi, Belchier and Hanchet), experienced members of the Scientific Committee (Drs Barrera-Oro and M. Vacchi (Italy)) and the Science Manager (Dr Reid).

13.10 The applications were rated by panel members according to the following five criteria:

(i) scientific and other qualifications of the applicant

(ii) relevance of the scientific background and proposed area of research to the work priorities and work plan of the Scientific Committee

(iii) once selected, the extent to which it will strengthen the scientific capacity and engagement in the work of the Scientific Committee of the applying Member

(iv) strength of the linkages of the mentor scientist(s) and the applicant

(v) justification for the budget requested.

13.11 The Chair of the review panel was pleased to announce that Dr Anna Panasiuk-Chodnicka, an early career research associate at the Department of Marine Plankton Research, Institute of Oceanography, University of Gdańsk, Poland, was elected to receive a CCAMLR Scholarship. Dr Panasiuk-Chodnicka provided a very detailed application describing her research experiences in Antarctica, both on board a research vessel at sea and at a research station, related to marine biology in the Western Antarctica Peninsula. The work proposed in her application is part of a multidisciplinary ecosystem monitoring program at Admiralty Bay, involving both krill and krill-dependent predators, thus closely related to the priority work of feedback management.

13.12 Dr M. Korczak-Abshire (Poland) expressed her delight and gratitude for the recognition of Dr Panasiuk-Chodnicka as an early career scientist with the potential to contribute to the work of CCAMLR and undertook to fully support her engagement with WG-EMM.

13.13 During the review process, the review panel found that the quality of the applications differed very much in terms of the amount of information provided. Consequently, the review

panel agreed to amend the application pro forma by providing more detailed instructions to guide the applicants, and this will be done by the Science Manager, in cooperation with other panel members, during the upcoming intersessional period.

SECRETARIAT-SUPPORTED ACTIVITIES

14.1 The Scientific Committee noted the intersessional work of the Secretariat (CCAMLR-XXXII/26), including:

(i) the further development of the CCAMLR website and the Secretariat's content management system

(ii) delivery of reports and website material in the four official languages of the Commission

(iii) development of a new web-based GIS for displaying georeferenced data relevant to CCAMLR (WG-EMM-12/70). The GIS prototype is currently located at gis.ccamlr.org and contains basic data layers (e.g. management areas, bathymetry, sea-ice). The project is being implemented in two stages, with stage 1 nearing completion and stage 2 being implemented in 2014 (see also Annex 4, paragraphs 5.10 to 5.12; Annex 5, paragraphs 7.10 to 7.12; Annex 6, paragraph 7.11).

(iv) re-development of the observer and fishery databases and associated data-quality assurance processes. A revised conceptual data model has been developed which better suits the current form and contents of the observer data ('top-down' approach), and this model is currently being mapped to the existing database ('bottom-up' approach).

14.2 As part of a general review of how to make the science undertaken in CCAMLR available to as wide an audience as possible, the Secretariat had developed two options for how working group papers may be made available in the public domain (SC-CAMLR-XXXII/10). These options incorporated the advice of the working groups (Annex 4, paragraphs 5.2 to 5.9; Annex 5, paragraphs 7.1 to 7.8; Annex 6, paragraphs 12.1 and 12.2). The Scientific Committee did not have time to consider this matter during the meeting and the options would be further considered during 2014.

14.3 In 2012, the Scientific Committee encouraged the Secretariat to explore opportunities for collaboration in FAO's ABNJ Deep Seas Project and to contribute to aspects of this work (SC-CAMLR-XXXI, paragraphs 10.24 to 10.27).

14.4 The CCAMLR and FAO secretariats presented an update on the project (SC-CAMLR-XXXII/BG/10) and identified CCAMLR's main collaboration as a contribution of information, background material and expertise for the sharing of experiences and lessons learned. This contribution would be coordinated by the CCAMLR Secretariat and may include CCAMLR Members, chairs and conveners. The update included a draft letter from the CCAMLR Secretariat identifying co-financing support for the ABNJ Deep Seas Project, in

the form of an in-kind contribution representing relevant activities identified in the Secretariat's Strategic Plan. The contribution of data and information held by the Secretariat will be subject to the Rules for Access and Use of CCAMLR Data.

ELECTION OF CHAIR AND VICE-CHAIR

15.1 Dr Jones's first term as Chair ended with this meeting and the Scientific Committee welcomed his indication of a willingness to serve for a further term. Dr Kock, seconded by Dr Sharp, nominated Dr Jones as Chair for a second term of two regular meetings (2014 and 2015).

15.2 Dr Zhao's term as Vice-Chair ended with this meeting and the Scientific Committee sought nominations for a new Vice-Chair. Dr Arata nominated Dr Welsford and this nomination was seconded by Dr Watters. Dr Welsford was unanimously elected to the position for a term of two regular meetings (2014 and 2015). A very warm welcome was extended to the incoming Vice-Chair who thanked the Committee for this honour.

15.3 Prof. Pin, on behalf of the Scientific Committee, thanked both the outgoing and incoming Vice-Chairs for their support of the Scientific Committee.

OTHER BUSINESS

16.1 The Scientific Committee did not consider any other business.

ADOPTION OF THE REPORT

17.1 The report of the Thirty-second meeting of the Scientific Committee was adopted.

CLOSE OF THE MEETING

18.1 At the close of the meeting, Dr Jones warmly thanked Members of all delegations for their open engagement that was the essence of the success of the Scientific Committee. He sincerely thanked the rapporteurs and the Secretariat for their excellent work in preparing text for the report, often on very short timescales and that it was an honour to present the report to the Commission on behalf of the Scientific Committee.

18.2 On behalf of the Scientific Committee, Dr Arata thanked Dr Jones for his successful chairmanship of the meeting, in particular in the way he dealt evenly with both the difficult and more enjoyable moments of the meeting.

18.3 The Scientific Committee noted that this would be the last year at CCAMLR for Dr Sharp and thanked him for the major impact he had achieved in the working groups and

the Scientific Committee. In response, Dr Sharp reflected on his pleasure at being part of an organisation where science was the basis for the decision-making process and that he would remain committed to the work of CCAMLR, even if he was not able to attend in person.

18.4 The Scientific Committee acknowledged the tremendous contribution to the work of CCAMLR of Dr Kock for over 30 years. During this time he has provided guidance, insight and mentorship to many and has been unparalleled in his commitment to CCAMLR and to Antarctic fish research. In response Dr Kock admitted that he 'liked' CCAMLR and felt that his experiences over the last 30 years had been some of the most rewarding in his career.

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Table 1: Preliminary total catch (tonnes) of toothfish, icefish and krill reported in 2012/13, including catches taken as by-catch or during research. (Source: catch and effort reporting system to 20 September 2013, unless indicated otherwise.)

Species	Country	Subarea or division																			Total
		48.1	48.2	48.3	48.4	48.5	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	58.4.4a	58.4.4b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3	
Toothfish	Argentina			<1[b]																	<1
Dissostichus	Australia														2 413						2 413
eleginoides	Chile			321																	321
	France*									7				3 239		504					3 750
	Japan						3			9			31[b]								43
	New Zealand			609	31													<1			641
	South Africa						6									22	117				146
	Spain							<1													<1
	UK			1 168	41													<1			1 209
Dissostichus	Australia														<1						<1
mawsoni	Japan						141		4												145
	Korea, Republic of							3										1 253	23		1 279
	New Zealand				24													535[c]	362		922
	Norway																	226	8		234
	Russia					60[b]												278	68		405
	South Africa						87														87
	Spain							45										375			420
	UK				15													455	13		484
	Ukraine																	63	2		66
Total (toothfish)		0	0	2 098	111	60	237	48	4	16	0	0	31	3 239	2 413	526	117	3 185	476	0	12 565
Icefish	Argentina			<1[b]																	<1
Champsocephalus	Australia														644						644
gunnari	Chile			225																	225
	China	<1[a]		<1[a]																	<1
	UK			1 127																	1 127
	Ukraine		5[a]	<1[a]																	5
Total (icefish)		<1	5	1 354	0	0	0	0	0	0	0	0	0	0	644	0	0	0	0	0	2 003
Krill	Chile	4 852		2 661																	7 512
Euphausia	China	25 324	1 245	5 376																	31 944
superba	Korea, Republic of	32 423	4 579	2 986																	39 988
	Norway	91 207	21 448	16 202																	128 856
	Ukraine	296	3 178	1 025																	4 498
Total (krill)		154 102	30 450	28 250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	212 798

* Catch in EEZ reported in fine-scale data to July 2013; [a] By-catch; [b] Research; [c] Includes research

Table 2: Catches (tonnes) of toothfish, icefish and krill reported in 2011/12, including catches taken as by-catch or during research. (Source: STATLANT data.)

Species	Country	Subarea or division																			Total
		48.1	48.2	48.3	48.4	48.5	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	58.4.4a	58.4.4b	58.5.1	58.5.2	58.6	58.7	88.1	88.2	88.3	
Toothfish	Australia														2 717						2 717
Dissostichus	Chile			238																	238
eleginoides	France									37				4 899		673					5 608
	Japan						<1				5		28[b]								35
	Korea, Republic of																	1			1
	New Zealand			346	32													2	<1		380
	Russia																	1	<1	<1[b]	2
	South Africa						5									32	221				258
	Spain			245																	245
	UK			977	24																1 001
	Germany	<1[b]																			<1
Dissostichus	Japan						244				4										248
mawsoni	Korea, Republic of							157	40									861	22		1 081
	New Zealand				6													820[c]	152		978
	Norway																	180			180
	Russia																	472	45	4[b]	522
	South Africa						133		14												147
	Spain																	523			523
	UK				16													317	204		538
Total (toothfish)		<1	0	1 806	78	0	382	157	54	37	9	0	28	4 899	2 717	705	221	3 177	423	4	14 702
Icefish	Australia														4[b]						4
Champsocephalus	Chile			<1[a]																	<1
gunnari	Germany	8[b]																			8
	Korea, Republic of			<1[a]																	<1
	UK			999																	999
Total (icefish)		8	0	999	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	1 011
Krill	Chile	4 428	2 945	3 290																	10 662
Euphausia	China	3 689	576																		4 265
superba	Japan	13 151		3 107																	16 258
	Korea, Republic of	22 910	219	3 971																	27 100
	Norway	31 453	25 300	46 047																	102 800
Total (krill)		75 631	29 040	56 415	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	161 085

[a] By-catch; [b] Research; [c] Includes research

Table 3: Landings of *Dissostichus eleginoides* (estimated live weight) reported in the CDS for fisheries operating outside the Convention Area in the calendar years 2011 to 2013 (to 16 September 2013; refer to the *Statistical Bulletin* for previous years).

Ocean sector	FAO Area	Flag State	Estimated live weight (tonnes)		
			2011	2012	2013
Southwest Atlantic	41	Argentina	2 983	3 299	2 748
		Chile	89	0	105
		Korea, Republic of	2 323	2 381	871
		Russian Federation	150	0	63
		Spain	317	133	41
		UK	1 300	1 239	727
		Ukraine	450	307	262
		Uruguay	408	211	174
	Subtotal		8 020	7 570	4 991
Southeast Atlantic	47	Japan	164	79	0
		South Africa	32	46	0
	Subtotal		196	126	0
Western Indian	51	France	29	20	18
		Japan	0	0	5
		Korea, Republic of	448	165	231
		South Africa	192	114	43
	Subtotal		669	298	296
Eastern Indian	57		0	0	0
	Subtotal		0	0	0
Southwest Pacific	81	Australia	357	349	418
		Chile	0	2	0
		New Zealand	55	26	1
	Subtotal		412	377	419
Southeast Pacific	87	Chile	4 163	5 570	2 587
		Peru	103	115	122
	Subtotal		4 266	5 685	2 709
	Total		13 563	14 057	8 415

Table 4: Recommended catch limits for research blocks and other research proposals in the 2014 season. Estimates of local biomass, local exploitation rate and tag recaptures associated with catch limits in research blocks are also shown; recommended catches associated with the Spanish depletion experiment described in WG-FSA-13/15 and the prospecting phase of research in Subarea 48.5 (WG-FSA-13/09) are denoted by *. Combined catch limits at the scale of SSRUs recommended for 2013/14 are shown in Table 5 (WG-FSA-13, Table 14).

Area or SSRU	Block – species	SSRU	Biomass estimation method	Local biomass	2013 tags predicted	2013 tags observed	2014 recommended catch limit	2014 local exploitation rate	Proportion of fishable depths (600–1800 m) in SSRU contained in research blocks	2014 tags available	2014 tag recaptures estimated
48.5	Option 1-a		CPUE RSR	2 562	0.0	0	60	0.023		233	5.5
	Option 1*		n/a	n/a	n/a	n/a	213	n/a	n/a	n/a	n/a
	Option 2*		n/a	n/a	n/a	n/a	48	n/a	n/a	n/a	n/a
	Option 3*		n/a	n/a	n/a	n/a	112	n/a	n/a	n/a	n/a
48.6A, G	a, b – TOP	486A, G	CPUE 484N	697	1.5	0	28	0.040	[1.000]*	366	14.7
	b – TOA	486A, G	CPUE 882H	6 886	8.7	6	170	0.025		1 079	26.6
48.6	c – TOA	486D	CPUE 882H	3 624	8.4	2	50	0.014		752	10.4
	d – TOA		CPUE RSR	2 515	15.3	0	100–150	0.40–0.060	0.650	743	29.5–44.3
	e – TOA	486B, C	CPUE RSR	6 622			190	0.029	0.444	352	10.1
58.4.1	C-a – TOA		CPUE RSR	3 140			125	0.040	0.697	114	4.5
	C-b – TOA		CPUE RSR	2 337			90	0.039		598	23.0
	E-a – TOA	5841E	CPUE RSR	7 061			280	0.040	0.432	226	9.0
	E-b – TOA		CPUE RSR	930			35	0.038	0.432	72	2.7
	G – TOA	5841G	Petersen	674		0	26	0.039	0.206	369	14.2
	C*			n/a	n/a		42	n/a	n/a	n/a	n/a
	D*			n/a	n/a		42	n/a	n/a	n/a	n/a
	G*			n/a	n/a		42	n/a	n/a	n/a	n/a
	H*			n/a	n/a		42	n/a	n/a	n/a	n/a
58.4.2	E – TOA		CPUE RSR	877	1.0		35	0.040		214	8.5
58.4.4a, b	C – TOA		CASAL	635	6.8	3	25	0.039	1.000	215.5	8.5
	D – TOA		CPUE 5844-C	870	0.8	0	35	0.040	1.000	39.2	1.6
58.4.3a	Whole		Petersen	372	15.0	11	32	0.086	1.000	353	30.4
	Whole		CPUE 484N	2 798	2.0	11	32	0.011	1.000	353	4.0

Table 5: Recommended catch limits (tonnes) for *Dissostichus* spp. in Subareas 48.5 and 48.6 and Divisions 58.4.1, 58.4.2, 58.4.4 and 58.4.3a in 2013/14.

Subarea/division	SSRUs	Catch limit (tonnes)	
		D. eleginoides	*D. mawsoni*
48.5	-	-	433
48.6	North A and G	28	170
	South B–F	-	340–390
58.4.1	C	-	257*
	D		42*
	E	-	315
	G	-	42*
	H		42*
58.4.2	E	-	35
58.4.4	C	25	-
58.4.4	D	35	-
58.4.3a	A	32	-

* Includes 42 tonnes for depletion experiments.

Table 6: Observer sampling requirements for *Dissostichus* spp. in 2013/14.

1. Observer sampling requirements for *Dissostichus* spp. in longline fisheries based on the data collection plan described in WG-FSA-10/32 (SC-CAMLR-XXIX, Annex 8, paragraph 5.34; SC-CAMLR-XXIX, paragraph 3.187). These sampling requirements serve as the default sampling requirements by subarea or division, unless alternative sampling requirements are agreed through the research plan review process. General sampling requirements are listed in Annex 1 of the CCAMLR Scheme of International Scientific Observation.

2. Biological measurements Type I: includes species, total length, sex, and gonad stage as per CM 41-01, Annex B, paragraph 6.

3. Biological measurements Type II: includes species, total length, sex, gonad stage and total weight as per CM 41-01, Annex B, paragraph 6.

4. Biological measurements Type III: includes otolith samples and all Type II data.

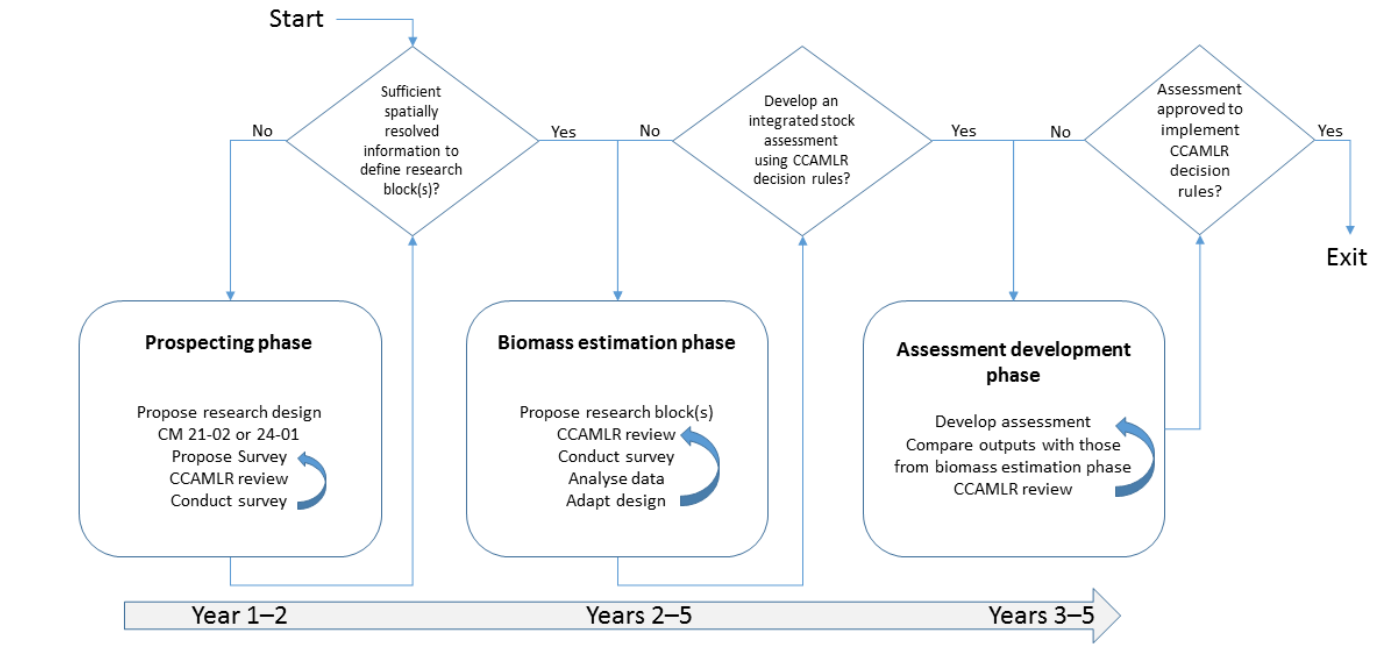
5. All recaptured toothfish should be sampled as Type III in addition to the sample number in the table.

Sample numbers in the table below indicate sampling of all fish up to the number listed in the table.

Fisheries in subarea/division	Species/group	Type I	Type II	Type III
48.2, 48.5, 58.4.4a,	*D. mawsoni*	n/a	35	10
58.4.4b, 88.3	*D. eleginoides*	n/a	35	10
48.6, 58.4.1,	*D. mawsoni*	n/a	35	10
58.4.2, 58.4.3a	*D. eleginoides*	n/a	35	10
88.1, 88.2	*D. mawsoni*	n/a	35	10
	D. eleginoides	n/a	35	10

Biological measurements to be recorded for each sample type for *Dissostichus* spp.

Sample type	Total samples per set	Total length	Sex	Gonad stage	Weight	Otoliths
Type I	n/a					
Type II	35					
Type III	10					



Prospecting phase

- See WG-SAM-11, paragraph 2.49, WG-SAM-13, paragraph 2.7.
- Research is effort limited, with a research catch limit based on an analogous high CPUE.
- Effort should be spatially distributed throughout the area (shorter line lengths and wider line spacing preferred) to characterise CPUE in the area.
- Tagging should be at a high rate
- Biological sampling should be at a high rate (length, weight, gonad weight, otoliths, diet).

Biomass estimation phase

- See WG-SAM-11, paragraph 2.49, WG-SAM-13, paragraph 2.7
- Each research block should be a defined area with fishable bathymetry 600–1 800 m, with locally high CPUE and likely annual access.
- Generate preliminary estimates of local biomass using CPUE x fishable area (WG-SAM-11, paragraph 2.49(ii)). Where tag recaptures are available also use the Chapman estimator.
- Research is catch limited. Catch based on the projection of at least six expected tag recaptures and not to exceed a precautionary exploitation rate at the scale of the stock or SSRU.
- Develop stock hypothesis and account for stock removals.
- Collect biological sampling to develop data for future stock assessment (length, weight, gonad weight, otoliths, diet).
- Conduct ancillary analyses to support stock assessment (e.g. length at age, IUU catch history, age at maturity, suitability of fish for tagging).

Assessment phase

- As a time series of biomass estimates is developed (e.g. from tagging data or depletion experiments), supporting data (e.g. length at age, IUU catch estimates) should be used in preliminary integrated stock assessments to estimate biomass and yield using CCAMLR decision rules.
- As these models are developed and reviewed, an increase in robustness of biomass and status estimates is expected between different estimation methods (e.g. CPUE x seabed area, Chapman estimator, CASAL stock status).

Figure 1: Research plan flowchart describing key aspects of the prospecting phase, biomass estimation phase and assessment phase, and the means of transiting between phases.

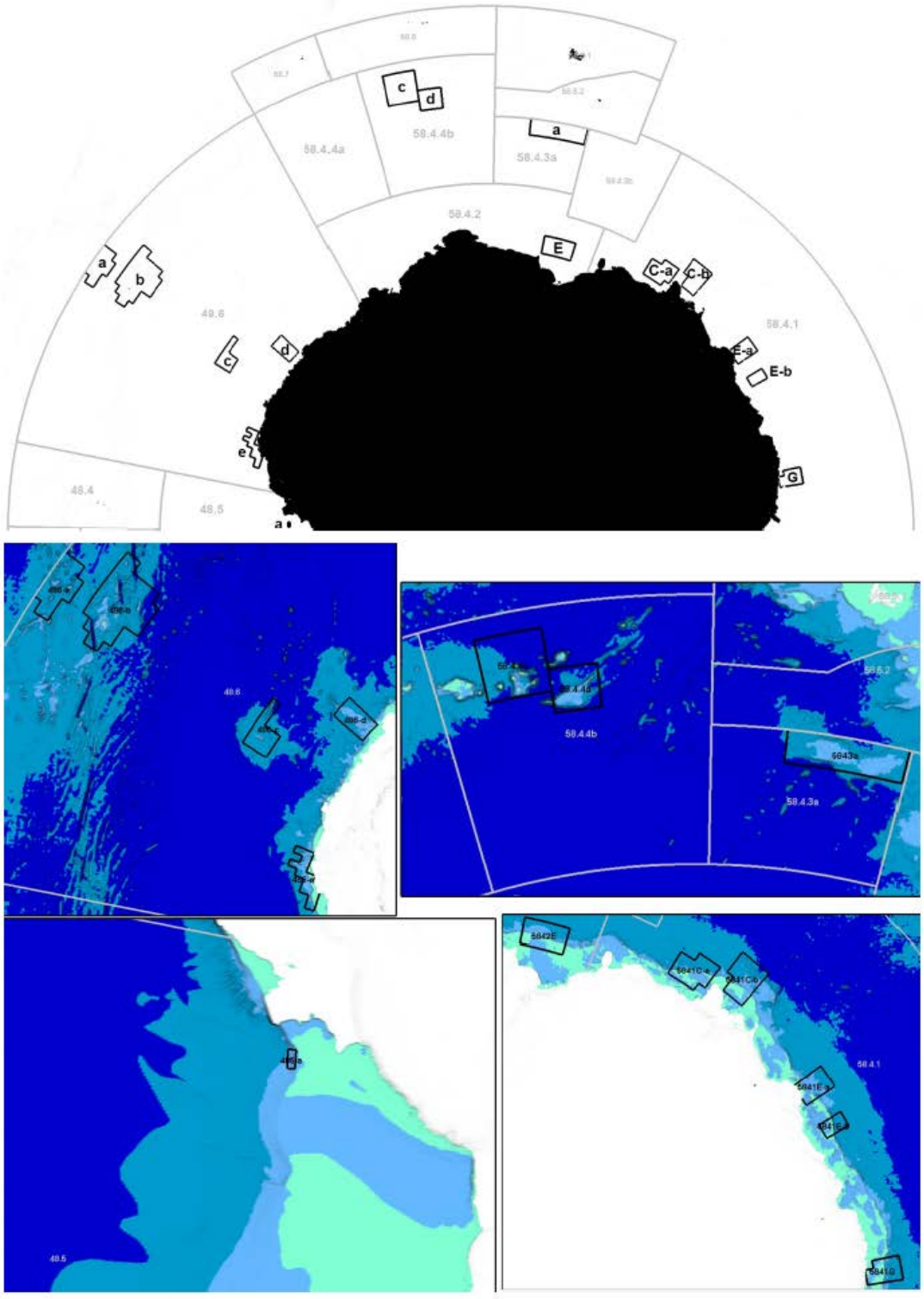


Figure 2: Location of research blocks (top) and close-ups, including the Gebco bathymetry.

Annex 1

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Mr Philippe Tanguy
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Dr Emy Watt

Annex 2

List of documents

LIST OF DOCUMENTS

SC-CAMLR-XXXII/01	vacant
SC-CAMLR-XXXII/02	vacant
SC-CAMLR-XXXII/03	Report of the Working Group on Ecosystem Monitoring and Management (Bremerhaven, Germany, 1 to 10 July 2013)
SC-CAMLR-XXXII/04	Report of the Working Group on Fish Stock Assessment (Hobart, Australia, 7 to 18 October 2013)
SC-CAMLR-XXXII/05	Report of the Working Group on Statistics, Assessments and Modelling (Bremerhaven, Germany, 24 to 28 June 2013)
SC-CAMLR-XXXII/06	Proposal by the Russian Federation to open Areas of Special Scientific Interest in three sectors of Antarctica in the CAMLR Convention Area Delegation of Russia
SC-CAMLR-XXXII/07 Rev. 1	Review of the CCAMLR Scheme of International Scientific Observation (26 to 30 August 2013, CCAMLR Headquarters, Hobart, Tasmania) CCAMLR SISO Review Panel
SC-CAMLR-XXXII/08	Establishing an international collaborative CCAMLR project to spatially manage the South Orkney Islands Delegations of Norway and the UK
SC-CAMLR-XXXII/09	Formalising the invitation and management of experts and observers to meetings of CCAMLR Scientific Committee subsidiary bodies Chair of the Scientific Committee
SC-CAMLR-XXXII/10	CCAMLR papers: accessibility, availability and publication – options for the future Secretariat

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SC-CAMLR-XXXII/BG/01	Catches in the Convention Area 2011/12 and 2012/13 Secretariat

SC-CAMLR-XXXII/BG/02	Observer's Report of the 65th Meeting of the Scientific Committee of the International Whaling Commission (IWC) (Jeju Island, Republic of Korea, 3 to 15 June 2013) CCAMLR Observer (K.-H. Kock, Germany)
SC-CAMLR-XXXII/BG/03	Calendar of meetings of relevance to the Scientific Committee in 2013/14 Secretariat
SC-CAMLR-XXXII/BG/04	Committee for Environmental Protection: 2013 Annual Report to the Scientific Committee of CCAMLR CEP Observer to SC-CAMLR (Dr P. Penhale, USA)
SC-CAMLR-XXXII/BG/05	Marine debris and entanglements at Bird Island and King Edward Point, South Georgia, Signy Island, South Orkneys and Goudier Island, Antarctic Peninsula 2012/13 Delegation of the United Kingdom
SC-CAMLR-XXXII/BG/06	Vacant
SC-CAMLR-XXXII/BG/07	Progress report on the scientific data compilation and analyses in support of the development of a CCAMLR MPA in the Weddell Sea (Antarctica) Delegation of Germany
SC-CAMLR-XXXII/BG/08	The Scientific Committee on Antarctic Research (SCAR) Annual Report 2012/13 Submitted by SCAR
SC-CAMLR-XXXII/BG/09	COLTO report on toothfish fisheries – 2012/13 Submitted by COLTO
SC-CAMLR-XXXII/BG/10	Update on FAO's ABNJ Deep Seas Project Submitted by FAO and the CCAMLR Secretariat
SC-CAMLR-XXXII/BG/11	CEMP Special Fund Submitted by the Interim Task Group of the CEMP Special Fund: Olav Rune Godø, Institute of Marine Research, Bergen Nordnes, Norway Andrew Constable, Australian Antarctic Division, Kingston, Tasmania, Australia Christopher Jones, Antarctic Ecosystem Research Division, NOAA Southwest Fisheries Science Center, La Jolla, California, USA

SC-CAMLR-XXXII/BG/12	Application of the precautionary approach in the Ross Sea, Antarctica WG-FSA contributors
SC-CAMLR-XXXII/BG/13	Location data associated with anomalous catch data Secretariat

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CCAMLR-XXXII/01	vacant
CCAMLR-XXXII/02	vacant
CCAMLR-XXXII/03	Examination of the audited financial statements for 2012 Executive Secretary
CCAMLR-XXXII/04	Review of the 2013 budget, draft 2014 budget and forecast budget for 2015 Executive Secretary
CCAMLR-XXXII/05 Rev. 1	Notification of Chile's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Chile
CCAMLR-XXXII/06 Rev. 1	Notification of the People's Republic of China's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of the People's Republic of China
CCAMLR-XXXII/07 Rev. 1	Notification of the Republic of Korea's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of the Republic of Korea
CCAMLR-XXXII/08 Rev. 1	Notification of Norway's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Norway
CCAMLR-XXXII/09 Rev. 1	Notification of Poland's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Poland
CCAMLR-XXXII/10 Rev. 1	Notification of Ukraine's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Ukraine

CCAMLR-XXXII/11	Notification of France's intention to conduct an exploratory longline fishery for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of France
CCAMLR-XXXII/12	Notifications of Japan's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of Japan
CCAMLR-XXXII/13	Notifications of the Republic of Korea's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of the Republic of Korea
CCAMLR-XXXII/14	Notifications of New Zealand's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of New Zealand
CCAMLR-XXXII/15	Notifications of Norway's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of Norway
CCAMLR-XXXII/16	Notifications of Russia's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of Russia
CCAMLR-XXXII/17	Notifications of South Africa's intention to conduct an exploratory longline fishery for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of South Africa
CCAMLR-XXXII/18	Notifications of Spain's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of Spain
CCAMLR-XXXII/19	Notifications of Ukraine's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of Ukraine
CCAMLR-XXXII/20	Notifications of the United Kingdom's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in 2013/14 Submitted by the Secretariat on behalf of the United Kingdom

CCAMLR-XXXII/21 Rev. 1	Information on IUU fishing in Statistical Area 58 Assessment of IUU fishing in French waters around Kerguelen and Crozet Islands Report of observations and inspections carried out in the CCAMLR Area 2012/2013 season (15 July 2012–23 August 2013) Delegation of France
CCAMLR-XXXII/22	Proposal for amendment to the CCAMLR Conservation Measure 21-03 to improve data provision requirements Delegation of the EU
CCAMLR-XXXII/23	Search and Rescue: Issues arising from ATCM XXXVI, Brussels, Belgium, May 2013 Secretariat
CCAMLR-XXXII/24	Options for the sustainable financing of CCAMLR: Considerations of the Intersessional Correspondence Group Intersessional Correspondence Group – Sustainable Finance
CCAMLR-XXXII/25	Proposal: Fishing capacity and effort in CCAMLR exploratory fisheries Delegation of the EU
CCAMLR-XXXII/26	Executive Secretary's Report – 2013 including Second Year Implementation Report for the Strategic Plan (2012–2014) and Second Year Implementation Report for the Staffing and Salary Strategy Executive Secretary
CCAMLR-XXXII/27	A proposal for the establishment of a Ross Sea Region Marine Protected Area Delegations of New Zealand and the USA
CCAMLR-XXXII/28	Implementation of Conservation Measures 10-06 and 10-07 CCAMLR IUU Vessel Lists Secretariat
CCAMLR-XXXII/29 Rev. 1	An independent review proposal for CCAMLR's Catch Documentation Scheme (CDS) for *Dissostichus* spp. Secretariat

CCAMLR-XXXII/30	CCAMLR's Vessel Monitoring System (VMS) VMS Technical Working Group
CCAMLR-XXXII/31	Proposal: Discussion paper on the adoption of trade-related measures by CCAMLR in order to promote compliance Delegation of the EU
CCAMLR-XXXII/32	Proposal: Discussion paper on the follow-up to CCAMLR Performance Review in 2008 Delegation of the EU
CCAMLR-XXXII/33	Prohibition of finning of sharks caught in the CAMLR Convention Area Delegation of the USA
CCAMLR-XXXII/34 Rev. 1	Proposal for a conservation measure establishing an East Antarctic Representative System of Marine Protected Areas Delegations of Australia, France and the European Union

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CCAMLR-XXXII/BG/01	Report from the CCAMLR Observer (Chile) to the First Commission Meeting of the South Pacific Regional Fisheries Management Organisation (SPRFMO) CCAMLR Observer (Chile)
CCAMLR-XXXII/BG/02	Thirty-sixth Antarctic Treaty Consultative Meeting (Brussels, Belgium, 20 to 29 May 2013) Summary Report Executive Secretary
CCAMLR-XXXII/BG/03	Vacant
CCAMLR-XXXII/BG/04	Description of the General Fund budget Secretariat
CCAMLR-XXXII/BG/05	Calendar of meetings of relevance to the Commission in 2013/14 Secretariat
CCAMLR-XXXII/BG/06 Rev. 1	Implementation of conservation measures in 2012/13: Fishing and related activities Secretariat
CCAMLR-XXXII/BG/07	CCAMLR Compliance Evaluation Procedure (CCEP) Secretariat

CCAMLR-XXXII/BG/08	Implementation of Conservation Measure 10-05 CCAMLR's Catch Documentation Scheme (CDS) Secretariat
CCAMLR-XXXII/BG/09 Rev. 1	Mapping trends in activity of illegal, unreported and unregulated (IUU) fishing in the CAMLR Convention Area Secretariat
CCAMLR-XXXII/BG/10	Summary report on the fire incident of the fishing vessel *Kaixin* Delegation of the People's Republic of China
CCAMLR-XXXII/BG/11	Climate change and the conservation of Antarctic marine living resources: Developing better informed management Delegations of the United Kingdom and Norway
CCAMLR-XXXII/BG/12	Report of the Depository Government for the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) Delegation of Australia
CCAMLR-XXXII/BG/13	CCAMLR Performance Review Delegation of Australia
CCAMLR-XXXII/BG/14	The Concept of Representativeness in MPA Design Submitted by ASOC
CCAMLR-XXXII/BG/15	Climate Change, Marine Ecosystems, and Non-Native Species: The view from the Southern Ocean Submitted by ASOC
CCAMLR-XXXII/BG/16	Key Principles in Designating Marine Protected Areas and Marine Reserves Submitted by ASOC
CCAMLR-XXXII/BG/17 Rev. 1	'When close is too close' – Krill fishing close to the coast Submitted by ASOC
CCAMLR-XXXII/BG/18	Proposals for the governance and control of fishing vessels and fishing support vessels operating in the Southern Ocean Submitted by ASOC
CCAMLR-XXXII/BG/19	Update on CCAMLR's Performance Review Submitted by ASOC

CCAMLR-XXXII/BG/20	Information on air surveillance mission in Subarea 48.1 Delegation of Argentina (submitted in English and Spanish)
CCAMLR-XXXII/BG/21	Australia's observations on IUU activities and the Heard Island and McDonald Islands Exclusive Economic Zone 2012/2013 IUU catch estimate for Patagonian toothfish Delegation of Australia
CCAMLR-XXXII/BG/22 Rev. 1	IUCN expresses regret at CCAMLR discussions on MPAs Submitted by IUCN
CCAMLR-XXXII/BG/23 Rév. 1	Le *Tchaw*, navire inscrit sur la liste INN Secrétariat
CCAMLR-XXXII/BG/24	Observer's report from the Seventh Advisory Committee Meeting, and Associated Working Groups, of the Agreement for the Conservation of Albatrosses and Petrels CCAMLR Observer (New Zealand)
CCAMLR-XXXII/BG/25	Report to CCAMLR Submitted by the Association of Responsible Krill Fishing Companies (ARK)
CCAMLR-XXXII/BG/26	Report of the European Union – CCAMLR Observer to the 85th IATTC Meeting (Veracruz, Mexico, 10 to 14 June 2013) CCAMLR Observer (European Union)
CCAMLR-XXXII/BG/27	Report of the European Union – CCAMLR Observer to the 17th Plenary Session of the Indian Ocean Tuna Commission (IOTC) (Mauritius, 6 to 10 May 2013) CCAMLR Observer (European Union)
CCAMLR-XXXII/BG/28 Rev. 1	CCAMLR Compliance Evaluation Procedure (CCEP) Part 2 Secretariat
CCAMLR-XXXII/BG/29	Report from the CCAMLR Observer to the 9th Regular Session of the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (WCPFC) (2 to 6 December 2012, Manila, the Philippines) CCAMLR Observer (Republic of Korea)

CCAMLR-XXXII/BG/30	Summary of activities of the Commission during the 2012/13 intersessional period Report of the Chair
CCAMLR-XXXII/BG/31	Informe de las medidas tomadas en relación con barcos incluidos en las listas de barcos de pesca INDNR Delegación de España
CCAMLR-XXXII/BG/32	INTERPOL and the IUU-listed vessel *Snake* Secretariat
CCAMLR-XXXII/BG/33	Clarification on the IUU-listed vessel *Ray* port visit and other instances of IUU-listed vessel port visits Submitted by Singapore
CCAMLR-XXXII/BG/34	Report from the CCAMLR Observer to the First Meeting of the Parties to the Southern Indian Ocean Fisheries Agreement (18 and 19 October 2013, Melbourne, Australia) CCAMLR Observer (Australia)
CCAMLR-XXXII/BG/35	Report from the CCAMLR Observer to the Meeting of the Extended Commission for the 20th Annual Session of the Commission for the Conservation of Southern Bluefin Tuna (14 to 17 October 2013, Adelaide, Australia) CCAMLR Observer (Australia)
CCAMLR-XXXII/BG/36	Observer's report of the Second Consultation Meeting of Project Scale Regional Consultation on Fisheries Crime CCAMLR Observer (South Africa)

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Other Documents

SC-CAMLR-IM-I/05 Rev. 1	Proposal by the Russian Federation to open areas of special scientific interest in the CCAMLR Convention Area (Part 1, Ross Sea and East Antarctica) Delegation of Russia
SC-CAMLR-IM-I/07	Is it necessary to establish MPAs in Divisions 58.4.1 and 58.4.2 to protect krill resources from the impact of fishing? Delegation of Russia

Annex 3

Agenda for the Thirty-Second Meeting
of the Scientific Committee

AGENDA FOR THE THIRTY-SECOND MEETING OF THE SCIENTIFIC COMMITTEE

1. Opening of meeting

    1.1 Adoption of agenda
    1.2 Chair's report

2. Advances in statistics, assessments, modelling, acoustics and survey methods

    2.1 Statistics, assessments and modelling
    2.2 Acoustic survey and analysis methods
    2.3 Advice to Commission

3. Harvested species

    3.1 Krill resources
        3.1.1 Status and trends
        3.1.2 Ecosystem effects of krill fishing
        3.1.3 Advice to Commission

    3.2 Fish resources
        3.2.1 Status and trends
        3.2.2 Advice from WG-FSA
        3.2.3 Advice to Commission

    3.3 Fish and invertebrate by-catch
        3.3.1 Status and trends
        3.3.2 WG-FSA advice
        3.3.3 Advice to Commission

    3.4 New and exploratory finfish fisheries
        3.4.1 Exploratory fisheries in 2012/13 season
        3.4.2 Notifications for new and exploratory fisheries in 2013/14 season
        3.4.3 Advice to Commission

4. Incidental mortality arising from fishing operations

    4.1 Incidental mortality of seabirds and marine mammals associated with fisheries
    4.2 Marine debris
    4.3 Advice to Commission

5. Spatial management of impacts on the Antarctic ecosystem

    5.1 Bottom fishing and vulnerable marine ecosystems
        5.1.1 Status and trends
        5.1.2 Advice to Commission

5.2 Marine protected areas
5.2.1 Scientific analysis of proposals for MPAs
5.2.2 Advice to Commission

6. IUU fishing in the Convention Area

7. CCAMLR Scheme of International Scientific Observation

7.1 Scientific observations
7.2 Advice to Commission

8. Climate change

9. Scientific research exemption

10. Cooperation with other organisations

10.1 Cooperation with the Antarctic Treaty System
10.1.1 Committee for Environmental Protection
10.1.2 Scientific Committee for Antarctic Research

10.2 Reports of observers from other international organisations
10.3 Reports of representatives at meetings of other international organisations
10.4 Future cooperation

11. Budget for 2013 and forecast budget for 2014

12. Advice to SCIC and SCAF

13. Scientific Committee activities

13.1 Priorities for work of Scientific Committee and its working groups
13.2 Intersessional activities and future directions
13.3 CCAMLR Scientific Scholarships Scheme
13.4 Invitation of experts to meetings of working groups
13.5 Next meeting

14. Secretariat-supported activities

15. Election of Chair and Vice-Chair

16. Other business

17. Adoption of report of Thirty-second Meeting

18. Close of meeting.

Annex 4

Report of the Working Group
on Statistics, Assessments and Modelling
(Bremerhaven, Germany, 24 to 28 June 2013)

CONTENTS

REPORT OF THE WORKING GROUP ON STATISTICS, ASSESSMENTS AND MODELLING

(Bremerhaven, Germany, 24 to 28 June 2013)

INTRODUCTION

Opening of the meeting

1.1 The 2013 meeting of WG-SAM was held at the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, from 24 to 28 June 2013. The meeting was convened by Dr S. Hanchet (New Zealand) and local arrangements were coordinated by Dr S. Hain (AWI) with support from the German Federal Ministry of Food, Agriculture and Consumer Protection.

1.2 Drs Hain and Hanchet welcomed participants (Appendix A) and Dr Hanchet outlined the work ahead. WG-SAM is a technical working group which advises on quantitative issues relevant to the work of the Scientific Committee and its other working groups (SC-CAMLR-XXV, paragraphs 13.4 to 13.8).

Adoption of the agenda and organisation of the meeting

1.3 The Working Group referred the papers on toothfish biology (WG-SAM-13/19, 13/26 and 13/27), submitted to subitem 4.2, to WG-FSA for consideration. The agenda was adopted (Appendix B).

1.4 Documents submitted to the meeting are listed in Appendix C. While the report has few references to the contributions of individuals and co-authors, the Working Group thanked all the authors of papers for their valuable contributions to the work presented to the meeting.

1.5 In this report, paragraphs that provide advice to the Scientific Committee and its other working groups have been highlighted. A list of these paragraphs is provided in Item 6.

1.6 The report was prepared by Drs M. Belchier (Convener WG-FSA), C. Darby (UK), D. Ramm, K. Reid (Secretariat), Mr R. Scott (UK), Drs B. Sharp (New Zealand), D. Welsford and P. Ziegler (Australia).

RESEARCH IN DATA-POOR EXPLORATORY FISHERIES

2.1 The Working Group recalled the procedure that it adopted last year when reviewing research proposals, and agreed to structure this section of the report such that general points that apply to all toothfish research plans are presented, as well as commentary and recommendations specific to research plans provided by Members.

General points applicable to research in data-poor areas

2.2 The Working Group noted that the research plans for fishing in data-poor exploratory fisheries are included as a part of the notification process required under Conservation Measure (CM) 21-02 (and CM 24-01 in respect of research in other fisheries). These plans were then extracted by the Secretariat and submitted to the Working Group by the Secretariat on behalf of the notifying Member. In some cases the notifying Members had also provided papers, and gave presentations at the Working Group that provided additional information.

2.3 The Working Group agreed that in order to clarify the process, and avoid potential confusion, Members should submit their research plans as stand-alone papers directly to the Working Group rather than for these to be extracted from the notifications by the Secretariat. The Working Group requested that the mechanism by which changes in research plans associated with notifications are recorded be reviewed, especially as the research plan is often revised prior to the meetings of WG-FSA and the Scientific Committee, such that the final research plan may not be the same as in the initial notification.

2.4 The Working Group noted that estimates of fishable area used in the early stages of developing stock assessments rely on bathymetry datasets which may be at low resolution in areas of the Southern Ocean. It encouraged Members to collate bathymetry data from their fishing and research vessels to assist with producing more accurate estimates of fishable area in data-poor areas, and also to use the most up-to-date bathymetric datasets available (e.g. GEBCO-08 which includes updated bathymetry for the Southern Ocean: www.gebco.net). It was further noted that seabed area could be estimated as either the planimetric area or the surface area of the seafloor in three dimensions, and that analyses should be clear as to which area is used in any calculations.

Road map for developing and reviewing research plans

2.5 The Working Group noted that the recent focus by the Scientific Committee and its working groups had led to relatively rapid development of a framework for developing research plans to collect data and develop stock assessments in data-poor areas. It was noted that WG-SAM-13/37 collated and summarised this advice, particularly for developing tag-based toothfish assessments. The Working Group agreed that such a summary was useful and should be further developed.

2.6 The Working Group requested that an annotated flowchart be developed by Members showing the different stages of research leading to a stock assessment and that this be presented to WG-FSA, noting that this could also provide an efficient framework for summarising and reviewing progress of research plans.

2.7 The Working Group agreed that the following points are useful to guide the development and implementation of research plans:

(i) In subareas or small-scale research units (SSRUs) for which no data are available, the objective of research in the ‘prospecting phase’ is to map the area for fish abundance in order to locate appropriate research blocks for the next phase of the research focused on recapturing tagged fish. In the prospecting phase research should be effort limited, not catch limited; however, catch limits

in tonnes should also be calculated by applying a high CPUE from an analogous area, on the assumption this catch limit will not be reached and the full number of sets will be completed unless the CPUE is considerably higher than expected.

(ii) Once CPUE has been characterised in an area, research blocks should be defined in which subsequent effort will be constrained during the tag-recapture phase. The delineation of research blocks should prioritise spatially contiguous areas where CPUE is high and (if possible) where tag releases have already occurred.

(iii) A mechanism should be proposed to ensure that fishing effort is spatially distributed across fishable depths within the research block. Appropriate mechanisms could include grid-based designs, minimum separation rules, assigning sets within multiple pre-defined strata, or other mechanisms.

(iv) Not all cohorts of tagged fish can be assumed to be equally available for recapture, especially from years in which the tag-overlap statistic was low. One appropriate mechanism for deciding which tags are used in the estimation of local biomass would be to use only tags from those vessels from which at least one tagged fish has been recaptured, in the year of that tagged fish's release and in subsequent years.

(v) Proponents should estimate the number of expected tag recaptures per year for a given research design as a function of research catch, tagging rate and the preliminary biomass estimate. Research catch limits should be designed to produce sufficient tag recaptures to obtain a stock assessment in a reasonable time period (e.g. 3 to 5 years).

(vi) There is no simple formula to estimate the number of tag recaptures required to attempt a stock assessment. Previous experience and modelling approaches have suggested that a minimum of 10 (WG-FSA-12/18) or 15–20 (WG-SAM-13/37) cumulative tag returns are likely to be required in a reasonable time period.

(vii) Precautionary exploitation rates should be evaluated at the level of the stock, but where a stock hypothesis is unknown, then estimating exploitation rate at the scale of the SSRU is appropriate.

(viii) Combined catch limits for all research blocks or SSRUs should be evaluated to ensure that the combined catch is lower than a precautionary exploitation rate. The Working Group recognised that exploitation rates of 3–4% of $B_{current}$ (at the scale of the stock or SSRU) are appropriate for stocks with current status ranging from 20% to 100% B_0, consistent with previously utilised methods (SC-CAMLR-XXX, Annex 7, paragraphs 5.22 and 5.34) to ensure that research catches do not delay recovery for depleted stocks (Welsford, 2011).

(ix) Because stock- or SSRU-scale biomass estimates are unavailable for data-poor fisheries, estimated exploitation rates at this scale will be highly uncertain. Research plans should include an estimation of local exploitation rates (i.e. within research blocks) and also report the proportion of the fishable depth

in the areas of the stock or SSRU that is contained within research blocks, to inform evaluation of to what extent the proposed research catch limits are appropriately precautionary.

(x) Noting that many of the data-poor areas are very large, developing multi-vessel and multi-Member plans provides benefits, including allowing standardisation between vessels.

2.8 Dr A. Petrov (Russia) made the following statement:

'In my opinion, the introduction of research blocks in areas with insufficient data limits the ability to conduct research in those areas where research is being conducted for the first time (Weddell Sea). Therefore, I consider not suitable for this approach, which does not meet the recommendations of the Scientific Committee (SC-CAMLR-XXX, Annex 5, paragraphs 2.26 to 2.29 and 2.35).'

Specific advice on research proposals

Subarea 48.6

2.9 WG-SAM-13/05, 13/09, 13/11, 13/22 and 13/29 were considered under this section.

2.10 WG-SAM-13/05, 13/09 and 13/11 described research conducted by one South African and one Japanese vessel in 2012/13 in this subarea as proposed in 2012. Fishing focused in the four research blocks identified last year as being likely to have highest tag densities, as described in WG-FSA-12/60 Rev. 1. It was noted that fishing in 2012/13 may still continue in the north of Subarea 48.6 as the catch limit had not yet been taken, however, the southern area was now inaccessible due to sea-ice.

2.11 The Working Group recalled that within-season recaptures of tagged fish were exceptionally high in 2011/12; 32 of a total of 34 recaptures were fish released in that year. In 2012/13, 3 of the 13 recaptures were from fish released within season. While it was noted that within-season recaptures may have limited value in estimating stock biomass due to limited time for mixing, it was agreed that, due to the extensive coverage of much of the northern SSRUs in 2012/13, further investigation of the within-season recaptures from 2011/12 and 2012/13 should be conducted to ensure the maximum information on behaviour of toothfish after tagging and abundance of toothfish can be extracted. The Working Group requested that the Secretariat provide an analysis of within-season recaptures, including sex, species and size distribution, apparent growth, time and movement between release and recapture for consideration by WG-FSA.

2.12 The proponents of this research requested consideration of the following modifications to the research plan in Subarea 48.6:

(i) a relaxation of the requirement to set lines with a separation of 3 n miles to enable greater operational flexibility

(ii) a change to the distribution of proposed species-specific toothfish catch limits to reduce the risk that catches of Patagonian toothfish (*Dissostichus eleginoides*) prevent achievement of the Antarctic toothfish catch limit agreed between the proponents

(iii) changing the catch limits to achieve an objective of 25 tag returns per annum by 2016

(iv) inclusion of an additional research block (48.6e), where tagged fish have also been released in the past

(v) a change to the application of the *Macrourus* by-catch move-on rule, to reduce the risk of by-catch preventing achieving the research objectives.

2.13 The Working Group noted that bias can arise from tag-based estimates of abundance where tags are not distributed proportional to the underlying abundance of the fish (WG-SAM-12/23). The requirement for 3 n mile spacing of lines was one means of ensuring that fishing did not concentrate in just areas of high abundance, allowing an unbiased evaluation of abundance within a research block. It also noted that other mechanisms, such as fishing across a grid, or assigning sets to strata defined geographically as well as by depth, could achieve the same goal. Therefore, the Working Group agreed that research proponents could propose an alternative method of ensuring spatial coverage of the research block in their revised proposal to WG-FSA.

2.14 The Working Group noted that species-specific catch limits in this subarea were established as part of a collaborative research implementation plan between South Africa and Japan, based on the results of analyses presented in WG-FSA-12/60 Rev. 1. The proponents agreed to revise the design of the research blocks and/or propose an alternate catch-limit split between the two species of toothfish prior to review in WG-FSA-13, noting the need to avoid overexploitation of either species of toothfish while attempting to maximise coverage of research blocks where tagged fish had been released in previous years.

2.15 The Working Group recalled its previous discussions that the nature of tag-recapture programs made it difficult to prescribe a target number of recaptures of tagged fish, as the number of recaptured tagged fish is a function of the vulnerable biomass, tagged fish released and fish recaptured, which are all likely to vary spatially. It further noted that tag overlap also influenced the relationship between tagged fish recaptures and biomass estimates. It therefore recommended that research proponents provide a rationale for an appropriate number of expected tag returns, drawing on the advice provided in previous reports such as WG-SAM-11 (SC-CAMLR-XXX, Annex 5) and papers such as WG-FSA-12/18.

2.16 The Working Group noted that the research blocks used in Subarea 48.6 in 2012/13 were designated based on the numbers of tagged fish released in previous years, and noted that WG-SAM-13/09 identified another potential research block (48.6e) where over 300 tagged fish were estimated to be available for recapture in 2013/14. It was noted that very few tagged fish recaptures had occurred from fish released in the southern SSRUs of Subarea 48.6 (such as research block 48.6d on Gunnerus Ridge) and that a possible hypothesis for this may be that toothfish move out of areas where tagged fish have been released. It was noted that while toothfish can move large distances over their lifetime, it was unlikely that many fish had moved from research block 48.6d to 48.6e, and therefore

expanding the boundaries of research block 48.6d may be more likely to detect tagged fish that have moved off Gunnerus Ridge to the continental slope. Therefore, it was suggested that the proponents consider expanding research block 48.6d to include contiguous areas of the slope and continental shelf.

2.17 The Working Group noted that paragraph 6 of CM 33-03, which regulates by-catch in new and exploratory fisheries, was intended for multi-vessel fisheries to prevent individual vessels from catching the full catch limit for by-catch species and thereby triggering a fishery-wide closure for other vessels. For this reason, application of this paragraph may be inappropriate or unnecessary in the context of research plans involving only a few vessels. It noted that paragraph 8 of CM 41-03 was changed to address this issue in Subarea 48.4 (SC-CAMLR-XXVIII, Annex 5, paragraphs 6.28 to 6.31). It therefore agreed that information on by-catch in Subarea 48.6 be collated to enable an appropriate threshold for the by-catch limit to be determined, and that a paragraph similar to paragraph 8 of CM 41-03 be developed for Subarea 48.6.

2.18 The Working Group noted that WG-SAM-13/09 included point estimates of biomass exploitation rates and expected tagged fish recaptures in the research blocks in Subarea 48.6. However, many of the input parameters would have associated uncertainty, which would propagate through to the estimates of biomass, exploitation rates and expected tag recoveries. The Working Group therefore:

(i) recommended that such uncertainties be presented in future to assist in interpreting the results of such calculations

(ii) noted that fishable depths calculations in WG-SAM-13/09 be revised to include habitat between 600 and 1 800 m, rather than between 550 and 2 200 m

(iii) noted that the inverse variance weighted biomass estimates presented in the paper did not account for the lack of independence between the estimates, and requested the authors consider including these data in an integrated assessment framework to avoid this issue

(iv) noted that the use of a tagging mortality rate estimate of 0.2 (rather than the usual 0.1) was initially recommended for trotlines in 2011 following concerns about potentially higher tagging mortality for fish released from trotlines (SC-CAMLR-XXX, Annex 7, paragraph 5.20). However, since that time Japan has undertaken and submitted considerable further work demonstrating that the fishing gear utilised in these experiments captures an adequate number of single-hooked fish in a state suitable for tagging

(v) recommended that the proponents reconsider applying the standard tagging mortality rate estimate of 0.1 rather than 0.2.

2.19 The Working Group discussed the changes to research catch limits proposed by Japan based on the criterion of achieving an estimated 25 annual tag returns by the 2016 season. It supported the practice of setting research catch limits to achieve a target number of tagged fish recaptures necessary for a stock assessment, but agreed that 25 recaptures in a single year was higher than what has been required to achieve stock assessments in the past.

2.20 The Working Group noted that there had been no ageing of any toothfish from this subarea. It recalled that catch-at-age data are a key input into stock assessments, along with tag-recapture data, and requested that research proponents provide detail as to how such data will be acquired.

2.21 The Working Group congratulated Japan and South Africa for working together to deliver the research plan for this area. It noted the benefit of achieving agreements between proponents that avoid the race to fish during research, and encouraged such collaboration between proponents in other areas where research is planned.

2.22 The Working Group reviewed a research notification submitted by Ukraine to fish in Subarea 48.6 (WG-SAM-13/13 Rev. 1), with reference to the research plan evaluation table used by WG-FSA to evaluate new research plans in the same area in 2012 (SC-CAMLR-XXXI, Annex 7, Table 10). The Working Group noted that some of the necessary information to fully evaluate the proposed research was not provided. Ukrainian scientists said that they would provide a more fully developed plan to WG-FSA-13. The Working Group encouraged Ukraine to coordinate their efforts with ongoing research by Japan and South Africa in this area.

2.23 A Bayesian biomass model using catch and standardised CPUE was developed for toothfish in Subarea 48.6 (WG-SAM-13/29). The results were strongly influenced by priors, indicating that very little useful information on stock dynamics was contained in the available data. It was noted that this reinforced the need for an absolute index of abundance for assessing toothfish, such as from a tag-recapture program.

2.24 The Working Group noted that the catch-rate standardisations shown in WG-SAM-13/09 and 13/29 produced different results and requested that reasons as to why such differences may have arisen, such as differences in input data or analysis method, be investigated further. It was further noted that recording of lost hooks, and distinguishing between longline methods, had changed over the period analysed and that this needs to be considered in such standardisations.

Divisions 58.4.1 and 58.4.2

2.25 Japan, the Republic of Korea and Spain had all conducted research in Division 58.4.1 in 2012/13 as reported in WG-SAM-13/09, 13/10, 13/12, 13/28 and 13/30. All vessels encountered significant difficulties in conducting research due to sea-ice conditions and the *Shinsei Maru No. 3* was also unable to complete research in Division 58.4.2 due to low CPUE, attributed to potential localised depletion arising from activities by an IUU vessel.

2.26 Regarding the Japanese research plan in WG-SAM-13/09, the Working Group recalled that the spatial design and research plan methodology is largely unchanged from WG-FSA-12/60 Rev. 1, which was the basis for the Scientific Committee's advice in these areas in 2012, and that very little new data was available to inform revisions to this design. Examination of variable ice patterns to evaluate the likely accessibility of potential research blocks between years (as in WG-SAM-13/07) would be useful to inform evaluation of future plans.

2.27 The Working Group noted that its advice for Subarea 48.6 (above) – i.e. regarding spatial separation of sets, by-catch move-on rules, tagging mortality estimates for trotline-caught fish, research catch limits based on expected tag returns, and fishable depths ranges to be used in area-based estimates of abundance – applies also to the plans in Divisions 58.4.1 and 58.4.2.

2.28 Regarding the research report and plan by the Republic of Korea in WG-SAM-13/10 and 13/28, the Working Group expressed appreciation for the dedication of the Korean vessel attempting to complete the planned research despite considerable operational difficulty arising from unfavourable ice, and for providing a considerable amount of biological and other data available from the small numbers of fish that were caught. It encouraged Korea to continue its research and to progress toothfish ageing from otoliths collected in these areas. It encouraged Korea to submit a revised research plan outlining methods to be used to evaluate hooking injuries and suitability for tagging from fish captured from this particular trotline configuration (as in WG-FSA-11/13 Rev. 1 and WG-FSA-12/56), and to ensure that their gear is described in the CCAMLR gear library.

2.29 Regarding the Spanish depletion experiment and ongoing research plan in WG-SAM-13/12 and 13/30, the Working Group noted that this research design combines aspects of both the prospecting phase and also the tag-recapture phase, requiring that the vessel return to the locations that they fished in 2013. The Working Group encouraged Spain to continue its research, including developing a framework for which the data collected can be developed into a stock assessment. It noted that the highest priority for the at-sea research should be returning to those locations, to evaluate CPUE variability between years and to recapture tagged fish, enabling comparisons between depletion-based and tag-based estimates of abundance, but that further prospecting sets are also valuable. The Working Group recommended that prospecting sets be conducted across a range of depths to inform improved area-based estimation of biomass within fishable depths at the SSRU scale.

2.30 The Working Group noted that local biomass estimates were obtained in both locations at which depletions were conducted, and that these estimates were different despite similar initial CPUEs because the slope of the depletion was steeper in SSRU 5841G relative to SSRU 5841H. The Working Group requested that the resubmission of the research plan to WG-FSA provide more detailed diagrams of set sequence and location within the area of the depletion experiment to evaluate to what extent observed CPUE declines are likely to represent actual depletion in a single location or that the vessel has moved away from the location of highest abundance.

2.31 The Working Group noted that there were no within-season recaptures of toothfish during either of the depletion experiments despite the numbers of tagged fish released and the observed decline in CPUE.

2.32 The Working Group noted that more than one research plan is proposed and that these may occur in the same SSRUs in these divisions, such that subsequent evaluations should consider research catches combined for all research plans in the area, relative to precautionary exploitation rates at the SSRU scale.

2.33 The Working Group noted that a standardised catch rate time series in WG-SAM-13/09 showed declining catch rates in SSRU 5841G since 2005. It recalled that CPUE is a generally poor index of changing abundance over time and that the level of volatility apparent

in the observed catch rates could not be expected to track an actual abundance trajectory. Nonetheless it agreed that these observations warranted further consideration in future discussions regarding stock status and trends in this area, and the likelihood that proposed research catch limits could be achieved in this SSRU.

Division 58.4.3a

2.34 The Working Group noted that France and Japan had proposed research in this Division in 2012/13, and the *Shinsei Maru No. 3* conducted sets that caught a total of 9 tonnes of toothfish. It further noted that France and Japan proposed to continue research in this division as described in WG-SAM-13/08 (France) and 13/09 (Japan).

2.35 The Working Group noted that the management advice for Division 58.4.3a was in some respects more advanced than in other data-poor areas – for example the research catch limit has been set based on an analysis that incorporates the intent of the CCAMLR decision rules. It therefore encouraged the continued development of an integrated assessment for this area, and noted that inclusion of data from fish aged by France and Japan was a priority.

2.36 The Working Group noted that no French scientists attended the Working Group and recalled that this situation was the same at WG-SAM-12. It also noted that this research proposal did not contain sufficient detail so that it could not be evaluated without reference to other documents such as working group reports or previous research plans, and recalled that the previous research proposal to which WG-SAM-13/08 makes repeated cross-reference (WG-FSA-12/29) was itself judged by WG-FSA to require considerable changes and additional information (SC-CAMLR-XXXI, Annex 7, Table 12).

2.37 WG-SAM-13/41 provided a characterisation of catch and effort in Divisions 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b. The Working Group noted that some of the patterns in catch and effort in the region analysed overlapped a period of known IUU fishing as well as changes in management measures, and that these need to be considered when interpreting patterns in catch and effort. The Working Group noted the high standard of graphics presented in the paper and requested that the Secretariat work with the authors to learn some of the data visualisation methods used in WG-SAM-13/41 for inclusion in Fishery Reports.

REVIEW OF SCIENTIFIC RESEARCH PROPOSALS FOR OTHER AREAS (E.G. CLOSED AREAS, AREAS WITH ZERO CATCH LIMITS, SUBAREAS 88.1 AND 88.2)

Subarea 48.5

3.1 The results of the first year of a multi-year research survey of Antarctic toothfish (*D. mawsoni*) carried out by Russia in Subarea 48.5 (Weddell Sea) were presented in WG-SAM-13/23. Due to the prevailing ice conditions experienced in late February/March, the survey was restricted to one region in the east of the Weddell Sea and therefore followed option 1 of the research plan. A total catch of 59.5 tonnes (from a survey catch limit of

60.6 tonnes) was taken on eight longline sets. A high CPUE meant that it was not possible to achieve the planned number of research sets (50) as the catch limit was reached very quickly, which therefore constrained the spatial coverage of the survey.

3.2 A tagging rate of 5 tags per tonne was achieved with 314 *D. mawsoni* released with a tag-overlap statistic of 64%. Information on fish maturity, diet and size composition of target species was presented with additional details on by-catch and VME. It was noted that otoliths had been collected for subsequent ageing studies. Further details of the survey will be presented to WG-FSA.

3.3 The Working Group thanked Russia for the report and noted the considerable amount of information presented.

3.4 Recalling WG-FSA-12/18, the Working Group noted that, whilst the minimum 60% tag overlap required in CM 41-01 had been achieved, it would be desirable to increase the overlap to ensure that large fish were tagged in proportion to their abundance in the catch. It was also noted that there was an apparent decrease in mean length with depth, which differs from the situation observed in most other fisheries where fish tend to be larger at greater depths.

3.5 A proposal for the second year of the survey series during the 2013/14 season was presented (WG-SAM-13/07). The proposal was essentially the same as that presented to WG-SAM and WG-FSA in 2012 and again provided three options to cover different regions of the Weddell Sea depending on accessibility due to ice conditions. The major difference between the proposals was the increase in catch for the 2013/14 survey for all three of the research proposal options. The increase in catch was proposed in order that the survey would not be truncated (in terms of number of proposed sets) based on the experience of 2012/13 when the existing catch limits were achieved in considerably fewer line sets due to the high CPUEs achieved during the survey.

3.6 The Working Group noted that any proposed increase in catch in 2014 should be spatially constrained to the area surveyed last year in which tagged fish were released. The application of catches based on the high CPUE data outside the area surveyed in 2012/13 may not be appropriate. Calculation of a catch to be taken from within the area (box) surveyed during 2012/13 could be undertaken using the approach outlined in the roadmap for developing research plans in data-poor fisheries (paragraphs 2.5 and 2.6) based on the application of 'ChartMaster' to generate a preliminary local biomass estimate inside the research block and applying an appropriate precautionary exploitation rate.

3.7 Outside the previously surveyed block, the research was still in the prospecting phase as limited catch data were available and due to the high level of uncertainty associated with extrapolating outside the surveyed area, the Working Group considered that this would not be appropriate for areas outside the surveyed area. Outside the surveyed area, a greater spatial spread of sets is desirable in order to obtain spatial CPUE information and consequently, in order to increase spatial coverage, it was suggested that shorter longlines be deployed in the forthcoming survey, or that the distance between sets in the research areas be increased, as this would provide increased spatial and depth information on the distribution of *D. mawsoni* in the Weddell Sea whilst balancing the potential impact on the stock in un-surveyed areas for which no data are available.

3.8 Dr Petrov expressed concern that the deployment of shorter lines was operationally difficult and that, in order to deploy the required 50 lines, the proposed increased catch limits would be necessary. He undertook to consider the suggestions made by the Working Group and resubmit the proposal to WG-FSA.

3.9 Dr Petrov made the following statement:

> 'In my opinion the calculations provided for the required resource potential for research in the 2013/14 year, for that would do a completely research program (set 50 scientific research lines by option 1 (WG-SAM-13/07)), calculated according to the recommendations of the Scientific Committee (SC-CAMLR-XXX, Annex 5, paragraph 2.40(ii)) and meets all the requirements of CM 24-01, including a research agenda item (rationale that proposed catch limits are consistent with Article II of the Convention). Also, I would like to remind the Working Group that we obtained data on CPUE for option 1 in Subarea 48.5 is currently the best for CCAMLR and used by us to calculate the required yield for achieving the goals recommended by the Scientific Committee (SC-CAMLR-XXX, Annex 5, paragraphs 2.25 to 2.29 and 2.35).
>
> We do not support the proposal of the Working Group to the limit research to the square (WG-SAM-13/37) where they were carried out (eight sets) last year. We believe that this proposal restricts our research and does not give the possibility to obtain new data on the distribution of fish in the study area, and the proposed Working Group setting of short lines are not feasible from a technical point of view. But we have informed the Working Group that in WG-SAM-13/07 plan is detailed and station positions (with coordinates) research lines, including water area, is taken into account, where the fish were tagged in 2013 and we plan to catch us previously marked fish from this area. But we also plan to expand our research and new data on the spatial distribution of the target species and the study of all by-catch species, and we believe that our proposed resource potential for research in option 1 is required for the full implementation of the given program.'

Additional information

3.10 The Working Group noted that a new international standard GEBCO bathymetric dataset is available for the Weddell Sea region and this could assist with refinement of the calculation of fishable area in future research proposals in the region.

3.11 Details of a proposed scientific survey of the eastern Weddell Sea, scheduled for December 2013–March 2014 using the vessel *Polarstern*, was presented to the Working Group by Germany. The multidisciplinary survey will include biological, geological and hydrographic studies of the region close to the location of the proposed Russian survey. It was noted that this is a known biological hotspot with large numbers of higher predators observed during summer. Germany has also deployed three acoustic moorings in the region and was requested to provide the location of the moorings to the Secretariat following the example in SC CIRC 13/22.

Subareas 48.1 and 48.2

3.12 The Working Group considered a proposal by Chile to conduct research on finfish distribution and abundance in Subareas 48.1 and 48.2 (WG-SAM-13/14). It noted a number of inconsistencies and omissions from the proposal that made it difficult to provide a thorough appraisal. The Working Group recommended that further details be provided to WG-FSA so that the proposal can be evaluated.

(i) It was not clear whether a pelagic survey was intended (as suggested by the gear/net selection) or a demersal survey (as suggested in the accompanying text). Greater detail on the proposed analysis of acoustic data was requested. The proposed use of a non-scientific echosounder may make the acoustic data difficult to analyse quantitatively and it was not clear how this was to be achieved.

(ii) The Working Group could not clearly determine the aims of the survey and how this was to be achieved using the survey design which only examined the area to the north of the South Orkney Islands chain. The USA and Germany have conducted a considerable number of demersal research surveys in the region and it was not clear what information the new survey would add. Consequently, reference to previous studies is encouraged, especially as these could be used to guide the proposed survey stratification.

(iii) It was recommended that the proponents of the research should also consider the likelihood of the survey taking place close to, or within, areas of high VME abundance as notified by CCAMLR (www.ccamlr.org/node/78917) and that, if the fishing gear used was likely to come into contact with the seafloor, then this should be addressed in the revised submission.

3.13 The Working Group recommended that the proponents of this proposal consider the advice that had been provided and submit a revised proposal to WG-FSA.

Subarea 48.2

3.14 A proposal submitted by Ukraine (WG-SAM-13/38) for research starting in 2013/14 on *Dissostichus* spp. using bottom-set trotlines at depths between 600 and 2 000 m in Subarea 48.2 was reviewed by the Working Group.

3.15 The Working Group noted that the proposed research was for the austral summer period and recalled that a risk assessment had been carried out for the region by WG-IMAF (SC-CAMLR-XXVIII, Annex 7, Tables 13 and 14, Figure 2) and that, due to the risk of incidental mortality to seabirds by demersal longlines, the mitigation measures relating to longline fishing in the region should be followed and addressed in the proposal.

3.16 Previous research on toothfish distribution and abundance in Subarea 48.2 had been carried out by Chile in 1998 (Arana and Vega, 1999) and reported low catch rates of Patagonian toothfish (*D. eleginoides*) (and no *D. mawsoni*) from seven hauls in the region. This information could be useful in refining the spatial extent of the survey.

3.17 The large spatial extent of the survey area was noted and it was suggested that it would be difficult for one vessel to effectively cover all of the proposed research area. It was recommended that smaller spatial units could be sampled more effectively.

3.18 The Working Group recommended that a stock hypothesis for *Dissostichus* spp. within the proposed area should be developed. It is currently uncertain what the relationship is between toothfish found within Subareas 48.1 and 48.2 and those in neighbouring subareas.

3.19 The Working Group also noted that the proposal includes two sets within the boundaries of the South Orkney Islands southern shelf MPA (CM 91-03).

3.20 It was recommended that the proponents of the research should also consider the likelihood of the survey taking place close to, or within, VMEs as notified by CCAMLR (www.ccamlr.org/node/78917) and address this in the revised submission by illustrating the proximity to the areas at risk.

3.21 The Working Group recommended that the proponents of this proposal consider the advice that had been provided and submit a revised proposal to WG-FSA.

Subarea 88.1

Sub-adult survey

3.22 The Working Group considered WG-SAM-13/32 and 13/33 describing the results of the second longline survey of sub-adult *D. mawsoni* in the southern Ross Sea in 2013 and a proposal to continue the time series of research in 2014. The results were broadly similar to those of the 2012 survey, with a total retained catch of 30.7 tonnes of toothfish taken from 65 longline sets, a slightly lower total than obtained in 2012, with a comparable CV.

3.23 Catch rates during the survey were comparable to those obtained by commercial vessels operating in the same area prior to the survey, except in a localised area near the ice shelf of stratum A, where the survey CPUE was much lower than in the commercial fishery. In particular, a large contrast was apparent from a single vessel for which catch rates were substantially higher than reported by other vessels or in previous seasons.

3.24 In reviewing the proposal for a survey in 2014, the Working Group noted that the survey design and number of sets for the three core strata are unchanged from the 2013 survey. Fifteen sets exploring new strata in 2013 failed to locate areas containing substantial numbers of the target size range of fish. The proposal suggests a new exploration stratum for those 15 sets in the southern part of SSRU 881M, which was selected as it was considered a likely habitat for sub-adult *D. mawsoni* and could provide tagged fish which had moved west from the survey area. Survey timing and methods will remain the same as in previous years, although the number of sets is proposed to be reduced by five sets to a total of 60 with a catch limit of 50 tonnes.

3.25 In light of the apparent localised reduction in survey CPUE following commercial fishing activity, the Working Group discussed whether it may be better to conduct research prior to the start of the fishery. However, whilst this may be desirable, it was likely to be

operationally impractical given the ice conditions in the region. The Working Group supported the proposed survey design and effort limitations by strata for the 2014 season and agreed that they required no further modification.

3.26 The Working Group discussed potential mechanisms by which a catch limit should be applied to the survey, which will include SSRU M (which has a catch limit of 0 tonnes). The Working Group requested that this matter be considered by the Scientific Committee and the Commission.

Divisions 58.4.4a and 58.4.4b (Ob and Lena)

3.27 WG-SAM-13/20 reported the results of a research survey for *D. eleginoides* conducted by Japan in SSRUs C and D within Divisions 58.4.4a and 58.4.4b during the 2012/13 season. A total catch of 31.1 tonnes was reported from 64 longline sets. A total of 233 fish were tagged and released (achieving a tag-overlap statistic of 81%) with three recaptures of tagged fish from releases in SSRU C (in 2007/08 and 2010/11). In addition to the target species, new information on the distribution and abundance of by-catch species was provided in the study.

3.28 The Working Group reviewed the proposal by Japan (WG-FSA-13/21) to continue research in SSRUs C and D in 2013/14 with a proposed catch of 50 tonnes. The survey design would remain the same as that used in 2012/13. Noting the continued development of integrated stock assessments for SSRUs C and D, the Working Group supported the proposal and agreed that it required no further modification and thanked Japan for the effort that had been undertaken to progress this work. The Working Group further noted that the effort limit could be removed from the survey design as this research is in the catch-limited phase. Specific advice provided by the Working Group relating to the development of the model is provided in paragraphs 4.15 and 4.16.

METHODS FOR ASSESSING FINFISH STOCKS IN ESTABLISHED FISHERIES, NOTABLY *DISSOSTICHUS* SPP.

Toothfish assessment

4.1 WG-SAM-13/18 reported on a new method using length-frequency data to inform how to allocate hauls to fisheries for a stock assessment. The model uses length-frequency distributions which are simplified to length quantiles at a range of cumulative probabilities, applying a generalised additive mixed model (GAMM) to fit cubic smoothing splines to these length quantiles, and a flexible combination of the covariates such as gear type, depth strata, fishing region or the sex of the sampled fish. The Working Group noted the value of performing sensitivity analyses with different fishery structures in any stock assessment, and noted that this method provided a tool for informing such analyses. The Working Group also noted the main limitation of this method is the need for arbitrary splits in the data that can subsequently be tested. It further recommended that any suggested split be tested in sensitivity analyses.

4.2 WG-SAM-13/24 presented a revised stock assessment of Patagonian toothfish in Subarea 48.4. The revised assessment retained much of the structure of previous assessments, but was revised to include data for Subarea 48.4 South, employed a revised maturity ogive and different assumptions about the functional form of the selection pattern.

4.3 The Working Group noted the strong dependence of the assessment on the 2009 age composition data that gave rise to the very large recruitment event estimated early in the time series. It recommended that the weighting of age-composition data be reinvestigated along with a comparison of alternative assumptions for incorporating uncertainty in recruitment into the projections of future stock status (using e.g. bootstrapping or resampling methods).

4.4 The Working Group welcomed the intention to age more fish otoliths and re-age some of the 2009 otoliths for the assessment which will be presented at WG-FSA-13. It also referred to the recommendation from the Ageing Workshop during WG-FSA-12 on inter-laboratory exchange of otoliths.

4.5 WG-SAM-13/34 reported on further developments of a tag-detection performance index and its application to the stock assessment of toothfish in the Ross Sea fishery. Following on from work last year (WG-FSA-12/47 Rev. 1 and SC-CAMLR-XXXI, paragraph 3.167), the paper included simulations to evaluate the power of performance indices for tag-induced mortality and tag detection. Although the two methods resulted in a similar performance ranking of vessels, the former was found to have only low power and was therefore not further developed.

4.6 In reviewing the paper, the Working Group noted that the proposed application of the method in a stock assessment assumes a relationship between the performance of a vessel in releasing tagged fish with its performance in detecting tagged fish, since all tagging data, including released tagged fish, are excluded from a stock assessment for vessels with a low tag-detection index. It also noted that, because the vessel selection imposes a binary distinction (inclusion or exclusion of the vessel data) based on a continuous index, the particular choice of the selection criteria is arbitrary. The Working Group recommended further development of the method that would allow a selection or weighting of vessel data which is based completely on a statistical procedure as well as estimating the relationship between the tagging and detection of tagged fish for an individual vessel.

4.7 Most Members agreed that the method proposed in WG-SAM-13/34, instead of the method used in the 2011 assessment, should be used to select vessels for the 2013 toothfish stock assessment in the Ross Sea.

4.8 Dr S. Goncharov (Russia) made the following statement to WG-SAM:

> ‘Some Members have stated doubt about the necessity of the use of the presented method for a stock assessment in 2013, because of a small representativeness of the data. I suggest to continue work on the presented method on more statistical material.’

4.9 The Working Group noted that a poor tag-detection rate of a vessel could simply arise from vessels that do not scan all fish for the presence of tags, whereas the scanning and detection rate of tagged fish in a CASAL stock assessment is assumed to be constant across all vessels and years of a fishery.

4.10 The Working Group recommended that the results from the analysis presented in WG-SAM-13/24 should be used to improve the overall performance of the tagging program, through the investigation of potential operating procedures that may lead to low tag-detection rates for those vessels with a low tag-detection index, and subsequent evaluation of ways for improvement. It noted that the introduction of the tag size-overlap requirement had led to an increase in the number of fish being measured and may have improved the tag-scanning and tag-detection rates. This indicates that specific management measures can have further-reaching effects than anticipated. The Working Group noted that it would be useful if this method was used in other areas of CCAMLR, as it could inform on the performance of vessels that fish mainly in other areas.

4.11 Some Members suggested that opening closed SSRUs would also help with this method. However, the authors explained that the method is independent of fish movement or location of fishing as it accounts only for the tagged fish available in a location. Opening closed SSRUs would only provide useful information for this method if fishing effort was highly concentrated in these SSRUs, since the case-control method works only when multiple vessels fish in close proximity to each other.

4.12 WG-SAM-13/35 and 13/36 reported on further developments of a spatially explicit population dynamics operating model for Antarctic toothfish in the Ross Sea region and, using this operating model, an investigation of potential biases in the assessment of Antarctic toothfish in the Ross Sea fishery. The Working Group noted that, whilst results are still preliminary, the modelled toothfish distributions and movements are consistent with available data. Simulations of the effect of these movements on the single-area stock assessment point towards a conservative stock assessment and are broadly consistent with WG-FSA-12/45.

4.13 The Working Group noted uncertainty arising from the use of data from only fished areas to inform assumed distributions and movements in the entire Ross Sea region, and the uncertainty in the choice of the shape of assumed movement parameter functions. The Working Group noted that further data collection would be beneficial to the parameterisation of movement functions in the model, particularly making collection of gonad weight measurements routine, and recommended WG-FSA consider how best this might be undertaken. The Working Group noted that surveying likely spawning grounds during winter, and obtaining data from areas not fished to date, would also be beneficial.

4.14 The Working Group noted that for a given fish movement scenario, the model can simulate the likely effects on the stock assessment of different spatial management options affecting the distribution of fishing effort, data collection and/or tagged fish releases. The Working Group encouraged the submission of papers describing alternative movement hypotheses in order to evaluate the robustness of different spatial management options against a range of movement hypotheses.

4.15 WG-SAM-13/21 reported further progress on the CASAL stock assessment of Ob and Lena Banks (Division 58.4.4a). The Working Group noted that there were issues with data weighting and recommended that further investigations be carried out. While some initial runs were carried out during the meeting, the Working Group recommended the model be investigated further, including increasing the weighting of tag data in order to improve fits. The Working Group noted that although the fits to the 2012 tag data were problematic, these data should be included in the model if at all possible, as the tagging vessel has had tagged

fish recovered in previous years in this area. It also noted that although IUU catches are not calculated by the Secretariat anymore, estimates for recent years were required for inclusion in sensitivity runs.

4.16 The Working Group recommended a stand-alone paper be presented at WG-FSA on this stock assessment showing all the fits and diagnostics and sensitivities to data weighting. It also welcomed any expert review by other Members to help progress this stock assessment.

Results of the Korean workshop on anomalous CPUE

4.17 Arising from the discussion of anomalously high CPUEs reported from some Korean vessels in data-poor exploratory fisheries (SC-CAMLR-XXXI, paragraph 3.117), the Republic of Korea held a workshop in May 2013.

4.18 The Working Group thanked Korea for holding this workshop and also thanked Dr I. Yeon (Republic of Korea) for her very detailed presentation of the report of the workshop (WG-SAM-13/39). In endorsing the key points and recommendations for future work in WG-SAM-13/39, the Working Group noted in particular the following:

(i) recognition that a high CPUE by itself is not a problem but the anomalous pattern of high CPUEs requires an explanation

(ii) during the fishing trips concerned (*Insung No. 22* in 2009, *Insung No. 2* in 2010 and *Insung No. 7* in 2011), the gear configuration (including the bait) did not change during the trips, although there were differences between vessels and trips

(iii) different measures of effort (number of hooks, length of line, hauling time) showed a consistent pattern within trips. The catch in tonnes showed a similar pattern of variation to the CPUE

(iv) a description of the fishing patterns from an Insung captain indicated that fishing occurred in SSRU 5841G until ice conditions allowed the vessel to move to preferred fishing areas

(v) it is apparent that the experience and skill of the captain and crew is very important in understanding the differences in CPUE between vessels and years, however, this is very difficult to quantify and was unlikely to change within a single fishing trip

(vi) data analysis and information presented to the workshop provided a greater understanding of the available data and allowed the analysis to move from data exploration to the identification and testing of hypotheses of how the anomalous CPUE might have arisen

(vii) further work should be undertaken to:

    (a) test the hypotheses developed at the workshop as well as additional hypotheses that can be produced

(b) identify and quantify additional factors that might help interpret and standardise CPUE data, including the skill of the captain and crew, improved fishing gear, bait, sea-ice pattern, seabed and the density of toothfish.

4.19 Following an undertaking given at the workshop, Dr Petrov presented WG-SAM-13/16, which had previously been presented in Russian at the Korean workshop. The authors highlighted the difficulties in interpreting non-standardised CPUE and that, in their opinion, this meant that further analysis to determine the reasons for the high CPUE from the Korean vessels was not appropriate. The Working Group thanked Dr Petrov for presenting the paper.

4.20 Dr Yeon pointed out that an analysis of the CPUE variation of all vessels in exploratory fisheries also indicated some cases of unusually high CPUEs by some vessels that were even higher than the highest CPUEs recorded in Divisions 58.4.1 and 58.4.2 and Subarea 48.6. She also said the captains and crews who had more experience would be more likely to achieve higher CPUEs, and most of the high CPUEs appeared with the relatively lower fishing efforts even though the catch was low. She also emphasised that it would be very useful to focus on developments in the approaches to the use of CPUEs collected from different fishing gears, areas, skills of captains and crews, ice conditions, seabed etc.

4.21 The Working Group agreed that work on standardisation of CPUE between vessels with different characteristics should continue and also that all uncharacteristically high CPUEs recorded in CCAMLR fisheries should be investigated.

4.22 Dr Petrov also noted that the Scientific Committee made a recommendation that on Korean vessels in Divisions 58.4.1 and 58.4.2 and Subarea 48.6 there were anomalously high CPUEs but that the Scientific Committee had not provided criteria for 'anomalously high' CPUEs and questioned what should be considered as an anomalously high CPUE. He also noted that WG-SAM-13/16 presented results of analysis of different gear, analysis of soak of gear, which clarify that operation factors should be taken into account, but they were not taken into account in WG-FSA-12/07 on which all accounts are based.

4.23 The Working Group recognised that there has been considerable discussion of the complexities surrounding the choice of metrics of CPUE and how such metrics can be compared between vessels and fisheries. In the case of the data from the three Korean vessels, there was also a recognition that, while it was the occurrence of high CPUEs that had stimulated the detailed analysis presented in WG-SAM-13/39, attention could now also focus on the pattern of CPUE throughout the trips made by the three vessels.

4.24 The Working Group encouraged interested Members to engage appropriate experts in the construction and testing of hypotheses to examine factors that might produce the observed patterns of CPUE, including analyses of data from all fishing vessels in CCAMLR exploratory fisheries, and to present these results to WG-FSA.

Other

Spatial data and analyses

4.25 WG-SAM-13/04 gave an introduction to the ChartMaster GIS software, including examples of its application for mapping the spatial distribution of commercial species, three-dimensional analysis and visualisation of the seafloor topography and methods for the estimation of total biomass from research fishing and survey abundance indices.

4.26 The Working Group agreed that the software was a useful tool for data visualisation and spatial analysis and noted that the facility to consider the three-dimensional topography of the seafloor when interpolating CPUE, rather than using the sea-surface area (in the horizontal plane) that covers the study area, was particularly useful. Several methods of interpolation are facilitated by the software. The Working Group noted that the results obtained from ChartMaster have been validated by comparison with other spatial analysis software (SURFER). It welcomed the detailed description of the algorithms employed by ChartMaster and supporting references but requested some further information on the methods of interpolation used by the ChartMaster software. Dr Goncharov directed the Working Group to the English references in WG-SAM-13/04.

4.27 The Working Group considered that the software could be used to provide a preliminary estimate of stock biomass, based on CPUE and seabed area, but that such estimates should not be based on extrapolations beyond the spatial bounds of the sample data. It further noted that the software had applications for the estimation of krill biomass and acoustic-based analyses and could be of interest to WG-EMM and encouraged the authors of WG-SAM-13/04 to submit it to WG-EMM and SG-ASAM.

Methods for forecasting the closure of fisheries

4.28 WG-SAM-13/06 outlined a work in progress to refine the method currently used by the Secretariat to forecast the closure dates of fisheries. The forecast model was developed in 1991 based on a linear regression of cumulative catches against reporting period (CCAMLR-X/BG/09; subsequently published as Agnew, 1992). The method uses a linear projection of catches derived from the mean daily catch rate of vessels for the three most recent reporting periods and assumes that the fishery will operate in the future in the same way that it did in the period from which data are used to make the projection. As a consequence, overruns of the catch quota in some instances are inevitable.

4.29 The Working Group noted that both over- and under-catches are normal operational outcomes of the method by which CCAMLR manages fishery closures. It considered that the current method for predicting the closure of a fishery was generally effective. It noted that the potential for an overrun of the catch quota is more likely when catch limits are small and when many vessels participate in the fishery, and that it is particularly difficult to predict the closure of a fishery when there are insufficient data to determine a linear relationship for recent catch rates. The Working Group suggested that other modelling approaches, such as GAMMs and quantile regression, could be explored but noted that the problem is likely to

persist in situations where data are sparse. It noted that in the case of very small quotas no such prediction method would be effective as the quota could be taken before sufficient data is available to run modelling methods.

Skate tagging

4.30 WG-SAM-13/25 Rev. 1 provided an overview of global tagging studies in skates, a review of tag loss and tag shedding in elasmobranch fishes, a summary of tag data from studies conducted in European waters to inform on typical return rates in those studies and some initial observations on some of the tagging work undertaken under the auspices of CCAMLR. The report made a number of recommendations regarding the recording of data on tagged skates. These included taking multiple length measurements (e.g. total length and wing spread) to allow for data validation as well as improved species identification and data checking prior to submission to the Secretariat. The report further recommended that tagging studies in which individuals are tagged with multiple tags of different types be developed to investigate tag shedding in skates.

4.31 The Working Group considered the paper to be a very useful overview of tagging practices both within and outside of the CAMLR Convention Area. It supported the recommendations on the collection and validation of data on tagged skates and recommended that the paper be forwarded to WG-FSA for further consideration along with the Secretariat review of skate data requested last year (SC-CAMLR-XXXI, Annex 7, paragraph 8.18).

Icefish assessment in Subarea 48.3

4.32 WG-SAM-13/31 Rev. 1 described a retrospective analysis and sensitivity evaluation of the performance of the CCAMLR harvest control rule (HCR) for the mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.3. The retrospective analysis showed the harvest control rule generates levels of exploitation that are considered precautionary. The sensitivity analyses demonstrate that the application of fixed von Bertalanffy growth and length-to-weight relationship parameters does not introduce significant bias or noise to the potential catch estimates.

4.33 The Working Group noted that the retrospective analysis showed biomass projections using the CCAMLR HCR algorithm for the Subarea 48.3 icefish (which do not include recruitment) fall below the subsequent year's survey estimates with a high probability, indicating that the projections upon which the catch advice is based are consistent with the objectives of the CCAMLR HCR. It further noted that the timing of survey series should, as far as possible, be kept consistent, as the distribution of icefish differed at different times of the year, and would impact on the results.

4.34 The Working Group further noted that icefish length-distribution data were available from studies on the diets of higher predators in Subarea 48.3 and that these data could be compared to survey length distributions to investigate the potential development of a recruitment index for the stock.

Algorithms for checking the quality of observer data

4.35 WG-SAM-13/40 presented ongoing work by the Secretariat to develop an algorithm for checking the quality of observer data submitted by Members. The algorithm is able to detect and report invalid data formats, as well as value inconsistencies, through a limited set of logical tests. For each logbook inspected, a text report and set of figures are produced indicating the occurrence of faulty entries. The Working Group agreed that the approach presented was useful and encouraged the Secretariat in further developing algorithms for automated data checking.

4.36 The Working Group recognised that the timing of making changes to the observer logbooks and instructions following the Commission meeting meant that the information was not available in all languages before the beginning of the fishing season. The Secretariat agreed that this was an unfortunate process issue and encouraged everyone who had experienced such difficulties to respond to the recently released CCAMLR Scheme of International Scientific Observation (SISO) review survey which was an integral part of the review of the observer scheme (SC-CAMLR-XXXI, paragraphs 7.3 to 7.6).

OTHER BUSINESS

Discussion of Joint WG-SAM–WG-EMM Focus Symposium on Spatial Modelling in 2014

5.1 The Working Group considered the proposal to hold a spatial-modelling symposium in 2014 (SC-CAMLR-XXXI, paragraph 15.2) and agreed that, while such a workshop would be of interest scientifically, it may not be a priority given current workloads and priorities. The conveners of WG-SAM and WG-EMM both reflected on the range of science programs (e.g. ICED) that were working on models of the Southern Ocean and encouraged Members to engage in these programs to ensure that CCAMLR benefits from the scientific synergies available.

Accessibility and availability of CCAMLR science to a wider audience

5.2 The Working Group discussed a proposal for making the science undertaken in CCAMLR more widely available within the public domain (WG-SAM-13/17) and specifically how working group papers might be made available, via the search facility of the CCAMLR website, to a wider audience.

5.3 Proposals for delaying the release of the paper on the CCAMLR website (publication embargo) until at least after the meeting of the Scientific Committee were considered. Such an embargo may be applied for varying time periods, depending on the content of the paper and, at the discretion of the Scientific Committee representative, may be subject to further extension, where necessary, in order to protect sensitive information.

5.4 The Working Group recognised that the papers must be considered in the context of the discussions as recorded in the working group report to which the papers had been submitted and discussed. It was further noted that disclaimers could be appended to working group papers including, inter alia:

(i) the paper should not be cited without the prior permission of the author

(ii) the working group report should be consulted prior to citing the paper to ensure the correct context

(iii) the content of the paper reflects a contribution to scientific discussions that are ongoing, and does not necessarily reflect the ongoing views of the Member submitting it, or of CCAMLR.

5.5 The Working Group agreed that for each paper a tick-box system could allow the submitter to choose the type of embargo to be applied to the paper, which could be revisited at the appropriate working group if another Member disagrees with the proposed embargo.

5.6 The need for clarity on the application of the CCAMLR data access rules as applied to working group papers and those in the public domain was noted, as well as a requirement for guidance on how the working group papers should be cited.

Editorial procedures of *CCAMLR Science*

5.7 The Working Group discussed a proposal for revising the editorial procedures for papers submitted to *CCAMLR Science*. The proposal included a recommendation that papers that are to be considered for publication in *CCAMLR Science* should be submitted in the format required for the journal to the working group meeting or within one month of the working group meeting. The Working Group considered that this deadline may prove difficult for those participants in WG-FSA who were also engaged in Scientific Committee and Commission meetings, and also that the contents requirements of a scientific paper and a working group paper are different, which might result in insufficient information presented at CCAMLR working groups where the paper is intended for submission.

5.8 The Working Group considered that Microsoft Word templates and EndNote reference styles would be useful tools to assist authors when submitting manuscripts. Similarly, LaTeχ style files and templates were also requested.

5.9 The Working Group noted that the official language of *CCAMLR Science* was English and this was considered to be a problem by some Members who stated this to be the reason that few Russian papers had been published in the journal in recent years.

CCAMLR web-based GIS

5.10 The Secretariat presented a prototype of the CCAMLR web-based GIS which is being developed jointly with the British Antarctic Survey (BAS) to provide state-of-the-art capacity

for displaying geo-referenced data relevant to CCAMLR (WG-EMM-12/70). This development will include capacity building at the Secretariat and a phased handover of the system to the Secretariat.

5.11 The development of the GIS will be implemented in two stages, with stage 1 nearing completion and stage 2 being implemented in 2014. The prototype is currently located at gis.ccamlr.org and contains basic data layers (e.g. management areas, bathymetry, sea-ice). An option to download data is available to users authenticated on the CCAMLR website. The Secretariat encouraged users to provide feedback.

5.12 The Working Group agreed that this web-based GIS will be a valuable tool and congratulated BAS and the Secretariat on progress to date.

ADVICE TO THE SCIENTIFIC COMMITTEE

6.1 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) Research plans for exploratory fisheries in Subareas 48.6 and 58.4 in 2013/14 –

  (a) submission of research plans (paragraph 2.3).

(ii) Scientific research proposals for other areas –

  (a) research in Subarea 88.1 (paragraphs 3.25 and 3.26)
  (b) research in Divisions 58.4.4a and 58.4.4b (paragraph 3.28).

(iii) Methods for assessing finfish stocks in established fisheries –

  (a) routine collection of gonad weights (paragraph 4.13).

(iv) Other matters –

  (a) papers on toothfish biology referred to WG-FSA for consideration (paragraph 1.3).

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

7.1 The report of the meeting of WG-SAM was adopted.

7.2 In closing the meeting, Dr Hanchet thanked the participants for their contributions to the meeting and their work during the intersessional period, the subgroup coordinators for motivating in-depth discussions, the rapporteurs for preparing the report, and the Secretariat for its support. Dr Hanchet also thanked AWI and the German Federal Ministry of Food, Agriculture and Consumer Protection for hosting the meeting and Dr Hain and colleagues for their kind hospitality and assistance during the meeting.

7.3 Dr T. Ichii (Japan), on behalf of the Working Group, thanked Dr Hanchet for facilitating discussions in a convivial atmosphere which had resulted in a successful meeting.

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Welsford, D.C. 2011. Evaluating the impact of multi-year research catch limits on overfished toothfish populations. *CCAMLR Science*, 18: 47–55.

Appendix A

LIST OF PARTICIPANTS

Working Group on Statistics, Assessments and Modelling
(Bremerhaven, Germany, 24 to 28 June 2013)

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Appendix B

AGENDA

Working Group on Statistics, Assessments and Modelling
(Bremerhaven, Germany, 24 to 28 June 2013)

1. Introduction

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

2. Evaluation of research plans from Members notifying to fish in new and exploratory fisheries in Subareas 48.6 and 58.4

3. Review of scientific research proposals for other areas (e.g. closed areas, areas with zero catch limits, Subareas 88.1 and 88.2)

4. Methods for assessing finfish stocks in established fisheries, notably *Dissostichus* spp.

    4.1 Toothfish assessments
    4.2 Toothfish biology
    4.3 Anomalous CPUE workshop
    4.4 Other

5. Other business

    5.1 Discussion of joint WG-SAM–WG-EMM focus symposium on spatial modelling in 2014

6. Advice to the Scientific Committee

    6.1 WG-FSA
    6.2 General

7. Adoption of report and close of meeting.

Appendix C

LIST OF DOCUMENTS

Working Group on Statistics, Assessments and Modelling
(Bremerhaven, Germany, 24 to 28 June 2013)

WG-SAM-13/01	Provisional Agenda for the 2013 Meeting of the Working Group on Statistics, Assessments and Modelling (WG-SAM)
WG-SAM-13/02	List of participants
WG-SAM-13/03	List of documents
WG-SAM-13/04	GIS 'ChartMaster' for aquatic living resources research in Antarctic V.A. Bizikov, S.M. Goncharov, A.V. Polyakov, S.B. Popov and A.F. Petrov (Russia)
WG-SAM-13/05	Progress report on the research longline fishery of *Dissostichus* spp. in Subarea 48.6 being jointly undertaken by Japan and South Africa: 2012/13 R. Leslie (South Africa), K. Taki, T. Ichii (Japan) and S. Somhlaba (South Africa)
WG-SAM-13/06	Review of fishery monitoring and forecast procedures Secretariat
WG-SAM-13/07	Notification for multi-year research in Subarea 48.5 Delegation of Russia
WG-SAM-13/08	Research plan for the exploratory fishery for *Dissostichus* spp. in Division 58.4.3a in 2013/14 Submitted by the Secretariat on behalf of France
WG-SAM-13/09	Research plan for the exploratory fisheries for *Dissostichus* spp. in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a in 2013/14 Submitted by the Secretariat on behalf of Japan
WG-SAM-13/10	Research plan for the exploratory fishery for *Dissostichus* spp. in Division 58.4.1 in 2013/14 Submitted by the Secretariat on behalf of the Republic of Korea
WG-SAM-13/11	Research plan for the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 in 2013/14 Submitted by the Secretariat on behalf of South Africa

WG-SAM-13/12	Research plan for the exploratory fisheries for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2 in 2013/14 Submitted by the Secretariat on behalf of Spain
WG-SAM-13/13 Rev. 1	Research plan for the exploratory fisheries for *Dissostichus* spp. in Subarea 48.6 and Division 58.4.1 in 2013/14 Submitted by the Secretariat on behalf of Ukraine
WG-SAM-13/14	Research plan to investigate finfish distribution and abundance in Subareas 48.1 and 48.2 Submitted by the Secretariat on behalf of Chile
WG-SAM-13/15	Research plan to assess the stock status of *Dissostichus* spp. in Subarea 48.2 Submitted by the Secretariat on behalf of Ukraine
WG-SAM-13/16	Assessment of the analysis of anomalous CPUE data from data-poor exploratory fisheries V.A. Tatarnikov, A.F. Petrov and I.I. Gordeev (Russia)
WG-SAM-13/17	CCAMLR Papers: accessibility, availability and publication – options for the future Secretariat
WG-SAM-13/18	A distribution-free model of length-frequency distribution to inform fishery stratification for integrated assessments S. Candy, P. Ziegler and D. Welsford (Australia)
WG-SAM-13/19	Results of reading tests of TOP otolith sections and time schedule of reading for *Dissostichus* otoliths caught in regions of data-poor fisheries K. Taki and T. Ichii (Japan)
WG-SAM-13/20	Reports on abundance and biological information of toothfish in Division 58.4.4a & b by *Shinsei Maru No. 3* in 2012/13 season K. Taki, T. Ichii, T. Iwami and M. Kiyota (Japan)
WG-SAM-13/21	Research plan for toothfish in Division 58.4.4a & b by *Shinsei Maru No. 3* in 2013/14 Delegation of Japan
WG-SAM-13/22	Operational difficulties in exploratory fisheries N. Miyagawa, J. Okamoto, N. Akimoto and K. Hirose (Japan)
WG-SAM-13/23	Results of research program of the Russian Federation in Subarea 48.5 (Weddell Sea) in season 2012/13 A.F. Petrov, I.I. Gordeev and E.F. Uryupova (Russia)

WG-SAM-13/24	A revised assessment of Patagonian toothfish in Subarea 48.4 R. Scott (United Kingdom)
WG-SAM-13/25 Rev. 1	An overview of tagging skates (Rajiformes) and CCAMLR skate tagging data S.R. McCully, D. Goldsmith, G. Burt, R. Scott and J.R. Ellis (United Kingdom)
WG-SAM-13/26	Diet composition and feeding strategy of Antarctic toothfish, *Dissostichus mawsoni* in SSRU 5841C-a for the exploratory longline fishery in 2012/13 of Korea I. Yeon, Y.J. Kwon, S.G. Choi, K.J. Seok, D.W. Lee, J.M. Jeong, S.J. Ye, H.J. Kim and G.W. Baeck (Republic of Korea)
WG-SAM-13/27	Reproductive analysis of *Dissostichus mawsoni* in SSRU 5841C-a for the exploratory longline fishery in 2012/13 of Korea I.J. Yeon, J.S. Lee, Y.J. Kwon, M.A. Jeon, S.K. Choi, K.J. Seok, D.W. Lee, K.Y. Ku and H.J. Kim (Republic of Korea)
WG-SAM-13/28	Results of the research for the exploratory longline fishery for *Dissostichus* spp. in SSRUs C and E in Division 58.4.1 in 2012/13 of Korea I.J. Yeon, Y.J. Kwon, D.W. Lee, S.G. Choi and K.J. Seok (Republic of Korea)
WG-SAM-13/29	A preliminary stock assessment in SSRUS 486A, G: A Bayesian and CPUE based biomass dynamic model R. Wiff, J.C. Quiroz (Chile) and R. Scott (United Kingdom)
WG-SAM-13/30	Research plan for the Spanish exploratory longline fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2: preliminary results of stage 1 (2012/13 season) R. Sarralde, L.J. López Abellán and S. Barreiro (Spain)
WG-SAM-13/31 Rev. 1	An evaluation of the performance of the CCAMLR mackerel icefish (*Champsocephalus gunnari*) harvest control rule as applied within CCAMLR Subarea 48.3 C. Darby, T. Earl and H. Peat (United Kingdom)
WG-SAM-13/32	Results of a CCAMLR sponsored research survey to monitor abundance of subadult Antarctic toothfish in the southern Ross Sea, February 2013 S.J. Parker, S.M. Hanchet, S. Mormede, A. Dunn (New Zealand) and R. Sarralde (Spain)

WG-SAM-13/33	Proposal to continue the time series of CCAMLR-sponsored research surveys to monitor abundance of subadult Antarctic toothfish in the southern Ross Sea in 2014 S.J. Parker, S.M. Hanchet, S. Mormede and A. Dunn (New Zealand)
WG-SAM-13/34	Further development of pairwise tag detection performance index and its application to the stock assessment of toothfish in the Ross Sea fishery S. Mormede (New Zealand)
WG-SAM-13/35	Further development of a spatially explicit population dynamics operating model for Antarctic toothfish in the Ross Sea region S. Mormede, A. Dunn, S. Parker and S. Hanchet (New Zealand)
WG-SAM-13/36	Investigation of potential biases in the assessment of Antarctic toothfish in the Ross Sea fishery using outputs from a spatially explicit operating model S. Mormede and A. Dunn (New Zealand)
WG-SAM-13/37	Considerations for research plan design and implementation in data-poor fisheries S.J. Parker, B. Sharp, A. Dunn (New Zealand) and K. Taki (Japan)
WG-SAM-13/38	Plan of research program of the Ukraine in Subarea 48.2 in 2014 Delegation of Ukraine
WG-SAM-13/39	Report of the Workshop for the Analysis on the Anomalously High CPUE by Korean Vessels in the CCAMLR Area Delegation of the Republic of Korea
WG-SAM-13/40	Development of an algorithm designed to assess observer data quality and performance Secretariat
WG-SAM-13/41	Characterising catch and effort from data-poor toothfish fisheries in CCAMLR Divisions 58.4.3 – 58.4.4 J.C. Quiroz, R. Wiff (Chile) and P. Martinez (Argentina)

Annex 5

Report of the Working Group
on Ecosystem Monitoring and Management
(Bremerhaven, Germany, 1 to 10 July 2013)

CONTENTS

REPORT OF THE WORKING GROUP ON ECOSYSTEM MONITORING AND MANAGEMENT

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INTRODUCTION

Opening of the meeting

1.1 The 2013 meeting of WG-EMM was held at the German Shipping and Maritime Museum, Bremerhaven, from 1 to 10 July 2013. The meeting was convened by Dr S. Kawaguchi (Australia) and local arrangements were coordinated by Dr S. Hain from the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research, with support from the German Federal Ministry of Food, Agriculture and Consumer Protection. The meeting was opened by Prof. K. Lochte, Director of the AWI.

1.2 Prof. Lochte welcomed the Working Group to its first meeting in Germany, and noted WG-EMM's wide remit for scientific assessments and the development of management advice on the status of Antarctic marine ecosystems and on aspects of spatial protection, including marine protected areas (MPAs) and vulnerable marine ecosystems (VMEs). In particular, this latter aspect was of special interest to the AWI, as the institute is currently carrying out scientific analyses for a German proposal for a CCAMLR MPA in the Weddell Sea. The first conceptual outline of this project was presented in WG-EMM-13/22 and the AWI would welcome contributions and input from working group experts to this work. Prof. Lochte wished the Working Group a successful and productive meeting and all participants a pleasant stay in Bremerhaven.

1.3 Dr Kawaguchi welcomed the participants (Appendix A) and outlined the work for the meeting. The agenda focused on the krill-centric ecosystem and issues related to the management of the krill fishery and spatial management (MPAs and VMEs). An evening colloquium was held at the AWI on 4 July 2013 entitled 'Science and scientific research in Antarctica under CCAMLR and at the AWI: A mutual information exchange'.

Adoption of the agenda and organisation of the meeting

1.4 The Working Group discussed the provisional agenda and agreed to expand item 2 to include specific consideration of climate change (consideration of this is presented in the future work section of this report). The revised agenda was adopted (Appendix B). Subgroups were formed to address detailed aspects of the agenda.

1.5 Documents submitted to the meeting are listed in Appendix C. While the report has few references to the contributions of individuals and co-authors, the Working Group thanked all authors of papers for their valuable contributions to the work presented to the meeting.

1.6 The Working Group noted that the CCAMLR website had evolved into a very useful and versatile meeting resource, and thanked the Secretariat for redeveloping the site.

1.7 In this report, paragraphs that provide advice to the Scientific Committee and its other working groups have been highlighted; these paragraphs are listed in Item 5.

1.8 The report was prepared by Drs A. Constable (Australia), C. Darby (UK), L. Emmerson (Australia), J. Hinke (USA), T. Ichii (Japan), K.-H. Kock (Germany), D. Ramm, K. Reid (Secretariat), G. Skaret (Norway), P. Trathan, J. Watkins (UK) and G. Watters (USA).

THE KRILL-CENTRIC ECOSYSTEM AND ISSUES RELATED TO MANAGEMENT OF THE KRILL FISHERY

Issues for the present

Fishing activities

Summary report on the fishery

2011/12

2.1 Twelve vessels from six Members fished for krill in Subareas 48.1, 48.2 and 48.3 in 2011/12 and the total catch of krill was 161 085 tonnes (Subarea 48.1: 75 630 tonnes; Subarea 48.2: 29 040 tonnes; Subarea 48.3: 56 415 tonnes) (see WG-EMM-13/37 Rev. 1). These catches did not trigger any closures in the fishery.

2.2 Norway reported the largest catches of krill with a total of 102 800 tonnes, the Republic of Korea reported 27 100 tonnes, Japan reported a catch of 16 258 tonnes, Chile reported 10 662 tonnes and the People's Republic of China (hereinafter referred to as China) reported 4 265 tonnes.

2.3 Most of the catch in 2011/12 was taken in four small-scale management units (SSMU): 50 218 tonnes from South Georgia East (SGE); 28 832 tonnes from South Orkney West (SOW); 28 657 tonnes from Bransfield Strait West (APBSW) and 20 424 tonnes from Drake Passage East (APDPE).

2.4 The Working Group noted that catches were concentrated in a small number of fine-scale rectangles (0.5° latitude × 1.0° longitude) within each SSMU (WG-EMM-13/37 Rev. 1, Figure 3). As an example, in Subarea 48.3, fishing was highly concentrated, often occurring in the same rectangle each season; there was also some evidence from analyses undertaken in 1996 that the fishery may move in a westerly direction along the South Georgia northern shelf as the season proceeds. These areas fished in the winter also correspond with the summer foraging grounds of some krill-dependent predators. Since scientific information on winter krill abundance in all subareas in Area 48 is limited, the Working Group agreed that acoustic data collected by fishing vessels would help understand patterns of krill abundance in the areas fished.

2012/13

2.5 Eleven vessels licensed from five Members (Chile, China, Republic of Korea, Norway and Ukraine) fished for krill in Subareas 48.1, 48.2 and 48.3. The total catch reported to May 2013 was 151 161 tonnes, 86% of which was taken from Subarea 48.1. So far this season, Chile has reported catching 2 028 tonnes of krill, China 23 934 tonnes, Korea 30 677 tonnes, Norway 106 327 tonnes and Ukraine 2 507 tonnes.

2.6 The monthly cumulative catch of krill in the fishery reported to May 2013 is greater than any of those reported to May in the past five seasons. Fishing has concentrated in Bransfield Strait in SSMUs Bransfield Strait West (BSW: 81 631 tonnes to date) and Bransfield Strait East (BSE: 17 553 tonnes). Subarea 48.1 was closed on 14 June and will remain closed to krill fishing until the end of the season (30 November 2013). The total reported catch in Subarea 48.1 at the time of the closure was 154 100 tonnes (99% of the apportioned limit of 155 000 tonnes; see Conservation Measure (CM) 51-07).

2.7 The Working Group noted that it was the second time that the krill fishery had triggered a closure in Subarea 48.1; the first occasion was in 2009/10 near the end of the fishing season. The recent closure occurred in the middle of the fishing season, reflecting a more rapid uptake of the catch during the first half of 2012/13. This more rapid uptake of catch resulted from concentrated krill aggregations and favourable weather/ice conditions.

2.8 The Working Group noted that sea-ice extent is an important factor influencing the location of the krill fishery. In 2012/13, sea-ice coverage was reported to be less extensive in Subarea 48.1, where fishing was concentrated, whereas coverage was extensive in Subarea 48.2, where relatively little fishing has been reported so far.

2.9 The Working Group agreed that it would be useful to have a consolidated summary of information related to the krill fishery in a similar format to the fishery reports that are completed for finfish fisheries in WG-FSA (www.ccamlr.org/node/75667). The Secretariat agreed to coordinate the preparation of a draft krill fishery report for consideration at WG-EMM-14 that would be similar in content to a finfish Fishery Report. It may include an analysis of the history and spatial distribution of catches, including methods of conversion to green weight, observer coverage and data collection, length-frequency distribution data and information of by-catch, as well as an analysis of notifications for the forthcoming season. As in a finfish Fishery Report, it would also summarise the current methodology for advising on catch limits and the background to the parameters used in this process.

2.10 The Working Group considered that it would be useful to have this Krill Fishery Report translated into the four official languages of CCAMLR and requested the Scientific Committee and the Commission to consider this issue.

Notifications for the 2013/14 fishing season

2.11 Six Members submitted notifications for a total of 19 vessels intending to participate in krill fisheries in 2013/14. The notifications are for trawl fisheries in Subareas 48.1, 48.2, 48.3 and 48.4; there was no notification for krill fisheries in Divisions 58.4.1 and 58.4.2, or the exploratory krill fishery in Subarea 48.6. The total intended krill catch was 545 000 tonnes (WG-EMM-13/37 Rev. 1, Table 7).

2.12 The Working Group reviewed all notifications (CCAMLR-XXXII/05 to XXXII/10) and confirmed that the required information had been provided. However, in line with the development of the feedback management strategy, a more thorough and detailed review process was conducted to facilitate the understanding of the krill fishery. The Working Group sought clarification of specific elements (Table 1) and requested that notifying Members submit any additional information to the Secretariat by 1 September 2013. In addition, the Working Group also requested that Members provide information on the make, type and frequencies of echosounders used on each vessel to assist with the development of the proof-of-concept program (paragraphs 2.137 to 2.142). This additional information will be appended to the original notifications.

2.13 The Working Group also reviewed the information requirements for notifications for krill fisheries (CM 21-03, Annexes A and B). The Working Group agreed that:

(i) information requirements for net configuration should be strengthened, and descriptions of trawl nets and seal exclusion devices should be submitted to WG-EMM for review and subsequent inclusion in the CCAMLR fishing gear library (www.ccamlr.org/node/74407), and relevant documents may be referred to in subsequent notifications

(ii) information on the relative amounts of product (% of catch), notified fishing months, expected proportion of time for each fishing technique, and the simple check-box to indicate the presence of mammal exclusion devices (this is a mandatory requirement) should be removed.

The Working Group requested the Scientific Committee to consider these revisions for notifications in 2014/15.

2.14 The Working Group noted that the revised guidelines for estimating green weight of krill (Appendix D) will require the Secretariat to update the C1 data form for use in 2013/14. The Working Group also requested that the Secretariat include examples of how to enter the green weight estimation parameters in the C1 form. Such examples should be placed on the CCAMLR website and would assist crew in completing the form.

Green weight

2.15 WG-EMM 13/41 and 13/42 Rev. 1 reported methods used for estimating green weight and associated uncertainty on board Norwegian krill fishing vessels (*Saga Sea*, *Antarctic Sea* and *Juvel*) and on board the Chilean krill fishing vessel *Betanzos* respectively. All vessels produce meal and/or oil on board, and report direct measurements of green weight to CCAMLR. *Betanzos* and *Juvel* both use flow meters (that measure the volume of krill and water) to estimate catch, where green weight is estimated from a measured volume in a time unit via a volume-to-mass conversion factor. On board the *Saga Sea* and *Antarctic Sea*, flow scales (that measure the mass of krill and water) are used, in these cases the conversion between measured catch weight and green weight is an estimate of the mass of krill remaining once water has been removed. Both papers presented details about processing methods, procedures for estimating catch and preliminary results.

2.16 The Working Group welcomed the contributions in WG-EMM-13/41 and 13/42 Rev. 1 since such information was important for progressing the work on deriving uncertainty estimates from the reported catch. Other Members engaged in the krill fishery were encouraged to submit similar descriptions and analyses to WG-EMM-14.

2.17 The Working Group reviewed the guidelines for estimating green weight of krill (CM 21-03, Annex B). The Working Group agreed that:

(i) some of the methods needed clarification regarding parameters needed for estimation and estimation procedure

(ii) some methods for green weight estimation used by some vessels, but not presently included, should be added to the guidelines

(iii) information related to observation steps and frequency of observations should be added.

2.18 The Working Group agreed that the revised guidelines more precisely address which information was expected to be provided by the industry related to green weight estimation, and requested the Scientific Committee to consider these revisions as part of the revised notifications in 2014/15.

Scientific observation

2.19 Analyses of the scientific observer coverage during the 2011/12 fishing season were presented in WG-EMM-13/38. During 2012 all 12 vessels that participated in the krill fishery carried observers for some, or all, of their fishing operations. From a total of 860 vessel days of fishing in 2012, observations of krill length measurements were collected on 375 days, and fish by-catch from 34 taxa was measured on 554 days. The Working Group appreciated this level of coverage and noted that the scientific observer coverage (79% of vessel months) exceeded the minimum requirements in CM 51-06.

2.20 The monthly length frequencies of krill exhibited the greatest changes between months in Subarea 48.1 when fishing occurred both in Bransfield Strait and to the west of the South Shetland Islands. The Working Group noted that the choice of fishing location, resulting from ice and weather conditions, appeared to be having an impact on the aggregated length distributions and that this required more detailed information and analysis.

2.21 As the time series of data develops the influence on length-frequency distribution resulting from fishing location, growth and recruitment should become clearer. In addition, the Working Group noted that the length-frequency distributions from commercial fisheries could also be compared with those recorded in the diet of predators and from research surveys at appropriate time and space scales.

2.22 The Working Group welcomed the presentation of the spatial distribution of fish by-catch in WG-EMM-13/38 and looked forward to further data collection by observers.

2.23 The Working Group recognised that differences in gear type, and consequently sampling methodology, would require standardisation of the data before spatial CPUE and

length frequencies could be fully utilised, but noted the outcomes of the discussion in WG-EMM-12 (SC-CAMLR-XXXI, Annex 6, paragraphs 2.38 to 2.40) in which the effect of vessel in that analysis on the length of krill caught was relatively minor compared to the spatial and temporal effects of the fishing strategy.

Observer sampling

2.24 As an aid to progressing future discussions, the Working Group requested that the Secretariat provide to WG-EMM in 2014 an analysis of the amount of data that has been submitted for each of the forms in the krill observer logbooks in order to allow review of the data availability, and as a basis for a review for the continued utility of the different data collection strategies.

2.25 The Working Group recalled that it is the responsibility of the vessel to report fish by-catch, and that of the observer to provide quantitative samples of the species composition. The Working Group reiterated that the rationale for the observer fish by-catch sampling was to obtain a quantified estimate of the fish by-catch through a structured sampling scheme (SC-CAMLR-XXXI, Annex 6, paragraphs 2.42 and 2.43). Other fish by-catch that is not recorded as part of the observer sampling process should be reported by the vessel as part of the C1 reporting requirement.

2.26 A draft identification guide for fish by-catch in the krill fishery (WG-EMM-13/07) was designed to assist observers in the identification of the most important fish by-catch taxa as requested by WG-EMM-12 (SC-CAMLR-XXXI, Annex 6, paragraph 2.44). The Working Group agreed that this guide provided a useful resource and noted the request from the Secretariat for Members to provide identification material (including photographs) of frequently reported taxa. Where possible, observers should identify by-catch to species level but, recognising that in some cases this was a specialist task, identification to the family level may be more appropriate.

2.27 The Working Group discussed the data collected by observers noting that some observers did not report fish by-catch while some fish by-catch reports included invertebrate by-catch. The Working Group requested those Members with vessels not providing fish by-catch to investigate the reasons why this is not occurring. It also asked those Members collecting information on invertebrate by-catch to provide a paper describing the reasons for the work, the protocol and results in order to allow WG-EMM to consider the desirability of expanding this aspect of observer data collection.

2.28 It was noted that length data on both finfish and krill were collected by observers but that the current krill observer logbooks required the measurement of krill to be recorded to the nearest mm below and finfish to the nearest cm below. Given that the majority of the fish by-catch is <5 cm in length, the Working Group requested that the K10(ii) form be revised to require fish lengths to be recorded to the nearest mm below.

2.29 WG-EMM agreed that it could be potentially useful to collect additional information on fishing behaviour, such as the reason for changing local fishing grounds (e.g. ice conditions and salp concentration), in addition to the information recorded on form K8 which is for large-scale movements across areas and subdivisions. Information on vessel movements

among fishing grounds could be linked to the analysis of VMS described in paragraph 2.86(ii). Such information would be linked to the work of SG-ASAM which may ask for additional information to be collected dependent on its requirements. Dr Kawaguchi, as Convener of WG-EMM, undertook to coordinate this.

2.30 The Secretariat is developing a standard algorithm for reporting on data quality from the observer scheme logbook forms (WG-SAM-13/40). As part of this process, the Secretariat had requested that, if observers were to add additional rows or columns to logbook forms, these should be added at the right-hand side or bottom of the form and not in the middle of the form.

Krill biology, ecology and management

Krill distribution and abundance

2.31 WG-EMM-13/40 presented preliminary results from the first cruise in the five-year winter oceanographic and biological sampling program of the US AMLR Program. Acoustic estimates of Antarctic krill density were obtained for ice-free areas only and were extremely low (0.79 g m^{-2} using the CCAMLR-approved method). Net sampling revealed that ice krill (*Euphausia crystallorophias*) was found only within the ice-covered areas, while Antarctic krill (*E. superba*) and bigeye krill (*Thysanoessa macrura*) were found in both ice-covered and ice-free areas but were more abundant in ice-covered waters. The length-frequency distribution of *E. superba* was similar in both ice-covered and ice-free regions with a modal length of 22 mm. The energy density of Antarctic krill and *T. macrura* was greater in winter than in summer.

2.32 The Working Group discussed whether the depth distribution of the large krill would change between winter and summer and agreed it would be appropriate to sample deeper than the 170 m maximum net depth used in WG-EMM-13/40.

2.33 WG-EMM-13/24 presented results from a survey of Antarctic krill populations in the outflow regions of the northwestern Weddell Sea in January–March 2013. Antarctic krill densities estimated from net samples were found to be highest in the western Peninsula region and lower in ice-covered Weddell Sea waters. The overall krill density was below the long-term average for the area and the stock was dominated by two- and three-year-old krill (mode 35 mm). The largest krill were found in the deep water north of the South Shetland Islands, however, such krill were low in abundance and spawning appeared to be late and poor, likely leading to very poor survival of the resulting krill larvae.

2.34 The Working Group noted that these two surveys overlapped in areal coverage and therefore provided an opportunity to compare winter and summer conditions which was very valuable. Thus, for instance, the dominant winter mode of 22 mm krill had grown to form the dominant mode of 35 mm krill observed in the summer. In addition, there was a striking scarcity of large krill found in both surveys.

2.35 The Working Group emphasised the importance of undertaking winter surveys and particularly welcomed the development of a winter program in this area, especially now that

the commercial fishery had moved to a winter-focused operation. Such surveys also provided opportunities for further collaboration, and the Working Group welcomed and encouraged comparisons with winter and summer surveys.

2.36 It was noted that, while the krill densities estimated from these research surveys appeared to be low, the catch in the commercial fishery was one of the highest taken in this subarea. In summer 2013, commercial fishing vessels operated close to the German research vessel sampling in the Bransfield Strait.

2.37 The Working Group noted that there was a large degree of similarity in the krill length-frequency distribution derived from the CCAMLR Observer measurements and the research vessel for this period, and that this may have positive implications for surveys conducted by fishing vessels. The Working Group agreed that, while such a concordance suggested that the size selectivity of the fishing vessels in this comparison was similar to that of the research vessel, it did not imply that all fishing vessels have the same net selectivity. The Working Group also recalled the analysis from last year (paragraph 2.23) where vessel effect had a very small influence on variation in the length-frequency distributions from krill fishery observer data.

2.38 The Working Group noted that WG-EMM-13/40 reported problems undertaking quantifiable ship-board acoustic measurements in the ice-covered areas. Sampling in ice-covered areas is technically challenging, requiring the development of techniques often different from those used in ice-free areas. The Working Group noted that new technologies, such as remote and autonomous vehicles, drop-cameras etc., were being developed in a variety of fora both inside and outside CCAMLR and it was important to be able to make use of, and assess, these different technologies.

Multi-year abundance analyses

2.39 The interannual variability in abundance and biomass of krill using the 15-year time series of acoustic observations undertaken in the Western Core Box survey area at South Georgia was presented in WG-EMM-13/14. The krill identification and biomass estimation using the CCAMLR-approved method produced maximum densities in 500 m sampling intervals greater than 10 000 g m^{-2}. The overall mean krill density determined each year was very sensitive to the number and density of the densest krill swarms detected. Years of moderate to high overall krill density (>30 g m^{-2}) were interspersed with years (1999–2000, 2004, 2009–2010) of low density (<30 g m^{-2}).

2.40 The Working Group noted that the interannual pattern of variation in median values of krill density presented in WG-EMM-13/14 was different from the pattern of variation in mean krill density. The Working Group suggested that the differences in interannual variation between the mean and median krill density, and the implications for understanding predator response indices, should be evaluated.

2.41 The Working Group noted that the analysis in WG-EMM-13/14 was based on a spatial scale of 500 m and that this was likely to be a key spatial scale at which many of the krill predators would operate. Therefore, the presentation of acoustic estimates at this scale was to

be encouraged in order to develop a better understanding of the spatial and temporal variability of krill swarms and aggregations at scales relevant to foraging predators.

2.42 The Working Group also noted that the underlying patterns of krill swarm aggregation dynamics were also extremely relevant to the understanding of how fishery indices (such as CPUE) may be used to characterise krill biomass distributions.

Length-frequency distributions to determine growth and recruitment

2.43 WG-EMM-13/39 described interannual and spatial variability in estimates of growth derived from length-frequency distributions of the omnivorous euphausiid *T. macrura*. Two surveys (conducted one month apart) per year were undertaken by the US AMLR Program from 1995 to 2011. Here, growth is estimated for four years with very different temperature and primary production characteristics; in each cruise, stations were grouped into warmer Antarctic Circumpolar Current (ACC) and colder Weddell Sea categories. Growth rates were higher in the ACC water than in Weddell Sea water in all four years, showing a strong correlation with temperature, but no correlation with chlorophyll-*a* concentration.

2.44 WG-EMM-13/P01 presented a general method for estimating a growth model from length-frequency samples collected from a single population on two separate dates. This method is then applied to the 19-year krill length-frequency data series of the US AMLR Program. These growth estimates align closely with existing growth rates for Antarctic krill but the new estimate rates show high between-year variation in annual growth. These growth rate variations correlated with chlorophyll-*a* concentration but large amounts of variation of growth is unexplained by environmental correlates.

2.45 WG-EMM-13/23 described a sensitivity analysis using a simple individual-based model of krill population dynamics to investigate length-based recruitment indices and their potential use with the krill length-frequency data collected from the krill fishery. The model tested the effect of plausible ranges of growth, mortality and recruitment rates on length-based recruitment indices. The results of the sensitivity analysis indicated that all of the indices of annual recruitment tested were at least as sensitive to changing recruitment as they were to mortality and/or growth. Furthermore, since the population size structure at a given time was the result of a mixture of several annual cohorts, using such indices to quantify the intensity of a given recruitment event would need to take into account the magnitude of previous recruitment events.

2.46 The Working Group recognised that there was a large degree of similarity between the results and, in particular, the common assumptions underlying estimates of growth derived from length-frequency distributions. It was emphasised that growth, mortality, recruitment and advection will all influence the shape of the length-frequency distribution and it is therefore important to understand such interactions when deriving population estimates of growth or recruitment.

2.47 The Working Group noted that the range of the environmental variables over which relationships with growth were investigated could have a major effect on the relationships observed. Thus, for some studies, the temperature range observed was relatively small

compared to the total range that the species may encounter, while simple measures of chlorophyll-*a* concentration take no account of the nutritional value of different types of phytoplankton (such as diatoms and dinoflagellates).

Net selectivity

2.48 WG-EMM-13/34 described the use of a model-based method to evaluate selection of Antarctic krill in towed fishing gear. FISHSELECT has been developed as an alternative to expensive fishing experiments and has previously been used in investigations into net selectivity for various species of finfish and the crustacean *Nephrops norvegica*. It uses a combination of measurements of animal morphology and the shapes of the relevant mesh types to predict the size selectivity of the net. The paper described the morphological cross-sections derived for Antarctic krill and the comparison of model-derived predictions of net selectivity against selectivity trials on board the Norwegian trawler *Saga Sea*.

2.49 The Working Group welcomed this work and agreed that such an approach could have great utility in assessing selectivity of the different fishing gears used to sample krill. However, the Working Group also agreed that the selectivity of the mesh in a net was only a small component of the total selectivity of the fishing gear, which would depend on a range of factors that include the overall net design, the conditions under which the net is fishing, and the amount of catch in the codend of the net.

2.50 The Working Group strongly encouraged further development of work to determine total net selectivity. The Working Group further noted that, while this paper dealt with net selectivity, it could also provide information on mortality of krill passing through the net, and further investigations on the level of escape mortality should be encouraged.

2.51 The Working Group noted that selectivity is inherent not only in all net data (both commercial trawls and research nets) but also in length-frequency data obtained from sampling predator diets. It was agreed that it would be very valuable to be able to use different sources of length-frequency data to determine spatial and temporal changes in krill population structure. Further work on this topic, including any necessary standardisation techniques to take account of different sampling strategies, was strongly encouraged.

Climatic variability and future changes in habitat

2.52 WG-EMM-13/20 described the potential future climate change effects on the habitat of Antarctic krill in the Atlantic and Antarctic Peninsula sectors of the Southern Ocean (0°–90°W). Climate model projections for warming in this sector suggest further widespread warming of 0.27° to 1.08°C over the next century. A statistical model linking Antarctic krill growth to temperature and chlorophyll-*a* to assess the influence of projected warming on habitat quality suggests that growth in the region of the ACC will be particularly vulnerable to warming, while growth in the region to the south of the ACC is relatively insensitive to warming. The direct effects of warming could reduce the area of growth habitat by up to 20%, while reduction of growth habitat within the range of predators, such as fur seals foraging from South Georgia, could be up to 50%.

2.53 The Working Group welcomed this analysis and noted that this paper, involving collaboration with climate scientists, was the first to be presented to the Working Group that demonstrated how results from the Intergovernmental Panel on Climate Change (IPCC) assessments can be utilised to provide analyses of direct relevance to CCAMLR.

2.54 The Working Group further agreed that the likely timescale and magnitude of these potential changes indicated in WG-EMM-13/20 could confound our ability to detect ecosystem changes due to fishing. It was therefore essential that feedback management strategies be able to take this duality into account so that attribution of the causes of change could be achieved as far as possible.

2.55 While the paper dealt with potential changes of future climate warming, the Working Group noted that warming had already been occurring in the Antarctic Peninsula region, and therefore it might be possible to utilise the changes that had already occurred to validate predictions for this current time period. For instance, it was noted that the current predicted Antarctic krill growth rates (WG-EMM-13/20, Figure 2) in the Marguerite Bay region are high; this could be validated against current measured growth rates in this region.

Analysis of krill CPUE

2.56 WG-EMM-13/25 provided a development of the analyses presented in WG-EMM-12/50, examining the relationship between krill fishery standardised CPUE and an index of environmental variability (the Antarctic oscillation (AAO) index) for the period 1986 to 2011. The analysis had shown that over these 25 years the timing of the fishery has moved from a spring/summer focus to an autumn/winter focus. The most significant switching of the fishery regime had occurred in the last six years (2006–2011), when the fishery in Area 48 and its Subareas 48.1, 48.2 and 48.3 had moved to a 'high CPUE' state; this period coincided with both major changes in fishing technology and a period with the highest positive values for the AAO index. An analysis of CPUE dynamics from fishery fleets using traditional trawling with many years' experience, showed a significant increase in CPUE in the period from 2006 to 2011 and these conventional trawls had CPUE significantly higher than vessels using continuous fishing methods. The authors concluded that it was ongoing climate changes influencing the space–time distribution of krill, rather than the fishing technology, that was responsible for the changes in CPUE observed in this study.

2.57 WG-EMM-13/32 analysed the dynamics of the krill fishery in Subarea 48.1 in relation to environmental variability, emphasising the importance of this subarea in the current krill fishery, with over half the total catch in the last three years being taken in this subarea. The paper presented the dynamics of the AAO index in relation to the variability of environmental parameters (air temperature, atmospheric transport intensity and ice situation) in Subarea 48.1. The CPUE dynamics observed in Subarea 48.1 are considered consistent with climatic changes of these environmental parameters. Recent environmental warming has led to reductions in winter sea-ice around the Antarctic Peninsula, thus facilitating the switch from spring/summer to winter fishing in this area.

2.58 The Working Group welcomed this reanalysis in WG-EMM-13/25 and noted that understanding the operation of the present day fishery and the factors determining both its evolving spatial and temporal distribution is very important in determining management

strategies. It was noted that while ongoing climatic changes may have caused the changes in the spatial–temporal patterns of krill distribution which is reflected in the observed changes of the fishery strategy, it is also clear that the krill fishery has become more spatially concentrated as well, and that this could also account for the increased fishery CPUE. The effect of concentrating fishing in areas with high density would need to be analysed to distinguish any confounding with possible environmental effects.

2.59 The Working Group noted that there are a large number of variables affecting CPUE and that these would likely be different from those considered in early analyses of fishery CPUE (Butterworth, 1988; Mangel, 1988; SC-CAMLR-VIII, Annex 4). Thus, for example, fishing strategy is linked with products being derived from catch, with status of processing and with quality of catch as well as spatial distribution of krill, and so is likely to impact CPUE. The Working Group therefore agreed that an up-to-date consolidated summary of the underlying variables affecting CPUE and the overall utility of these measures would be valuable. The Working Group agreed that understanding how the fishery operates is a priority and encouraged further analyses of fishery operations and the factors determining its strategy and efficiency.

2.60 The Working Group welcomed the increased submission of papers dealing with krill biology and ecology and encouraged further submissions on all topics of biology and ecology that would be necessary to underpin our knowledge of how the Southern Ocean ecosystem operates in a variable and changing environment.

2.61 The Working Group made a general observation that, when analyses of data are presented to the Working Group, model descriptions, residual diagnostic plots and standard statistical outputs, such as the probability level associated with model parameters, should be provided to allow the Working Group to review alternative hypotheses.

Issues for the future

Feedback management strategy

2.62 The Working Group noted several general points relevant to the development of a feedback management strategy and advised that these points be communicated more broadly within CCAMLR so that understanding of feedback management might be improved, in particular that:

(i) advice relevant to feedback management will include advice on the overall catch limit for the krill fishery and on the spatial distribution of the catch limit

(ii) while the work plan to develop a feedback management strategy has been noted (CCAMLR-XXX, paragraph 4.17), general guidance on desirable elements of a feedback management strategy is not available

(iii) CEMP and other observations can provide important data for formulating advice on fishery catch limits and the spatial distribution of these limits as they relate to the ecosystem effects of fishing

(iv) decision rules on how to respond to indicators from the CEMP or other observations would help specify what measures need to be taken to achieve the objectives in Article II, and these rules might include what types of data need to be collected if the value of an indicator crosses some threshold (e.g. if an indicator falls below some threshold, a krill survey might be required)

(v) indicators that reflect processes at different time and space scales might be used in different decision rules to adjust fishing over a range of time and space scales. For example, regional estimates of predator abundance or recruitment and trends in krill biomass may be used to establish an overall catch limit and spatial distribution of that catch limit for a period of several years, whereas adjusting the spatial distribution of that catch limit over shorter time periods might occur in response to indicators such as predator condition or estimates of standing krill biomass collected just prior to a fishing season (sometimes known as leading indicators). Indicators might be composite indices that integrate changes in multiple observation series.

2.63 The Working Group advised the Scientific Committee that its plan to develop a feedback management strategy by 2014 (SC-CAMLR-XXX, Annex 4, paragraphs 2.155 and 2.157) no longer seems feasible. WG-EMM-13/04 summarised the reasons why this is the case. Although WG-EMM has made concerted efforts to advance the development of a feedback management strategy, experience since 2011 has demonstrated that several factors have made it difficult for all Members to develop a common understanding. For example:

(i) communication among Members on issues relevant to feedback management has largely been limited to the regular meetings of WG-EMM

(ii) the regular meetings of WG-EMM and WG-SAM have full agendas, and there is insufficient time to work on feedback management issues at these meetings

(iii) the different research groups working to develop candidate feedback management strategies have emphasised work that would mature over different time frames and is focused on different spatial scales. Thus, discussion within WG-EMM has been confusing, and it has been difficult to envision how some management procedures might be implemented in a practical sense

(iv) the work to advance feedback management is highly technical, and WG-EMM needs more time to evaluate and understand several details

(v) it has proven difficult to follow the six steps agreed in 2011 (SC-CAMLR-XXX, Annex 4, paragraphs 2.155 and 2.157) sequentially, and improved understanding can likely be developed by considering issues more holistically.

2.64 Despite the difficulties noted in the preceding paragraph, the Working Group agreed that staged development of a feedback management strategy remains feasible if:

(i) in the short term, work focuses on the use of existing data and monitoring efforts (e.g. existing CEMP data and results from acoustic surveys by fishing vessels)

(ii) in the medium term, work progresses to extending data collection and monitoring efforts (e.g. establishing new CEMP sites, using remotely sensed

imagery and increasing acoustic survey effort on both fishing vessels and research vessels) while also investing in the tailoring of models to available data and the development of operational ecosystem models

(iii) in the long term, ecosystem models are used to guide the establishment of a 'final' feedback management strategy.

2.65 The Working Group noted its previous discussion on the staged development and implementation of a feedback management strategy (SC-CAMLR-XXX, Annex 4, paragraph 2.179 and Figure 4) and recommended that the four stages in the development of the fishery would be:

(i) Stage 1 – continuation of the current trigger level and its spatial distribution among subareas (CM 51-07 is to be reviewed in 2014).

(ii) Stage 2 – an increase from the trigger level to a higher interim catch limit and/or changes in the spatial distribution of catches that are adjusted based on decision rules that take account of results from the existing CEMP and other observation series such as absolute (or relative) biomass (or density) estimates made from krill surveys conducted by fishing vessels (it is expected that advice on this stage can be provided to the Scientific Committee in 2015 if WG-EMM, WG-SAM and/or SG-ASAM have sufficient time to evaluate methods as per SC-CAMLR-XXVIII, Annex 6, paragraphs 5.11 to 5.17).

(iii) Stage 3 – a further increase to a higher interim catch limit and/or changes in the spatial distribution of catches that are adjusted based on decision rules that take account of results from an 'enhanced' CEMP and other observation series (it is expected that this stage can be developed in the medium term).

(iv) Stage 4 – a fully developed feedback management strategy that is based on forecasts from ecosystem models may involve structured fishing and/or reference areas (SC-CAMLR-XXX, Annex 4, paragraphs 2.167 to 2.174 and 2.180) and includes catches up to the precautionary catch limit and/or changes in the spatial distribution of catches that are adjusted based on decision rules that take account of results from an enhanced CEMP and other observation series (it is expected that this stage will be developed over the long term).

2.66 In all stages, the spatial distribution of catches might be among subareas, individual or groups of SSMUs, or other areas that are defined by considering the spatial scales over which the fishery operates and over which CEMP data and other observations integrate.

2.67 The Working Group agreed that, during the implementation of each stage, it would work to continue the research and data collection that would be needed to advance to the next stage. It was also agreed that advancement from one stage to the next should not occur on a fixed schedule. Rather, advancement towards stage 4 should be determined by the availability and relevance of scientific information and tools so that progress to implement a fully developed feedback management strategy occurs at a pace that is determined by scientific advancement.

2.68 With respect to stage 1, the Working Group considered whether, on the basis of current uncertainties, the trigger level and its spatial subdivision are still regarded as being suitable to achieve the objectives of the Convention without further controls on the fishery. Implementation of the trigger level and its spatial distribution in CMs 51-01 and 51-07 are predicated on three conditions:

(i) catches up to the trigger level will not compromise the ability of the Commission to achieve the objectives of the Convention

(ii) the permitted spatial pattern of fishery catches will not compromise the ability of the Commission to achieve the objectives of the Convention

(iii) long-term ecosystem change will not invalidate the first two conditions during the period over which a feedback management strategy is developed.

2.69 The Working Group noted that the Commission will expect advice on CM 51-07 during 2014 and suggested a work plan, to be undertaken by interested Members during the 2013/14 intersessional period, to evaluate the conditions listed in the preceding paragraph and on which stage 1 is predicated:

(i) review the status and trends of the krill population and the spatial distribution of the krill stock relative to predators

(ii) estimate how much krill is needed to support predators in each subarea and to review predator foraging behaviours to characterise the link between successful feeding and the distribution and aggregation density of krill swarms, both the per-capita krill requirements of predators and how predator performance may be impacted when those requirements cannot be met, and to review the abundance of predators in each subarea

(iii) review the spatial distribution of fishing effort and the behaviour of the fishery to describe situations in which the distribution of fishing effort may change the availability of krill to predators

(iv) consider uncertainties in each of the above work elements to determine if the trigger level and its spatial distribution among subareas will meet the objectives of the Convention with a high level of confidence.

2.70 Existing datasets may be useful for evaluating these work elements. For example, the US AMLR time series around the South Shetland Islands and British Antarctic Survey (BAS) time series at South Georgia may be used to address element (ii), and catch and effort data from the fishery may be used to address elements (i) and (iii). Dr Watters indicated his willingness to share the US AMLR time series with Members interested in advancing these work elements. Dr S. Kasatkina (Russia) indicated that she will undertake an analysis of temporal and spatial variation in CPUE by the krill fishery in relation to variation in the US AMLR acoustic data. Dr Kasatkina agreed to provide a paper summarising this analysis to WG-EMM in 2014.

2.71 The Working Group noted that, with reference to stage 1, it would be important to consider whether the current management approach for the krill fishery (where fishing up to the subarea catch limits established in CMs 51-01 and 51-07 is spatially unconstrained)

impacts existing CEMP sites. Within each subarea, fishing activity can be highly concentrated in just a few fine-scale rectangles (paragraph 2.4) and, although the performance of predators monitored at CEMP sites integrates over processes at several spatial scales (e.g. at 10s to 100s km^2 during the breeding season and 100s to 1 000s km^2 or more during winter), some Members considered that such concentration of fishing activity might have adverse scientific consequences in stage 1. These Members noted that the baseline variation observed at current CEMP sites is considered to reflect natural variation and, after the establishment of a feedback management strategy, increased variation in CEMP parameters beyond that baseline might be used within a decision rule to adjust a catch limit or the spatial distribution of fishing.

2.72 The Working Group also noted that in recent years fishing effort in Subarea 48.1 has increased along the western coast of the Antarctic Peninsula. If the spatial distribution of fishing effort expands, either within stage 1 or stage 2, it may become difficult to identify reference areas for use in stage 4. For example, some Members considered the area around Cierva Cove to be a good candidate for establishing a reference area (WG-EMM-13/27), but fishing activity in this area during the 2012/13 fishing season may make this view questionable (paragraph 2.97).

2.73 Some participants indicated an interest to progress work on stage 2 immediately, simultaneous with evaluation of the trigger level and its spatial distribution. There is some urgency in proceeding to develop stage 2 because the krill fishery continues to expand, with increased numbers of vessels participating in the fishery (paragraph 2.11) and the increased ability of these vessels to attain subarea catch limits before the nominal end of the fishing season on 30 November each year (paragraph 2.6).

2.74 Evaluation of stage 1 may identify practical approaches, based on existing capabilities, for use in developing stage 2, such as:

(i) increasing the frequency of small-scale or larger-scale krill surveys, using research vessels, vessels of opportunity (e.g. as described in WG-EMM-13/17 Rev. 1) and specified fishery operations (e.g. surveys by fishing vessels early and late in the season as described in WG-EMM-13/15)

(ii) expanding the number of CEMP sites or sites where predator monitoring compatible with CEMP is conducted

(iii) assessing changes in the environment that could impact on krill, predators or fishing vessels (e.g. by participating in the work envisioned in WG-EMM-13/13)

(iv) develop data integration models considering time and space variations in the data.

2.75 Work to progress stage 2 could be done by establishing subarea-based intersessional task groups specifically tasked to propose, in detail, a feedback management strategy based on existing data sources available in each subarea. The work of these intersessional groups could be facilitated through a web-based communication forum managed by the Secretariat (groups.ccamlr.org).

2.76 The Working Group agreed to establish two intersessional task groups: one to advance the development of a feedback management strategy in Subarea 48.1 and another to advance

such development in Subarea 48.2. Drs Watters and Hinke agreed to co-convene the task group for Subarea 48.1, and Dr Trathan and Lic. M. Santos (Argentina) agreed to co-convene the task group for Subarea 48.2. Both task groups met briefly during WG-EMM to plan a future course of work.

2.77 The task group for Subarea 48.1 first discussed the work it intends to conduct with respect to stage 1. All Members that participate in this task group will review the work recently published by Watters et al. (2013) with the objective of determining whether the work presented therein is sufficient to advise the Scientific Committee and the Commission on CM 51-07 in 2014. The task group agreed to complete this review by 1 January 2014 and identify whether additional work is required to advise on CM 51-07. If additional work is required, the task group will specify what that work is and identify one or more individuals to complete the work in time to be reviewed by WG-EMM in 2014.

2.78 The task group for Subarea 48.1 then discussed work planned to progress the development of a feedback management strategy in stage 2. It was agreed that work in the task group will proceed on two parallel themes: a predator theme, and a krill and fishery theme. Work on the predator theme will be coordinated by Dr Hinke, and work on the krill and fishery theme will be coordinated by Dr O. Godø (Norway). Members of the task group will work within the theme with which they have the most expertise or interest, noting that:

(i) work on both themes will proceed to characterise important spatial distributions (i.e. predator foraging distributions, and the distributions of fishing effort and of krill within key fishing grounds). These parallel efforts will be synthesised to provide an improved characterisation of temporal and spatial overlap between krill predators and the fishery

(ii) this synthesis will be viewed within the context of an analysis, to be coordinated by the Secretariat, of how sea-ice affects the spatial distribution of fishing effort

(iii) both themes will work to propose candidate decision rules for adjusting the catch limit in Subarea 48.1 (or for adjusting the proportion of a larger regional catch limit for Area 48 that is taken in Subarea 48.1) on the basis of indicators (i.e. from CEMP monitoring activities and from the fishery or research surveys of krill) that are currently available and expected to be available in the near future. These decision rules may involve adjustments to the spatial distribution of catches within Subarea 48.1

(iv) after important spatial distributions have been characterised and candidate decision rules have been developed, the task group will formulate a detailed proposal for a feedback management strategy in Subarea 48.1. This proposal will be submitted to WG-EMM in 2015.

2.79 The task group for Subarea 48.2 discussed the available data collected at the South Orkney Islands. Currently there are two CEMP sites where penguins are monitored. At Signy Island, three species are monitored with five indices reported annually for Adélie penguins, five for chinstrap penguins, and three for gentoo penguins. At Laurie Island, two species are monitored with six indices reported annually for both Adélie and chinstrap penguins. The task group proposed that Argentina and the UK analyse these data collectively to determine how penguin populations are changing across the South Orkney Islands archipelago. Specific

comparisons to be made across these two CEMP sites will include a comparison of metrics describing penguin diets with information from the fishery. For example, it would be valuable to compare length frequencies of krill in penguin diets with those in commercial catches. It would also be valuable to examine diet compositions and relate these to environmental signals. The task group will also examine population trends in relation to the annual level of fishery extraction and annual environmental indices from both local weather stations and from remote sensing data. The task group will consider compiling a 'state of the ecosystem' report for Subarea 48.2 which could be used to consider the conditions of stage 1. The task group also suggested that it may be possible to use the model described in Watters et al. (2013) to further examine the conditions in stage 1.

2.80 The task group for Subarea 48.2 recognised that there are few data describing the prey field available to penguins, as annual acoustic surveys of krill have been carried out only recently. This means that few observations can currently be used to relate the prey available to penguins to the breeding performances of these birds. This will change in the future as Norway has made a commitment to maintain its annual krill survey into the future (SC-CAMLR-XXXI, paragraph 3.37). At present, however, the lack of prey field information means it could be very difficult to relate penguin responses to the annual harvest of the fishery. Historical data from acoustic surveys around the South Orkney Islands are available from the US AMLR Program (two surveys) and from the CCAMLR-2000 Survey. It was recognised that new information on krill distribution and biomass will be needed to move to stage 2. Information from a recently deployed mooring between Coronation Island and the Inaccessible Islands will provide information on the prey field, however, such data will only begin to become available later this year.

2.81 The task group for Subarea 48.2 also recognised that penguin foraging trip data could provide valuable information about the responses of predators to variations in krill availability, however, these data are expensive to collect and analyse. Although support for such studies would potentially be difficult to maintain over the long term, valuable information to support stage 2 could potentially be collected in only a few years (e.g. see discussion regarding the frequency of tracking studies in WG-EMM-13/08). The deployment of static cameras, use of remote sensing to estimate predator abundance and some other new techniques could also potentially help broaden the data available to WG-EMM for relating predator responses to the annual Norwegian acoustic biomass estimates.

2.82 The Working Group requested that all Members engage in the work of the intersessional task groups to evaluate stage 1 during 2014 and develop candidate feedback management strategies for stage 2 during 2014 and 2015. If possible, Members participating in the work of the task groups should submit their analysis methods and results for review by WG-SAM before consideration by WG-EMM. Given recent advancements in understanding krill and the Antarctic marine ecosystem (e.g. WG-EMM-13/21), Members were advised to consider results from papers published outside of the usual CCAMLR literature when conducting their work.

2.83 Discussions to coordinate work across the task groups for Subareas 48.1 and 48.2 will occur at the regular meetings of WG-EMM. These discussions will aim to ensure that the

separate approaches being developed by each task group can be harmonised so that the approach taken in Subarea 48.1 does not have a negative impact on the performance of the approach taken in Subarea 48.2 and vice versa.

2.84 The Working Group agreed that progressing work within the intersessional task groups for Subareas 48.1 and 48.2 would require a concerted effort and agreed there was insufficient capacity to simultaneously support task groups for Subareas 48.3 and 48.4. Task groups for these subareas will be formed when work for Subareas 48.1 and 48.2 has progressed further. It was noted that a workshop to study linkages across Area 48, similar to the Area 48 Workshop held in 1998, would be useful to consider how stage 2 feedback management strategies in Subareas 48.1 and 48.2 could be linked to such approaches in Subareas 48.3 and 48.4.

2.85 While the Working Group noted the priority region for developing a feedback management strategy was Area 48, it welcomed the development of procedures for other regions if that were possible. Dr C. Southwell (Australia) indicated that it may be possible for some Members to develop a feedback management strategy for Divisions 58.4.1 and 58.4.2 in 2014 and 2015.

2.86 To move beyond stage 2, several specific studies and field projects would be expected to provide important information. A non-exhaustive list of these studies and projects includes:

(i) quantifying the krill densities and/or biomass that are required to support both the fishery and krill predators

(ii) understanding fleet dynamics and how the fishery determines where it will operate using haul-by-haul, VMS and high-resolution sea-ice data and by talking directly with fishery operators

(iii) expanding acoustics estimation of krill density and distribution using research vessels and fishing vessels (which have the potential to survey large areas) and the use of such estimates in stock assessment models

(iv) establishing and maintaining periodic regional predator censuses (and estimates of total predator demand for krill)

(v) determining where new CEMP sites should, if possible, be established and what types of monitoring activities should be undertaken at those sites, noting that automated cameras can substantially expand monitoring activities at existing and new CEMP sites

(vi) methods for determining the flux of krill past CEMP sites.

2.87 The Working Group noted that specifying the location for new CEMP sites is a complex issue that involves practical, as well as scientific, considerations. At a minimum, to be practical, CEMP sites should be safely accessible and, from a scientific perspective, it would be useful if the temporal period or spatial area over which a new CEMP site might integrate (e.g. the summer and winter foraging areas of predators monitored at the site) fills a gap in coverage that is not currently provided by an existing CEMP site.

2.88 Several other issues were considered with respect to the establishment of new CEMP sites and reference areas during stage 4:

(i) New CEMP sites that provide monitoring of predator performance in reference areas could be useful for observing natural variability, trends and estimating rates of change attributable to climate change. When historical data are not available from a location, it may take several years of monitoring to observe these trends and estimate such rates at new CEMP sites. In general, the power to detect changes will increase with increases in the time over which monitoring occurs, increases in the magnitude of change, increases in the number of replicate CEMP sites and reference areas and decreases in observation error.

(ii) The sizes of candidate reference areas need to be considered in the context of krill flux, with increased flux expected through smaller areas and decreased flux expected through larger areas.

(iii) The locations of candidate reference areas need to be sited sufficiently close to fished areas to be comparable but sufficiently far from fished areas so that they are not unduly impacted by fishing.

2.89 The Working Group also noted that in advancing from stage 2 to stage 3 it would be important to learn from mistakes made during the development of stage 2. It is important to be flexible so that experience in application of any feedback management strategy can be used to facilitate future improvements.

2.90 Advancement to stages 3 and 4 could benefit from broader collaboration with other groups. WG-EMM-13/12 and 13/36 list several opportunities for such collaboration. The ICED (Integrating Climate and Ecosystem Dynamics in the Southern Ocean) program is developing ecosystem models and facilitating field programs (e.g. the Southern Ocean Sentinel) that may be particularly useful for developing advice related to feedback management. The SOOS (Southern Ocean Observing System) also offers opportunities for further data collection in the field, and temporally and spatially extensive datasets are needed to validate forecasts from ecosystem models like those being developed through ICED. COMNAP (Council of Managers of National Antarctic Programs), SCAR (Scientific Committee on Antarctic Research) and the International Whaling Commission Scientific Committee can also provide various forms of support to WG-EMM's efforts towards developing a feedback management strategy.

2.91 The Working Group agreed that the greatest benefits can be derived from cooperation with programs and committees outside of the CCAMLR community if Members interested in WG-EMM's work to develop a feedback management strategy engage directly with these entities. Direct engagement can help ensure that work conducted by such programs and committees can progress in directions that answer questions and address issues of direct relevance to WG-EMM. There are many mechanisms to facilitate such engagement (e.g. joint workshops and formal observation at regular meetings) and the Working Group's discussion of these mechanisms and related issues is summarised in paragraphs 6.1 to 6.11.

2.92 The Working Group noted the need to investigate quantitative objectives for implementing Article II in the contexts of climate change and feedback management. WG-EMM-13/20 forecasted substantial changes in growth habitat for Antarctic krill under a

range of climate change scenarios. The Working Group noted that climate change effects may, under some scenarios, be so great that they dwarf any effects from fishing. Feedback management strategies developed elsewhere generally incorporate reference points specifying, e.g. the relative abundances of various taxa that the management approach aims to achieve or to avoid (Caddy and Mahon, 1995). There is a need to identify operational objectives that are consistent with the principles of conservation in Article II of the Convention and acknowledge forthcoming changes caused by climate. These operational objectives could be expressed as reference points.

CEMP and WG-EMM-STAPP

2.93 The Working Group considered the following papers relevant to CEMP and WG-EMM-STAPP: WG-EMM-13/06 that presented a summary by the Secretariat of CEMP data submitted in 2012/13; WG-EMM-13/27 that presented population abundance estimates of chinstrap and gentoo penguin colonies on the Danco Coast; WG-EMM-13/43 and 13/09 for Adélie penguin populations at Esperanza/Hope Bay and along the East Antarctic coastline; WG-EMM-13/11 that reviewed monitoring plans for the Adélie penguin; WG-EMM-13/26 that presented a proposal for the use of satellite imagery to monitor Adélie penguins; WG-EMM-13/08 and 13/18 that presented results and proposed synthesis tools for penguin tracking studies. In addition, Dr Southwell provided an update on recent intersessional work related to WG-EMM-STAPP and there was discussion regarding submission of monitoring data to the CEMP and the use of the CEMP fund.

2.94 The Working Group noted that six Members had submitted CEMP monitoring data covering 13 parameters for 13 sites from the 2012/13 breeding season. Coverage included data from five seabird species and Antarctic fur seals. WG-EMM-13/06 indicated that no data was submitted from Area 88 and the Working Group noted that there were numerous other CEMP sites for which no data have been submitted recently. The Working Group recognised that some CEMP sites have had little or no monitoring activity since their inception and noted that future monitoring in some areas might be unlikely given financial and logistical constraints. The Working Group welcomed news that data reporting from Area 88 may resume in the near future (paragraph 2.107).

2.95 The Working Group noted that updated observations of penguin population sizes in Hope Bay (WG-EMM-13/43) and Cierva Cove (WG-EMM-13/27) were of considerable interest to WG-EMM-STAPP and CEMP. In particular, the updated census of the large colony of Adélie penguins in Hope Bay suggested a population decline from 123 890 breeding pairs in 1985 to 102 899 in 2012. The Working Group agreed that the new census data provided important information relevant to the estimation of prey consumption, a longstanding goal for understanding trophic interactions in the krill-centric ecosystem. The Working Group noted that the ongoing work to collect diet composition data and monitor foraging ranges of Adélie penguins in Hope Bay may provide useful ecological data that differ from data derived from smaller colonies.

2.96 The Working Group requested that future updates from census work provide an estimate of observation uncertainty as well as reporting, where possible, on factors that influence accuracy. Such estimates of uncertainty assist interpretation of trends in the

population by enabling an assessment of whether population changes may arise from demographic (i.e. changes in survival or recruitment rates to the colony) or behavioural changes (i.e. deferred breeding under adverse environmental conditions).

2.97 WG-EMM-13/27 suggested that the penguin colonies monitored near Cierva Cove within ASPA No. 132 may provide useful references for comparisons with other colonies in more commonly fished areas. This suggestion was based on observations of historically low fishing activity in the immediate vicinity of the colonies. However, information from the krill fishery report (WG-EMM-13/37 Rev. 1) indicated that the fisheries had recently operated in the vicinity of Cierva Cove, which may require the determination of criteria for a reference site and their evaluation to see if the fisheries had impacted the site and whether it could be used as a reference site (paragraphs 2.71 and 2.72).

2.98 In general, the Working Group raised a number of issues that concerned the establishment of potential reference sites (i.e. areas with relatively low or no fishing effort). The Working Group noted that a reference site may require a krill biomass estimate as baseline information from which to judge whether fishing impacts were detectable. Furthermore, the changing spatial distribution of the fishery might make identifying reference sites difficult. Alternatively, an assessment of changes in the rate at which monitored parameters vary may allow an assessment of the effects of fishing. This approach could also control for changing environmental conditions if reference sites were subjected to the same patterns of environmental variation in fished areas. Additional discussions relevant to determining potential locations for new CEMP monitoring sites (i.e. areas where no monitoring is currently conducted) was considered during discussions about the development of a feedback management strategy (paragraphs 2.71 and 2.72).

2.99 The Working Group welcomed the updated census data of Adélie penguins in the East Antarctic. WG-EMM-13/09 provided an up-to-date estimate of 1.31 million breeding pairs for Divisions 58.4.1 and 58.4.2 as a major contribution to WG-EMM-STAPP. The new estimate is substantially higher than a previous estimate of 767 000 breeding pairs in 1993. This increase is attributed to the discovery of new colonies, more thorough treatment of uncertainty to adjust raw count data and true population increases. The Working Group noted that this new estimate benefited from the use of remote cameras and aerial surveys. Such methods enable an efficient expansion of effort and provide a clear example of the utility of alternative census methods.

2.100 The Working Group noted the initiatives summarised in WG-EMM-13/11 for new and continuing studies on penguin populations and associated population processes by the UK. Methodologies that will be used include digital aerial survey from manned and remote-controlled platforms, satellite remote sensing, automated individual recognition and weighing, and time-lapse camera and automated image analysis. The Working Group noted that the methods presented in WG-EMM-13/11 parallel initiatives of other programs and broadly present progress on expanding the existing monitoring capabilities of CEMP. The initiatives had the benefit of including monitoring of penguin response parameters in addition to population size, including survival, demography and phenology, which would lead to a greater understanding of underlying ecosystem processes.

2.101 WG-EMM-13/26 presented a proposal to develop a tool to integrate and assimilate data using a Dynamic Bayesian Network to assist CEMP in obtaining estimates of local, regional and continental population estimates for the Adélie penguin. The tool would

assimilate remote sensing data from satellite imagery with field census data from long-term monitoring networks such as CEMP sites and predictions from state–space population models to compute metrics of Adélie penguin abundance at any user-defined spatial or temporal scale. The paper has been submitted to WG-EMM as one of several potential stakeholders who may be interested in using the tool and to seek input into the design of a user interface. The Working Group noted that the results from the proposal could augment work that is done through both CEMP and WG-EMM-STAPP.

2.102 The Working Group agreed that validation of new methods and tools, such as those described in WG-EMM-13/11 and 13/26, was an important step toward ensuring efficient use of new monitoring methods. The Working Group also noted that feedback management strategies could be developed, such that methods and approaches could be modified in the future when alternate methods have been evaluated.

2.103 The Working Group thought that the Bayesian model presented in the WG-EMM-13/26 proposal would be better evaluated by WG-SAM and encouraged the authors to submit the proposal for that purpose in 2014. The Working Group noted that while there are benefits to engaging the broader scientific community for delivery of CCAMLR-relevant assessments and methods, there is a need to ensure that these approaches are consistent with CCAMLR's needs and can be maintained and kept active into the future.

2.104 The Working Group noted that, in an ecosystem monitoring context, the large-scale approach taken in WG-EMM-13/26 may complement the more detailed data collected on a wider range of parameters at CEMP sites. While the Working Group recognised that the approach had the potential to provide broad-scale monitoring on Adélie penguin population size, there may be particular uncertainties associated with such a broad approach and these may need to be evaluated and considered against an alternate approach of monitoring population size at fewer sites using more direct methods. The Working Group agreed that in considering how to take CEMP forward to a feedback management strategy, it is important to determine the appropriate parameters and sites required to represent change over spatial and temporal scales of relevance for CCAMLR.

2.105 In relation to other items of ongoing WG-EMM-STAPP work identified in SC-CAMLR-XXXI, Annex 6, paragraphs 2.141 to 2.145, Dr Trathan indicated that the work plan to analyse Antarctic fur seal population data from South Georgia was expected to be completed in 2014 or 2015.

2.106 WG-EMM-13/30 presented data on annual variation and long-term trends in the number of breeding Adélie penguins at colonies along the western Ross Sea coast from 1981 to 2012. There were different long-term trends between northern and southern metapopulations, and between colonies in the southern metapopulation. It noted that:

(i) colonies showed evidence of density-dependent population regulation between years

(ii) interannual variation in southern metapopulation colonies was synchronised between years, presumably responding to environmental variability

(iii) wide-spread breeding failure in the southern Ross Sea was considered to correspond with oceanographic disruption associated with the grounding of two large icebergs in the southwest Ross Sea from 2001 to 2005.

2.107 The Working Group welcomed the submission of these results of long-term monitoring and noted their potential importance to both CEMP and WG-EMM-STAPP. In the case of the penguin population size data, the Secretariat advised the Working Group that the early part of the time series had been submitted to CEMP (up until 2003) and that discussions are currently under way with New Zealand to facilitate the submission of more recent data, which were collected using Standard Method A3b, to CCAMLR as part of CEMP.

2.108 WG-EMM-13/31 examined how Adélie penguin chick size, mass and condition varied among breeding colonies of different sizes on Ross Island during a period of high environmental variability. The presence of two giant icebergs from 2001 to 2005 increased sea-ice concentrations while reducing adult foraging efficiency and provided a natural experiment to test the effects of environmental conditions and competition on chick size, mass and condition. The results showed that size, mass and condition of Adélie penguin chicks are greater during times when environmental conditions allow for more efficient parental foraging and when chicks are fed silverfish rather than krill. In addition, the paper showed that in some cases increased intraspecific competition for available prey in the vicinity of larger colonies may be a more important driver of chick size than abiotic factors, with chicks smaller and lighter at larger colonies.

2.109 The Working Group noted that WG-EMM-13/30 and 13/31 demonstrate the complex relationships between predator populations and their biotic and abiotic environment, and the difficulty in distinguishing between the relative impacts of biotic and abiotic drivers in this region.

Partitioning krill consumption estimates developed by WG-EMM-STAPP using foraging data

2.110 Estimating krill consumption in small spatial units such as small-scale management units (SSMUs) will require the development of predictive foraging-environment models to partition region-wide krill consumption estimates (SC-CAMLR-XXXI, Annex 6, paragraph 2.147). At the request of WG-EMM in 2011, Dr Trathan has been liaising with representatives from BirdLife International and the SCAR Expert Group on Birds and Marine Mammals to assess areas of common interest and expertise that may expedite this work (SC-CAMLR-XXXI, Annex 6, paragraph 2.149). Through this liaison, funding has been obtained to develop a penguin tracking database described in WG-EMM-13/18, which is the first step in this process. The proposed database is similar to a successful database built by BirdLife International for petrels and albatross to build links between data owners and their data, to provide tools to support data submission and standardisation as well as to foster further seabird conservation work. The database would allow spatial analyses to be undertaken that would help inform a variety of CCAMLR analyses on the spatial planning processes.

2.111 The Working Group noted that the penguin tracking database approach would need to be consistent with CCAMLR's objectives and Dr Trathan indicated that BirdLife International would welcome CCAMLR's involvement on the steering committee to ensure this was the case.

2.112 WG-EMM-13/08 provided a synopsis of recent Australian Antarctic Division (AAD) GPS and satellite telemetry data for three major Adélie penguin population areas in the East Antarctic. The data highlighted the differences in summer and winter foraging activities and the association of the penguins with sea-ice during the winter months. The data will be an important contribution to the development of species–environment–foraging models for understanding krill consumption estimates of Adélie penguins in Divisions 58.4.1 and 58.4.2 when combined with results of population abundance and distribution outlined in WG-EMM-13/09.

CEMP Fund

2.113 The Working Group noted that the deadline (1 June) for submission of proposals to use the CEMP Fund for 2013 had passed and that several steps were required to define an administrative process for use of the fund. The Working Group recalled that these steps were outlined in the 2012 report of the Scientific Committee, including prioritisation of possible projects (SC-CAMLR-XXXI, paragraph 11.17) and development of a strategic plan for use of the CEMP fund (SC-CAMLR-XXXI, paragraph 11.19).

2.114 In reference to SC-CAMLR-XXXI, paragraph 11.17, the Working Group discussed priorities for the three possible projects/concepts that include:

(i) a workshop to explore revision of CEMP data collection methods to integrate new technologies (TDRs, cameras and remote sensing) and improve accuracy of data collection

(ii) conducting data 'mining' activities relevant to CEMP

(iii) construction of remotely operating cameras for use at multiple sites within the CAMLR Convention Area.

2.115 Of the three options outlined in SC-CAMLR-XXXI, paragraph 11.17, there was general agreement among the Working Group that the third project be accorded a high priority because of the benefit of expanded spatial and temporal monitoring afforded by remotely operated camera systems in the near term. There was acknowledgement that the current krill fishery potentially operates at a different spatial scale than current CEMP monitoring, and that an understanding of scales relevant to predator monitoring would be necessary in order to provide input for the development of a feedback management strategy.

2.116 The Working Group discussed general priorities for the CEMP Fund, acknowledging that the fund should be used in a way consistent with a strategic plan to progress the development of a feedback management strategy. Camera observing systems, including unmanned aerial vehicles (UAV) and stationary units were raised as potential candidates for CEMP Fund proposals. In particular, the Working Group noted that a primary benefit of both types of observing systems was that they provide an opportunity to expand spatial and

temporal monitoring efforts with minimal human disturbance. Remote cameras require infrequent service and can remain in the field for many months to years. UAVs can provide a rapid means for full-colony census work and the experience of some Members with UAVs in the Antarctic suggests that there is minimal behavioural response of seabirds and seals to small UAVs at low elevations (30–60 m). The Working Group noted that ethical considerations for the use of UAVs in the field may become important as their use expands. The Working Group noted that an expansion of monitoring for CEMP with camera systems is compatible with the plan for a staged development for a feedback management strategy.

2.117 The Working Group also discussed whether the CEMP Fund could be used to help develop image analysis systems. There was general agreement that vertical (downward-facing) photos from aerial surveys and oblique angle photos from stationary cameras on the ground would require separate image analysis techniques. The Working Group noted that current analysis of photos from stationary camera systems to provide a host of CEMP-like data, including reproductive success, breeding phenology and possibly foraging trip duration and body condition data, could be done manually or with automated software. Work to develop automated methods for some of these parameters is under development.

2.118 The Working Group noted that some Members provide support for ongoing CEMP monitoring via national programs, but there has been less commitment to monitoring studies from some national programs because it is not clear how the CEMP data are used for management purposes. A better demonstration of tangible management outcomes that derive from CEMP data may provide general incentives for new, or continuation of, monitoring by those national programs. An alternative use of the CEMP Fund could be to provide support for analysis of data with the goal of producing management-relevant results.

2.119 The Working Group then discussed how the CEMP Fund might be managed (SC-CAMLR-XXXI, paragraph 11.19), with special attention to developing a strategic plan for CEMP (SC-CAMLR-XXXI, paragraph 11.19i). In particular, developing priority outcomes of CEMP would be important to ensure that future CEMP activity align with the staged development of a feedback management strategy. The Working Group agreed that its work plan to develop a feedback management strategy should inform how CEMP would be developed further. In this regard, the Working Group considered that the strategic plan for CEMP should mirror the staged development of a feedback management strategy (paragraph 2.65). The Working Group noted that, initially, monitoring at existing CEMP sites could be strengthened (e.g. by using automated cameras to estimate breeding phenology when researchers cannot arrive on site in time to do so themselves). Then, over the medium term, new CEMP sites could be established to fill gaps in the temporal and spatial coverage provided by existing sites. Finally, over the long term, CEMP could be further enhanced to support periodic predator censuses and estimates of predator demand at regional spatial scales.

2.120 The Working Group acknowledged that technological developments in monitoring and analysis should also be considered with respect to CEMP and encouraged interested Members to work intersessionally to initiate consideration of these issues by the Working Group in 2014. Such an intersessional group may wish to involve participants of outside groups (e.g. SOOS) to engage relevant expertise.

2.121 The Working Group considered a general plan to establish a CEMP Fund Management Group. The Working Group agreed that an interim task group be formed to coordinate with

the Secretariat and the CCAMLR community to develop the management group. The interim task group would work until the meeting of the Scientific Committee in October 2013 to:

(i) define an administrative process for the management group, including linkages to a draft strategic plan (paragraph 2.113)

(ii) begin a search for Members interested in serving in the management group

(iii) develop an application pro forma for proposals to access the CEMP Fund.

2.122 The Working Group noted that the management group would consist of a Junior Vice-Chair, a Senior Vice-Chair and a Convener. Annual appointments to each position, with advancement from Junior Vice-Chair to Senior Vice-Chair to Convener, may provide a model for the administrative process.

2.123 The Working Group welcomed the voluntary participation of Drs Godø and Constable as the interim task group to progress work towards establishing the management group.

CEMP data and CEMP site designation

2.124 The Secretariat described how the process for data submission and acknowledgement of receipt of CEMP data differs from the designation of a CEMP site requiring additional protection under CM 91-01. Designation under CM 91-01 was intended to provide additional protection to a site where CEMP data was collected in order to ensure that activities at that site did not compromise the ability to collect the CEMP data. It was further noted that where Members sought specific protections for land-based monitoring sites where CEMP data are collected, that designation as an Antarctic specially managed area (ASMA) or Antarctic specially protected area (ASPA) under the Antarctic Treaty System may provide more effective mechanisms to afford this protection and would also harmonise the process for protection to terrestrial sites between CCAMLR and the ATCM (SC-CAMLR-XXVIII, Annex 4, paragraphs 5.28 to 5.30; CCAMLR-XXVIII, paragraph 12.5).

2.125 WG-EMM-13/33 presented information on a draft management plan, based on the requirements of CM 91-01, for new CEMP sites on Petermann and Galindez Islands in the Argentine Islands, Penola Strait, West Antarctic Peninsula area.

2.126 The Working Group welcomed the commitment from Ukraine to continue to collect monitoring data and to submit that data to the Secretariat as part of CEMP. The Working Group also urged Ukraine to consider the most appropriate mechanism for affording additional protection for these sites depending on the requirements to restrict activities that might compromise the ability to collect CEMP data. The Working Group looked forward to receiving an update on progress on the draft management plan contained in WG-EMM-13/33 in the near future.

2.127 The Secretariat clarified the procedure for submitting CEMP data from a site where such data has not previously been submitted. The Secretariat explained that this procedure simply involved specifying the location of the site/colony and the CEMP standard methods that were used in the collection and submission of the data to the Secretariat. Where a formal

acknowledgement was required, the Secretariat offered to provide a letter to the data originators to acknowledge that a CEMP site had been included in the CEMP database and that data had been submitted.

2.128 WG-EMM reiterated its acknowledgement (SC-CAMLR-XXXI, Annex 6, paragraphs 2.136 to 2.139) that additional monitoring data on krill-dependent predators exist, but that they are not currently submitted to CEMP. The Working Group confirmed that submission of such datasets would be welcomed but noted that other data portals are available that may contain more general ecosystem data (paragraph 6.5).

2.129 Dr M. Korczak-Abshire (Poland) notified the Working Group that Poland has just started to contribute monitoring data from its research program in King George Bay, King George Island, active since 2007, to the CEMP database. The Working Group welcomed this development and Poland's important contribution to CEMP.

2.130 The Working Group noted that the procedure for establishing a CEMP site and new time-series of data for CEMP is not easily understood. It requested the Secretariat to prepare a consolidated document for posting on the CCAMLR website containing descriptions of the current procedures, along with how methods are reviewed and standardised and how CEMP data are archived and validated.

Integrated assessment model

2.131 Dr Watters provided WG-EMM with a brief update on progress to develop an integrated assessment model for krill. Since the last meeting of the Working Group, work has focused on trying to reconcile differences between the time series of acoustic biomass estimates from US AMLR surveys and the time series of densities and size compositions from German and US AMLR research net tows in Subarea 48.1. The approach has been to fit all three time series (acoustics, German and US net densities combined and combined net size compositions) within the integrated model and estimate separate selectivity functions for the acoustics and the net tows. Last year, data from the acoustics and net tows were fitted in separate models. Estimating selectivity functions for each data series has been proven useful for integrating these data series into a single model. Work is also under way to handle the acoustics data in a different manner. Rather than fitting to estimates of acoustic biomass (where, external to the assessment model, the nautical area scattering coefficients (NASC) are converted to biomass using the size ranges of krill observed in net tows), consideration is being given to fitting NASC using the size ranges of krill predicted by the model. It is expected that an update on the integrated assessment model will be provided as a paper submitted to WG-SAM or WG-EMM next year.

Surveys from fishing vessels

2.132 WG-EMM-13/15 described the potential for using commercial fishing vessels as research platforms in the Southern Ocean and summarised the requirements to be met if scientific data collection from such vessels is to be carried out. Given that these requirements are met, data collection may be divided into four categories:

(i) non-interfering – happening during normal fishing operation
(ii) briefly interfering – ad hoc tasks like retrieval of moorings
(iii) routine monitoring surveys
(iv) specifically designed case studies.

2.133 The concept was exemplified by a new krill fishing vessel which is currently being built by the Norwegian fishing company Olympic. The vessel will be equipped for scientific use under the guidance of the Institute of Marine Research (IMR) in Bergen and will meet most requirements for being used as a research platform, including drop keel for acoustic instruments, a hangar for operating oceanographic instruments and cabin space for 20 extra scientific crew.

2.134 WG-EMM-13/35 provided an example of the use of a fishery vessel for a scientific survey. Fishery vessels from the Norwegian fishing companies Aker and Olympic have carried out annual monitoring surveys around the South Orkney Islands in January/February of 2011–2013. Among the various datasets collected, there is systematic observation of krill predators, including penguins, seals, whales and flying birds. The paper presented penguin observations with some preliminary results. Chinstrap penguins completely dominate the observations and the paper indicated specific areas with generally higher abundance of penguins. However, the authors cautioned that there are substantial differences in survey coverage and survey methods so comparison between years was premature.

2.135 Mr X. Wang (China) presented an example of acoustic data collected from a Chinese fishing vessel, where noisy data had been cleaned up using acoustic post-processing software. The Working Group welcomed the Chinese contribution and several other Members indicated that representatives of their domestic krill fishing vessels had expressed their willingness to collaborate in the acoustic data collection.

2.136 Dr Watkins, Co-convener of SG-ASAM, provided a verbal update of the progress of the CCAMLR 'proof-of-concept' program to investigate the scientific use of acoustic data collected from commercial fishing vessels (SC-CAMLR-XXXI, Annex 6, paragraph 2.167). Planning for the proof-of-concept program had been taking place during the intersessional period using an SG-ASAM correspondence group on the CCAMLR website to facilitate exchange of ideas.

2.137 The proof-of-concept program is currently being implemented in the krill fishery in 2013 and participating vessels have been requested to collect and submit example digital acoustic data to the Secretariat. These data will be evaluated for their potential use in providing information on distribution and abundance of krill. The program is being conducted in two stages:

(i) stage 1 is being implemented in 2013 to evaluate the current setup of acoustic equipment on participating vessels. The information collected will be used to develop instrument-specific instructions for stage 2

(ii) stage 2 will consist of acoustic data collected during a range of vessel activities, speeds and weather conditions to assess more fully the quality and utility of acoustic data from commercial fishing vessels.

2.138 For stage 1, participating vessels have been requested to collect trial position- and time-referenced acoustic data as follows:

(i) collect and submit a small set of position- and time-referenced data for initial testing. It is recommended that these data be recorded over an interval of 1 to 2 minutes

(ii) complete a form on essential metadata requirements for the initial proof-of-concept data collection

(iii) submit the data file(s) and completed form to the Secretariat via email.

2.139 The Working Group thanked the Co-convener of SG-ASAM for the update and strongly encouraged nations participating in the krill fishery to engage in both the SG-ASAM correspondence group and also in the proof-of-concept study.

2.140 The Working Group noted that the proof of concept contained no description of best practice for acoustic data collection on board fishing vessels. Protocols for data collection will be developed as part of future work in SG-ASAM, facilitated by the knowledge of the nature and quality of acoustic data which will arise during the proof-of-concept phase.

2.141 The Working Group further noted that SG-ASAM had taken account of the possibility that acoustic data provided by the fishing vessels, both in terms of sample quality and ways they are collected, will likely comprise a range of different levels of quality. The information provided by the data will therefore vary. These differences were taken into consideration and described by SG-ASAM (SC-CAMLR-XXXI, Annex 4), summarising a hierarchy of purposes for use for acoustic data of different quality.

2.142 The Working Group noted that as part of the future work of SG-ASAM, there will be a need to decide where and how the analysis of the acoustic data from different Members is going to be done. Similarly, the work towards standardisation of the data between the vessels will be important future work for SG-ASAM.

Joint WG-SAM–WG-EMM focus symposium on spatial modelling in 2014

2.143 The Scientific Committee asked the Conveners of WG-SAM and WG-EMM to prepare terms of reference for a symposium on spatial models (SC-CAMLR-XXXI, paragraph 15.2). The Working Group noted that spatial modelling is important to the work of SC-CAMLR and has been progressed through the following activities:

(i) a workshop in 2002 on SSMUs (SC-CAMLR-XXI, Annex 4, Appendix D)

(ii) a workshop in 2004 on modelling ecosystems relevant to developing management procedures for krill fisheries (SC-CAMLR-XXIII, Annex 4, Appendix D)

(iii) a joint CCAMLR-IWC workshop in 2008 on ecosystem data for modelling (SC-CAMLR-XXVII, Annex 12)

(iv) the development during the period 2005–2008 of models to consider spatial subdivision of krill catch limits (Plagányi and Butterworth, 2012; Watters et al., 2013)

(v) discussions in 2011 and 2012 on feedback management of krill fisheries, e.g. WG-EMM-12/19

(vi) discussions in 2012 and 2013 on climate change impacts on krill and the ecosystem, e.g. WG-EMM-13/20

(vii) WG-FSA modelling of finfish populations.

2.144 The Working Group noted the response of WG-SAM (Annex 4, paragraph 5.1) that while WG-SAM recognised the scientific utility of a workshop on spatial modelling, it currently has a very full workload.

2.145 The Working Group noted the ICED program of activities (WG-EMM-13/12 and 13/13) and that the ICED program has suggested developing joint activities of value to both the CCAMLR and ICED communities. The Working Group suggested that the Scientific Committee should consider how to further progress spatial modelling to support its work. One possibility is to approach ICED to determine if that group can help to address the needs of SC-CAMLR in the development of spatial models. Outcomes and recommendations for modelling approaches would be most useful if made available to WG-SAM and WG-EMM in time for their 2015 meetings.

SPATIAL MANAGEMENT

Marine protected areas (MPAs)

3.1 The Working Group recalled that the Scientific Committee had tasked WG-EMM with coordinating the work to support the planning and designation of MPAs (SC-CAMLR-XXVI, paragraph 3.93; SC-CAMLR-XXXI, paragraph 5.34). Consideration of work related to the designation of MPAs is therefore a standing agenda item for WG-EMM.

3.2 The Working Group recalled that planning processes for the designation of MPAs had originally centred around 11 priority areas (SC-CAMLR-XXVII, paragraph 3.55iv), but work had subsequently been focused on nine CCAMLR MPA planning domains (SC-CAMLR-XXX, paragraph 5.20). The Working Group recollected that these domains covered the whole Convention Area whereas the priority areas had covered only part of the Convention Area. The Working Group further noted that the domains better reflect the scale and location of current and planned research efforts and consequently can be helpful as reporting and auditing units (SC-CAMLR-XXX, Annex 6, paragraph 6.6). Furthermore, it recalled that the boundaries of the planning domains were not intended to confine or restrict research or other work to develop MPAs (SC-CAMLR-XXX, Annex 6, paragraph 6.7).

3.3 The Working Group discussed recent work in Planning Domains 1, 3, 4 and 5.

Domains 3 (Weddell Sea) and 4 (Bouvet–Maud)

3.4 WG-EMM-13/22 contained an initial conceptual outline and a description of the schedule of work needed to determine the scientific justification for the potential future designation of MPAs in the Weddell Sea. The paper noted that the area to be considered in the scientific analyses extends beyond Domain 3 and encompasses the southern part of Domain 4.

3.5 The Working Group noted that MPA planning was originally focused on 11 priority areas identified by WG-EMM on the basis of the results from workshops in 2006 and 2007, but was replaced by 9 planning domains resulting from the MPA Workshop in 2011 (paragraph 3.2). The new scheme divided the Weddell Gyre ecosystem into two separate planning domains, therefore creating some unintended confusion.

3.6 The Working Group recognised that the biogeography of ecological communities may span domain boundaries. This is the case in the Weddell Sea, where a single topographic and ecological entity on the eastern Weddell Sea shelf spans the boundaries between Domains 3 and 4. The Working Group suggested that, as a priority, the authors finalise the definition of the planning area as this will make retrieval and collation of available geo-referenced data more efficient. It will also facilitate data contributions and input from other experts who are part of the scientific analysis process.

3.7 The Working Group noted that the work plan identifies a time schedule, with defined milestones and deliverables. It also noted that the work plan identifies a wide range of data that have already been collated, while a number of data gaps have also been identified, including for phytoplankton and zooplankton, penguins, flying seabirds and part of the fish assemblages, in particular *Dissostichus* spp., and mesopelagic fish such as myctophids. The Working Group encouraged scientists from all CCAMLR Members with relevant data and expertise to contribute to, and actively engage in, the work; it also noted that SCAR-MarBIN could form a valuable data source, particularly the *Biogeographic Atlas of the Southern Ocean*, which will be released later this year.

3.8 The authors of WG-EMM-13/22 informed the Working Group that an international expert workshop concerning the scientific evaluation of the Weddell Sea is scheduled for early April 2014; the workshop will be organised and hosted by the AWI in Bremerhaven, Germany (contacts: Thomas.Brey@awi.de and Katharina.Teschke@awi.de). The major objective of the workshop will be to bring together scientists and experts from all CCAMLR Members to discuss the available data and any preliminary results derived from ongoing scientific studies and analyses to establish a robust scientific basis for formulating subsequent candidate proposals for spatial protection. Further information about the workshop will be circulated via an SC CIRC in the near future.

3.9 The Working Group welcomed the new initiative, and noted that the proposed work plan was consistent with the planning processes carried out in other parts of the Convention Area. The Working Group also encouraged interested scientists to attend the international expert workshop and to contribute data and expertise.

3.10 Dr A. Petrov (Russia) made the following statement:

> 'Our position on MPA discussion was announced at the last meeting of the Scientific Committee and was discussed among the countries and it was supported by several countries and by the Chair of the Scientific Committee (SC-CAMLR-XXXI, paragraphs 5.35, 5.74, 5.77 to 5.80).
>
> We think that in discussions of MPAs there should be a clear understanding between the Members. In the case if this proposal (WG-EMM-13/22) will be presented in the Scientific Committee and will be translated in four official languages of CCAMLR according to the procedure we will take part in discussion of this proposal. Now we would like to reserve our opinion on that proposal (WG-EMM-13/22) until the meeting of the Scientific Committee, where as I mentioned above the procedure provides the official translation of documents and interpretation during the discussion.'

Domain 1 (Western Antarctic Peninsula – South Scotia Arc)

3.11 Dr J. Arata (Chile) presented a brief outline of the data so far collated following the workshop in Valparaiso, Chile, in May 2012 (WG-EMM-12/69), on the identification of appropriate protection objectives and spatial data to represent those objectives, to inform upon MPA designation within Domain 1. He reported that, consistent with the protection objectives agreed at that workshop, considerable amounts of spatial data had now been collated and converted to GIS 'shapefiles'; further that appropriate metadata detailing the methods were also complete. Dr Arata reported that the GIS shapefiles and metadata would now be circulated to the group of scientists who had contributed the original data in order that the synthesised data could be validated and any errors corrected.

3.12 The Working Group noted that for a number of objectives the corresponding datasets remain to be converted, including information on areas of oceanographic upwelling, zooplankton and other prey species distributions, the location of penguin colonies and the winter distribution of various top predators. It noted that such data would be necessary prior to the start of any further work and encouraged their delivery as soon as feasible.

3.13 The Working Group debated how the collated data might now be made available to scientists within the CCAMLR community, recognising that this was a generic issue for all planning domains. It considered the following alternative approaches and requested that the Scientific Committee provide advice on how to proceed; the Working Group also noted that other approaches may be appropriate:

(i) data could be located within a private area of the CCAMLR website accessible only to a CCAMLR subgroup (groups.ccamlr.org)

(ii) data could be located within the private data area of the CCAMLR website dedicated to GIS shapefiles and data layers, available to all Members.

3.14 The Working Group noted that not all data layers need to be subjected to the same levels of restriction on access. The Working Group recalled that for data layers used in the design of MPA proposals in Domains 7 and 8 (i.e. the East Antarctic and the Ross Sea

region), summarised or derived data layers previously described in CCAMLR working group papers were available for download by all Members with access to the CCAMLR website, whereas layers containing raw data from CCAMLR databases (e.g. C2 catch histories) require a data request to the Secretariat.

3.15 Dr Arata reported on plans to develop an MPA proposal for consideration by WG-EMM in 2014; he welcomed interested individuals to contact him in order to help formulate the proposal.

3.16 The Working Group recalled the proposed time frame for the development of candidate systems of MPAs in Domain 1 (SC-CAMLR-XXXI, paragraph 5.18) and encouraged Members to work on the development of other proposals for consideration by WG-EMM in 2014.

3.17 The Working Group welcomed the progress made and congratulated Dr Arata and colleagues on their valuable contribution.

3.18 WG-EMM-13/10 presented a draft MPA Report for the South Orkney Islands southern shelf MPA; it noted that the report will subsequently contribute to the broader MPA Report for Planning Domain 1. The paper noted that there are many studies that have relevance to the development of the MPA Report for the South Orkney Islands, including, inter alia, oceanographic influences upon krill and the krill fishery in the Scotia Sea as well as historical information from finfish fisheries, the crab fishery and benthic surveys. Other papers, reports and studies also exist that relate to krill predators. The authors therefore encouraged scientists and researchers with relevant information to contribute towards a revised version of the document (however, see also paragraph 3.22).

3.19 The authors noted that the South Orkney Islands southern shelf MPA (CM 91-03) was designated prior to the agreement of the general framework for the establishment of CCAMLR Marine Protected Areas (CM 91-04) and that the requirements of the framework may need to be applied to this MPA conditional on advice from the Commission. The authors also noted that this is the first time that a draft MPA Report has been considered in detail by the Working Group. The authors therefore requested guidance from WG-EMM about the most appropriate structure for the MPA Report; currently WG-EMM-13/10 is structured using headings and subheadings taken from WG-EMM-12/49, but with a number of additional sections.

3.20 Dr Petrov stated:

> ‘Some Members noted that MPA in Subarea 48.2 was established in 2009 (CM 91-03) and until now it has not been adjusted in accordance with the requirements of Conservation Measure 91-04, although this measure was established in 2011.’

3.21 Dr Trathan agreed that the South Orkney Islands southern shelf MPA needed to be considered in the context of CM 91-04; however, he noted that it also needed to be considered in the context of other planning work in Domain 1. The development of new proposals for Domain 1 will provide opportunities for the existing MPA to be harmonised with CM 91-04 (paragraphs 3.15 and 3.16).

3.22 The Working Group recommended that WG-EMM-13/10 be revised to form three separate documents (paragraph 3.34):

(i) a management plan
(ii) a research and monitoring plan
(iii) an MPA Report that describes: (a) the evidence used to designate the MPA, and (b) information relevant to the MPA, but available subsequent to the designation of CM 91-04.

3.23 Drs Petrov and Kasatkina noted that the monitoring and research program outlined in WG-EMM-13/10 needed clarifications. They noted that it is necessary to define more exactly the following aims:

(i) Monitoring the effects of harvesting and other human activities on Antarctic marine living resources and on the ecosystem. Considering that the Antarctic fishery in the MPA area does not conduct, the localisation of the krill fishery in area of Coronation Islands and the close of fishery in Subarea 48.2 from the beginning of the 1990 that points of the Report should be reviewed.

(ii) Protection of features critical to the function of local ecosystems. Variability of the following features (krill flux, Southern Antarctic Circumpolar Current Boundary and the Southern Antarctic Circumpolar Current Front, frontal zone) is defined only by climatic processes and the regulation and management of them is impossible.

3.24 Dr Trathan indicated that the intention of WG-EMM-13/10 was to initiate a dialogue to develop the management plan, the research and monitoring plan and the MPA Report for the South Orkney Islands southern shelf MPA so that it was consistent with planning work for Domain 1 and CM 91-04. On the specific points raised, he noted that studies related to the recovery of finfish stocks would be of considerable interest, whilst variability in krill abundance and distribution was of evident importance.

3.25 Dr Kasatkina noted that the timeline of the research activities with detailed information on research areas should be included in the research/monitoring plan. It should include the number of participating Member vessels and the deadlines for report submission.

3.26 Dr Trathan recalled that under CM 91-04 all Members may undertake research and monitoring activities in accordance with the research and monitoring plan, and that the operational uncertainties of Antarctic research precluded specific and detailed commitments within a research and monitoring plan designed to be accessible to all Members and to be implemented over a number of years or decades.

3.27 Dr Kasatkina noted that the analysis of climate impact on the ecosystem was announced as one of the aims of the MPA establishment. However, the description of the current state of the ecosystem, and its individual elements at the moment of MPA establishment, were not presented.

3.28 Dr Trathan indicated that in WG-EMM-13/10 the implications of climate change were only included as a proposed objective for the South Orkney Islands region, not as a specific objective for the South Orkney Islands southern shelf MPA. The specific objectives for the

MPA were detailed in section 2.2 of the document and included protection objectives, e.g. pelagic bioregions, seasonal sea-ice areas, areas of high primary productivity, frontal areas and penguin foraging areas. He added that climate change was well known to be affecting areas within Domain 1, including at the South Orkney Islands, and that therefore a proposal for such an objective was reasonable for the wider South Orkney Islands region and also consistent with CM 91-04, paragraph 2(vi).

3.29 Dr Kasatkina noted that the large area of the MPA and the proposed research program imply a huge amount of complex scientific investigation which could only be undertaken by a group of research vessels with systematic and previously agreed expeditions (with methods, duration and areas of investigation outlined). The current proposal does not include details of the participants who will undertake the research in the MPA or details of any cooperation with other Members or organisations.

3.30 Dr Trathan recalled that under CM 91-04 all Members may undertake research and monitoring activities in accordance with the research and monitoring plan and that progress in implementing the plan could depend on the active engagement of different Members. He noted that CM 91-04 does not require these specific details. He also added that the extent and complexity of the plan required the active engagement of a range of Members in order to develop an appropriately scaled and realistic proposal.

3.31 Dr Petrov noted that it is necessary to provide an explanation for the period increase of MPA status from five years to 10 years (WG-EMM-13/10, part 6, point 3) and that discussion on the review period may be possible only after the presentation of the report (in accordance with CM 91-03).

3.32 Dr Trathan explained that the intent of WG-EMM-13/10, part 6, point 3, was a proposal to provide the Scientific Committee with the opportunity to review the research and monitoring plan, in case it was no longer fit for purpose. This proposal was additional and separate to the requirement under CM 91-04, paragraph 5(v) that stipulates that Members conducting activities according or related to the research and monitoring plan will compile a report on those activities every five years, including any preliminary results for review by the Scientific Committee. Dr Trathan emphasised that this proposal was also distinct from the review of the conservation measure itself (CM 91-03, paragraph 9) which stipulates a review at five-year intervals.

3.33 The Working Group recommended the Scientific Committee consider providing translations of the MPA Reports into the official languages which would allow for a better understanding of the research activities that take place in MPAs (paragraph 2.10).

3.34 The Working Group recommended that the authors circulate an SC CIRC encouraging interested individuals to contribute towards the revised version, suggesting that revisions of text should be located within a private area of the CCAMLR website accessible to a CCAMLR subgroup (groups.ccamlr.org).

Domain 5 (del Cano – Crozet)

3.35 Dr T. Samaai (South Africa) and Prof. P. Koubbi (France) reported that they are developing plans for Domain 5 and are beginning to collate data. The Working Group welcomed the continuation of this work (SC-CAMLR-XXXI, Annex 6, paragraphs 3.52 to 3.57) and looked forward to receiving further information in the future.

Vulnerable marine ecosystems (VMEs)

3.36 Notifications of encounters with VMEs during the course of research are notified under CM 22-06, Annex B. No new notification was made in 2013.

3.37 The Working Group encouraged participants and Member's national Antarctic research programs to continue work on the detection and identification of new VMEs in accordance with CM 22-06 and to notify these VMEs to WG-EMM.

ASMAs and ASPAs

3.38 The Working Group thanked Dr E. Secchi (Brazil) for introducing WG-EMM-13/05 on behalf of the ASMA No. 1 Management Group and noted that the Working Group had already considered the potential for commercial fishing to negatively impact the broad range of ecological and scientific values in the ASMA (SC-CAMLR-XXXI, Annex 6, paragraphs 3.8 to 3.15). This potential was reflected in the revised management plan for ASMA No. 1 by ensuring that any fishing should be conducted in a manner that is consistent with the values of the ASMA.

3.39 The Working Group noted the suggestion in the WG-EMM-13/05 that, consistent with the procedure established in ATCM XXVIII Decision 9 (2005), any proposal to undertake commercial harvesting should be submitted to CCAMLR for its consideration and that the activities outlined in that proposal should only be taken with the prior approval of CCAMLR. The Working Group agreed that the provision of advice from CCAMLR to the ATCM in order that such advice could be included in decision-making was consistent with the spirit of cooperation and harmonisation between CCAMLR and the ATCM.

3.40 The Working Group noted that CM 91-02 had been adopted last year to raise awareness of the geographic location and the management plans of ASMAs and ASPAs with marine components and requested that the Secretariat include a report of any fishing that occurs in ASMAs and ASPAs in its regular report on the krill fishery to the Scientific Committee.

ROLE OF FISH IN THE ROSS SEA ECOSYSTEM

4.1 WG-EMM-13/28 summarised information pertinent to the question if, and to what extent, the fishery on Antarctic toothfish (*Dissostichus mawsoni*) might impact on Weddell seals. Several methods from scat analyses to stable isotope method and nutritional value

assessment were applied to estimate the potential importance of toothfish for Weddell seals. Different methods led to different estimates with respect to the importance of individual food components which are currently difficult to reconcile. The paper noted that available evidence does not support the conclusion that toothfish are a major component in the diet of Weddell seals throughout the entire year or at the scale of the entire Ross Sea ecosystem. However, given its high metabolisable energy content, toothfish are likely to be important for Weddell seals in particular locations and at particular times of the year when energy demand increases, such as the period between pup weaning and embryo implantation, during which time breeding females must rapidly regain body mass lost during lactation. The paper noted that current understanding is hindered by:

(i) insufficient information on Weddell seal diet due to inadequate temporal coverage and biased methodology

(ii) uncertainty regarding Weddell seal abundance and spatial foraging patterns in the Ross Sea region.

4.2 WG-EMM-13/29 reviewed information on the potential importance of Antarctic toothfish in the diet of type C killer whales in the Ross Sea. The paper reported direct observations of predation in the McMurdo Sound area, and circumstantial evidence based on the high metabolisable energy content of toothfish relative to other prey, and likely availability of toothfish and potential alternate prey in this area. It noted that the balance of evidence suggests that toothfish are unlikely to constitute a major component in the diet of type C killer whales throughout the year or at the scale of the entire Ross Sea ecosystem, but are likely to be important for type C killer whales in McMurdo Sound in summer and potentially in other locations on the Ross Sea shelf. Research priorities to resolve remaining uncertainties include improved population estimates for type C killer whales and improved data indicative of spatial and temporal foraging patterns.

4.3 Dr Petrov noted that for the entire history of the fishery in the Ross Sea there were no observer reports on the impact of killer whales on fishing gear (longline), i.e. killer whales have not eaten caught fish from the hooks.

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

5.1 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.

5.2 The Working Group provided advice to the Scientific Committee and other working groups on the following topics:

(i) Krill fishery –

(a) activities in 2012/13 (paragraphs 2.6 and 2.7)
(b) krill fishery report (paragraphs 2.9 and 2.10)
(c) fishery notifications for 2013/14 (paragraphs 2.11 and 2.12, Table 1)
(d) green weight estimation (paragraphs 2.17 and 2.18)
(e) notification format (paragraphs 2.13 and 2.14, Appendix D)

(f) observer coverage in 2012/13 (paragraph 2.19)
(g) observer data forms (paragraph 2.28).

(ii) Krill biology and ecology –

(a) winter surveys (paragraph 2.35)
(b) CEMP fund (paragraphs 2.114, 2.115, 2.118, 2.121 to 2.123)
(c) climate variability impact on krill habitat (paragraph 2.54).

(iii) Feedback management strategy –

(a) development of the strategy (paragraphs 2.62 to 2.70, 2.74 and 2.76)
(b) surveys by fishing vessels (paragraphs 2.137 and 2.138)
(c) spatial modelling (paragraph 2.145).

(iv) Marine protected areas –

(a) MPA reports (paragraph 3.33)
(b) ASMAs and ASPAs (paragraphs 3.39 and 3.40).

(v) Future work –

(a) interaction with other scientific programs (paragraph 6.9).

FUTURE WORK

6.1 The Working Group considered a number of papers that related to international programs and organisations that conduct science of relevance to CCAMLR (WG-EMM-13/12, 13/13, 13/16, 13/17 Rev. 1, 13/19 and 13/36).

6.2 The Working Group noted the activities in the wider scientific community on understanding, assessing and monitoring climate change impacts on Antarctic and Southern Ocean marine ecosystems. WG-EMM-13/36 summarised activities in the IMBER-ICED program, SOOS, SCAR and COMNAP. Activities in SOOS, ICED (Southern Ocean Sentinel) and COMNAP are being coordinated to develop an integrated system to assess change in Southern Ocean ecosystems. It would be beneficial to coordinate activities at CEMP sites with at-sea activities to develop a circumpolar program for monitoring change. The SOKI wiki (www.soki.aq) is being used to help coordinate and develop these activities in ICED and SOOS.

6.3 A series of workshops and conferences are being held over the next 12 months that will support scientific work on climate change impacts on Southern Ocean ecosystems. These are described in WG-EMM-13/13 and 13/36 and include:

(i) Southern Ocean Food Webs and Scenarios of Change (ICED workshop at BAS, Cambridge, UK, November 2013)

(ii) Future Oceans – Research for marine sustainability: multiple stressors, drivers, challenges and solutions (IMBER Open Science Conference, Bergen, Norway, June 2014) – two workshops:

(a) Detecting, Projecting and Managing the Impacts of Change in Southern Ocean Ecosystems

(b) End-to-End Modelling for Research and Management

(iii) SOOS workshops throughout the year on monitoring ecosystem essential ocean variables.

6.4 The Working Group noted the request in WG-EMM-13/19 for information on datasets relevant to the Working Group's work that require digitisation. The authors of WG-EMM-13/19 intend to compile a list of such datasets and relevant metadata. This list will be made publically available to help facilitate future data recovery processes.

6.5 There are also a number of initiatives currently under way to develop data portals and repositories (through ICED, SOOS, SCAR, etc.) containing data that are likely to be of interest to CCAMLR. The Working Group recognised that it was unlikely that there would be a single repository that included all such data and that it is important to be aware of the developing range of data sources available. It requested that the Secretariat provide appropriate links on the CCAMLR website.

6.6 The Working Group noted the joint ICED-CCAMLR session at IMBER 2014 (WG-EMM-13/13) and welcomed this as an indication of the long-term interest and support of programs like ICED in the work of CCAMLR (SC-CAMLR-XXIV, Annex 4). However, the Working Group also noted that the dates for the IMBER meeting coincided with the regular timing of WG-SAM and WG-EMM.

6.7 The Working Group noted the report of the SCAR–CCAMLR Action Group meeting (SC-CAMLR-XXXI, paragraph 10.6) that had provided an opportunity for both SCAR and CCAMLR to better understand the processes and structures of the two organisations (WG-EMM-13/16). In considering the suggestion in WG-EMM-13/16 that engagement with SCAR scientists may be more effective at WG-EMM than at the Scientific Committee, the Chair of the Scientific Committee recalled that the proposal for standing invitations to scientists from other expert bodies, such as the IWC, was still under discussion.

6.8 The Science Manager indicated that a follow-up meeting with representatives from SCAR was planned for the SCAR Biology Symposium in July 2013 and would include feedback from the discussions at WG-EMM, as well as the potential coordination of population status and trends data for seabirds and marine mammals that were collected by CCAMLR and other organisations such as ACAP and the IWC.

6.9 In welcoming the papers on interactions with other programs/organisations, there was recognition that many scientists are involved in a number of international programs, including CCAMLR, and that taking experience of CCAMLR into other fora was very helpful in promoting the science undertaken in CCAMLR. However, noting the importance of the informal links created by individual scientists, the Working Group agreed that there is a need for clarity in the process for engagement with other programs, such as SCAR, SOOS and

ICED, to distinguish between individual scientists with experience of CCAMLR providing personal insights and those appointed by the Scientific Committee as observers to represent CCAMLR.

6.10 The Chair of the Scientific Committee indicated that a paper on the process for the engagement of experts in the working groups would be presented to the Scientific Committee this year. This would include a process for the selection of experts, as well as consideration of how to structure meetings in order to optimise their engagement (e.g. experts coming to a focus topic session would not be expected to remain for the entire working group meeting), as well as the implications of expanding participation for meeting logistics.

6.11 The Working Group welcomed the establishment of the SONA program (WG-EMM-13/17 Rev. 1) that will use ships of opportunity in the Southern Ocean to collect and analyse acoustic data to a set of common protocols. The Working Group noted the overlap between this proposal and the ongoing work of SG-ASAM, and encouraged coordination with CCAMLR, noting that many of the international partners are also part of SG-ASAM (paragraph 2.136).

OTHER BUSINESS

Accessibility and availability of working group papers

7.1 The Working Group noted that the new CCAMLR website had delivered a greater discoverability of the large archive of working group papers, and the Secretariat sought the views of the working groups on how these papers might be made publically available (WG-SAM-13/17). The proposal contained in WG-SAM-13/17 included the application of a variable embargo period to each paper that would determine when a paper would be available publically, including an option to have a paper available only on request from the Scientific Committee representative (see also Annex 4, paragraphs 5.2 to 5.6).

7.2 The Working Group agreed with the consideration of WG-SAM that working group papers that are placed in the public domain on the CCAMLR website should have a disclaimer that makes it clear that the paper may not have been reviewed by the working group, that the content of the paper does not necessarily reflect the views of CCAMLR and that the paper should be considered in the context of the relevant working group report.

7.3 The Working Group was concerned that making working group papers available in the public domain might compromise the subsequent publication in the peer-reviewed literature as some journals considered that a paper in the public domain was ‘published’, and noted that this may affect the embargo period that is chosen for some papers.

7.4 The Working Group thanked the Secretariat for this initiative and looked forward to the proposal to the Scientific Committee that incorporated the advice from all of the working groups.

Editorial procedures of *CCAMLR Science*

7.5 The Working Group discussed a proposal for revising the editorial procedures for papers submitted to *CCAMLR Science*. The proposal included a recommendation that papers

that are to be considered for publication in *CCAMLR Science* should be submitted in the format required for the journal to the relevant working group meeting or within one month of the working group meeting.

7.6 In considering the proposal, the Working Group considered whether there was a need for all papers in *CCAMLR Science* to be submitted via the working groups. Inviting submissions that do not require consideration by the working groups might bring in additional papers relevant to the work of CCAMLR, but there would likely need to be an editorial policy which ensures that submissions address issues of relevance to CCAMLR.

7.7 The Working Group agreed that it was useful to remove the two-stage review process but noted that working group papers may differ from peer-reviewed papers in format and content. In some cases authors of working group papers focus only on the details relevant to the working group and reduce the description of the broader context (that would be required in a peer-reviewed paper). However, the Working Group agreed that there was need for a balance of the desire for brevity with the recognition of the importance of including sufficient context as this is particularly important for engaging those who are new participants in the working group.

7.8 The Working Group also suggested that the 'Instructions for Authors' and the journal format be reviewed and the visibility of the journal on the CCAMLR website should be enhanced.

Global Environment Facility (GEF) proposal

7.9 Dr Samaai introduced WG-EMM-13/44 that provided an updated proposal for a GEF-funded project that was originally presented as WG-EMM-10/32. The Working Group welcomed the update on progress noting its previous discussion (SC-CAMLR-XXIX, Annex 6, paragraphs 6.1 to 6.3), including that the proposal had been endorsed by the Scientific Committee (SC-CAMLR-XXIX, paragraph 17.1) and encouraged South Africa to engage all GEF-eligible CCAMLR Members in discussion to ensure full engagement and to allow sufficient time for consultation both within and between delegations. The Working Group looked forward to receiving future updates on progress from South Africa on this project that has the potential to develop capacity in a number of important areas for CCAMLR.

CCAMLR web-based GIS

7.10 The Secretariat presented a prototype of the CCAMLR web-based GIS which is being developed jointly with the British Antarctic Survey (BAS) to provide state-of-the-art capacity

for displaying geo-referenced data relevant to CCAMLR (WG-EMM-12/70). This development will include capacity building at the Secretariat and a phased handover of the system to the Secretariat.

7.11 The development of the GIS will be implemented in two stages, with stage 1 nearing completion and stage 2 being implemented in 2014. The prototype is currently located at gis.ccamlr.org and contains basic data layers (e.g. management areas, bathymetry, sea-ice). An option to download data is available to users authenticated on the CCAMLR website. The Secretariat encouraged users to provide feedback.

7.12 The Working Group requested the Secretariat to develop guidelines for how the data posted on the website could be accessed to satisfy the Rules for Access and Use of CCAMLR Data.

CCAMLR scholarships

7.13 The two recipients of the CCAMLR scholarship in 2012 gave presentations to the Working Group describing the research that they were undertaking and how this will contribute to the objectives and priorities of CCAMLR.

7.14 Lic. Santos provided a description of the penguin research being conducted by Argentina in Subareas 48.1 and 48.2, including the work presented in WG-EMM-13/27 and 13/43 and also an inter-site comparison of penguin demography and foraging behaviour that will be presented to WG-EMM-14. Lic. Santos informed the Working Group that Argentina was currently focused on land-based penguin research but logistic constraints often meant that access to the monitoring site at Cierva Point was restricted and that because of this she hoped that it may be possible to deploy remote cameras to augment and enhance existing CEMP data collected. She thanked CCAMLR for the scholarship and her mentors Drs E. Barrera-Oro (Argentina) and Hinke for their help and guidance in understanding feedback management. She also dedicated her work to the memory of the late Dr Alejandro Carlini (1963–2010).

7.15 Mr Wang described the work undertaken to digitise photographs of the screen of the echosounder on krill fishing vessels and to develop an algorithm to produce an estimate of the density of krill swarms encountered during fishing operations in order to study the spatio–temporal variation in swarm characteristics. He also informed the Working Group that one Chinese vessel was recently equipped with a Simrad EK60 echosounder that would provide quantitative acoustic data that would also contribute to the work of SG-ASAM. Mr Wang thanked CCAMLR for the scholarship, his mentor Dr X. Zhao (China) and scientists from IMR in Norway for their help during the period that he was on board the krill fishing vessel *Juvel*.

7.16 The Working Group warmly welcomed the presentations by both of the CCAMLR scholarship recipients, noting that their positive engagement in the work of CCAMLR was exactly the outcome for which the scholarship scheme, including the mentoring arrangements, had been established.

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

8.1 The report of the meeting of WG-EMM was adopted.

8.2 In closing the meeting, Dr Kawaguchi thanked all participants for their contributions to the meeting, the subgroup coordinators for leading detailed deliberations, the rapporteurs for preparing the report and the Secretariat for its support. Dr Kawaguchi also thanked the AWI and the German Federal Ministry of Food, Agriculture and Consumer Protection for hosting the meeting, and Dr Hain and colleagues for their kind hospitality and assistance during the meeting. Dr Kawaguchi also thanked Prof. S. Kleingärtner, director of the German Shipping and Maritime Museum, for generously providing the meeting venue.

8.3 Dr Zhao, on behalf of the Working Group, thanked Dr Kawaguchi for guiding detailed consideration of the work of WG-EMM, including the further development of a feedback management strategy for the krill fishery.

8.4 The Working Group also thanked Lic. Santos and Mr Wang, the 2012 recipients of the CCAMLR scholarship, for their contributions to the meeting (paragraphs 7.13 to 7.16).

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Plagányi, É.E. and D.S. Butterworth. 2012. The Scotia Sea krill fishery and its possible impacts on dependent predators: modeling localized depletion of prey. *Ecol. Appl*., 22: 748–761.

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Table 1: Summary of specific elements on the notifications for krill fisheries in 2013/14 requiring clarification.

Member	Element requiring clarification
Chile	Method for estimating conversion factors for whole and meal product Type of echosounder used by each vessel (make, model, frequencies)
China	Method for weighing 1 000 kg of krill, for use in the estimation of conversion factors Mesh sizes of trawl nets, and minimum mesh size for the codend (including any liner) Type of echosounder used by each vessel (make, model, frequencies)
Korea, Republic of	Method for estimating conversion factors for whole and meal product Detailed drawings for the seal exclusion devices Information on the explosive sound device Type of echosounder used by each vessel (make, model, frequencies)
Norway	Product types and percentages (total should sum to 100%) Information on discarded product (location, composition, quantities) Type of echosounder used by each vessel (make, model, frequencies)
Poland	Method for estimating conversion factors for whole and meal product Type of echosounder used by each vessel (make, model, frequencies)
Ukraine	Method for estimating conversion factors for whole and meal product Circumference of the net mouth opening Type of echosounder used by each vessel (make, model, frequencies)

Appendix A

LIST OF PARTICIPANTS

Working Group on Ecosystem Monitoring and Management
(Bremerhaven, Germany, 1 to 10 July 2013)

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Appendix B

AGENDA

Working Group on Ecosystem Monitoring and Management
(Bremerhaven, Germany, 1 to 10 July 2013)

1. Introduction

    1.1 Opening of the meeting
    1.2 Adoption of the agenda and appointment of rapporteurs
    1.3 Review of requirements for advice and interactions with other working groups

2. The krill-centric ecosystem and issues related to management of the krill fishery

    2.1 Issues for the present
        2.1.1 Fishing activities
        2.1.2 Scientific observation
        2.1.3 Krill biology, ecology and management
        2.1.4 Role of fish in the Ross Sea ecosystem

    2.2 Issues for the future
        2.2.1 Feedback management strategy
        2.2.2 CEMP and WG-EMM-STAPP
        2.2.3 Integrated assessment model
        2.2.4 Fishing vessel surveys
        2.2.5 Joint WG-SAM–WG-EMM focus symposium on spatial modelling in 2014
        2.2.6 Climate change

3. Spatial management

    3.1 Marine Protected Areas (MPAs)
    3.2 Vulnerable Marine Ecosystems (VMEs)
    3.3 ASMA and ASPA

4. Role of fish in the Ross Sea ecosystem

5. Advice to the Scientific Committee and its working groups

6. Future work

7. Other business

8. Adoption of the report and close of the meeting.

Appendix C

LIST OF DOCUMENTS

Working Group on Ecosystem Monitoring and Management
(Bremerhaven, Germany, 1 to 10 July 2013)

WG-EMM-13/01	Provisional Agenda for the 2013 Meeting of the Working Group on Ecosystem Monitoring and Management (WG-EMM)
WG-EMM-13/02	List of participants
WG-EMM-13/03	List of documents
WG-EMM-13/04	Some thoughts on our work towards establishing feedback management scheme for krill fishery S. Kawaguchi (Convener, WG-EMM)
WG-EMM-13/05	Draft revised Management Plan for ASMA No. 1: Admiralty Bay, King George Island, South Shetland Islands J. Leal Madruga (Submitted by Brazil on behalf of the ASMA No. 1 Management Group – Brazil, Ecuador, Peru and Poland)
WG-EMM-13/06	CEMP indices: 2013 update Secretariat
WG-EMM-13/07	Fish identification guide for Observers in CCAMLR krill fisheries Secretariat
WG-EMM-13/08	Winter and summer foraging location of Adélie penguins from Mawson, Davis and Casey L. Emmerson, N. Kokubun and C. Southwell (Australia)
WG-EMM-13/09	Adélie penguin breeder abundance in CCAMLR Divisions 58.4.1 and 58.4.2 C. Southwell, J. McKinlay, L. Emmerson (Australia), A. Takahashi (Japan), C. Barbraud, K. DeLord and H. Weimerskirch (France)
WG-EMM-13/10	Draft MPA Report for the South Orkney Islands, Subarea 48.2; Part of CCAMLR MPA Planning Domain 1, Western Peninsula – South Scotia Arc P. Trathan and S. Grant (United Kingdom)

WG-EMM-13/11	New contributions to penguin monitoring to help underpin the development of feedback management approaches for the Antarctic krill fishery N. Ratcliffe, A. Fox, P. Fretwell, T. Hart and P. Trathan (United Kingdom)
WG-EMM-13/12	Developing research on Antarctic krill to facilitate the development and updating of feedback management procedures E.J. Murphy, R.D. Cavanagh (United Kingdom), A. Constable (Australia), E.H. Hofmann (USA), S.L. Hill, N.M. Johnston, P.N. Trathan and J.L. Watkins (United Kingdom)
WG-EMM-13/13	ICED workshop and conference session on Southern Ocean foodwebs and scenarios of change R.D. Cavanagh on behalf of the international ICED Scientific Steering Committee
WG-EMM-13/14	Inter-annual variability in krill density at South Georgia: 1997–2012 S. Fielding, J.L Watkins, P. Trathan, P. Enderlein, C. Waluda, C. Goss, G. Stowasser, G. Tarling and E. Murphy (United Kingdom)
WG-EMM-13/15	Commercial fishing vessel as research vessels in the Antarctic – requirements and solutions exemplified with a new vessel O.R. Godø (Norway), C. Reiss (USA), V. Siegel (Germany) and J.L. Watkins (United Kingdom)
WG-EMM-13/16	Report of the first SCAR-CCAMLR Joint Action Group meeting CCAMLR Secretariat and SCAR Executive Office
WG-EMM-13/17 Rev. 1	Southern Ocean Network of Acoustics (SONA) S. Fielding (United Kingdom), E. Josse (France), R. Kloser (Australia), R. O'Driscoll (New Zealand), C. Reiss (USA), G. Skaret (Norway) and M. Cox (Australia)
WG-EMM-13/18	Developing a penguin tracking database to help determine their most important foraging areas M. Hindell (SCAR), B. Lascelles (BirdLife) and P. Trathan (United Kingdom)
WG-EMM-13/19	Historical data synthesis in the Southern Ocean: Priority data sets N.M. Johnston, E.J. Murphy, J.R.D. Silk, C.M. Waluda, S.L. Hill and R.D. Cavanagh (United Kingdom) on behalf of the ICED Scientific Steering Committee
WG-EMM-13/20	Potential climate change effects on the habitat of Antarctic krill S.L. Hill, T. Phillips and A. Atkinson (United Kingdom)

WG-EMM-13/21	Recent British Antarctic Survey publications relevant to the agenda of WG-EMM 2013 Delegation of the United Kingdom
WG-EMM-13/22	Proposal for the establishment of a marine CCAMLR MPA in the Weddell Sea (Antarctica) – First conceptual outline K. Teschke, B. Dorschel, J. Gutt, S. Hain, H. Hellmer, K. Jerosch, R. Knust, K.-H. Kock, M. Schlüter, V. Siegel and T. Brey (Germany)
WG-EMM-13/23	A sensitivity analysis of a simple krill individual-based model designed to investigate length-based recruitment indices S. Thanassekos and K. Reid (Secretariat)
WG-EMM-13/24	Antarctic krill populations in the outflow region of the north-western Weddell Sea V. Siegel (European Union)
WG-EMM-13/25	Dynamic of the krill fishery in the Area 48 and its relation to climate variability and changes in fishing technology P.S. Gasyukov and S.M Kasatkina (Russia)
WG-EMM-13/26	Bayesian data-model synthesis for biological conservation and management in Antarctica H.J. Lynch and M. Schwaller (USA)
WG-EMM-13/27	Evaluation of populations of chinstrap and gentoo penguins at Cierva Cove (ASPA N° 132). Is this site an appropriate control area for non-fishing effects? M.M. Santos, N.R. Coria, E. Barrera-Oro (Argentina) and J.T. Hinke (USA)
WG-EMM-13/28	A critical re-examination of the evidence for a possible dependence of Weddell seals (*Leptonychotes weddellii*) on Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea, Antarctica R. Eisert, M.H. Pinkerton (New Zealand), S.D. Newsome and O.T. Oftedal (USA)
WG-EMM-13/29	To what extent do type C killer whales (*Orcinus orca*) feed on Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea, Antarctica? L. Torres, M.H. Pinkerton (New Zealand), R. Pitman, J. Durban (USA) and R. Eisert (New Zealand)

WG-EMM-13/30	Abundance and trends in the breeding population of Adélie penguins (*Pygoscelis adeliae*) in the western Ross Sea P. O'B. Lyver, M. Barron, K.J. Barton, S. Gordon (New Zealand), D. Ainley, A. Pollard (USA), P.R. Wilson and M.H. Pinkerton (New Zealand)
WG-EMM-13/31	Competition-mediated prey availability drives Adélie penguin (*Pygocelis adeliae*) chick size, mass and condition at colonies of differing size in the southern Ross Sea A.L. Whitehead (Australia), P. O'B. Lyver (New Zealand), G. Ballard (USA), K. Barton, B.J. Karl (New Zealand), D.G. Ainley, K. Dugger, S. Jennings (USA), A. Lescroël (France) and P.R. Wilson (New Zealand)
WG-EMM-13/32	The dynamic of krill fishery and the environment in the Antarctic Peninsula Subarea (48.1) S.M. Kasatkina, V.N. Shnar and S.N. Burikin (Russia)
WG-EMM-13/33	Information for the management plan for CEMP sites within the Argentine Islands Delegation of Ukraine
WG-EMM-13/34	A method to evaluate selection of Antarctic krill in towed fishing gears L.A. Krag, B. Herrmann (Denmark), S. Iversen, A. Engås, S. Nordrum and B.A. Krafft (Norway)
WG-EMM-13/35	Observations of penguins in the waters off South Orkney Islands, 2011–2013 B.A. Krafft, G. Skaret (Norway) and P. Trathan (United Kingdom)
WG-EMM-13/36	Assessing status and change in Southern Ocean ecosystems A. Constable (Australia), D. Costa (USA), E. Murphy (United Kingdom), E. Hofmann, O. Schofield (USA), A. Press (Australia), N. Johnston (United Kingdom) and L. Newman (Australia)
WG-EMM-13/37 Rev. 1	Krill fishery report: 2013 update Secretariat
WG-EMM-13/38	A summary of scientific observer deployments and data collection in the krill fishery during the 2011, 2012 and 2013 seasons CCAMLR Secretariat
WG-EMM-13/39	Temperature-dependent growth of *Thysanoessa macrura*: inter-annual and spatial variability R.M. Driscoll, C.S. Reiss and B.T. Hentschel (USA)

WG-EMM-13/40	Abundance, distribution, energy density and trophic position of euphausiids during winter 2012: preliminary results from the first US AMLR Winter Survey C. Reiss and C. Jones (USA)
WG-EMM-13/41	Uncertainty in green weight estimates from Norwegian krill fishing vessels G. Skaret and T. Knutsen (Norway)
WG-EMM-13/42 Rev. 1	Preliminary assessment of the green weight for a flow meter method J.A. Arata and C. Arias (Chile)
WG-EMM-13/43	Abundance estimation of Adélie penguins colony at Esperanza/Hope Bay M.M. Santos, N.R. Coria, E. Barrera-Oro (Argentina) and J.T. Hinke (USA)
WG-EMM-13/44	Proposal for GEF (Global Environment Facility) funding to support capacity building and training to the GEF-eligible countries with Antarctic interests Delegation of South Africa

Other documents

WG-EMM-13/P01	Among-year variation in growth of Antarctic krill *Euphausia superba* based on length-frequency data A.O. Shelton, D. Kinzey, C. Reiss, S. Munch, G. Watters and M. Mangel (USA) *Mar. Ecol. Prog. Ser.*, 481: 53–67
CCAMLR-XXXII/05	Notification of Chile's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Chile
CCAMLR-XXXII/06	Notification of the People's Republic of China's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of the People's Republic of China
CCAMLR-XXXII/07	Notification of the Republic of Korea's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of the Republic of Korea
CCAMLR-XXXII/08	Notification of Norway's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Norway

CCAMLR-XXXII/09	Notification of Poland's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Poland
CCAMLR-XXXII/10	Notification of Ukraine's intention to participate in the krill fishery in 2013/14 Submitted by the Secretariat on behalf of Ukraine

Appendix D

REVISED INFORMATION REQUIREMENTS FOR NOTIFICATIONS FOR KRILL FISHERIES

Replacement for Annex 21-03/A

NOTIFICATION OF INTENT TO PARTICIPATE IN A FISHERY FOR *EUPHAUSIA SUPERBA*

General information

Member: _____

Fishing season: _____

Name of vessel: _____

Expected level of catch (tonne): _____

Intended fishing subareas and divisions

This conservation measure applies to notifications of intentions to fish for krill in Subareas 48.1, 48.2, 48.3 and 48.4 and Divisions 58.4.1 and 58.4.2. Intentions to fish for krill in other subareas and divisions must be notified under Conservation Measure 21-02.

Subarea/Division	
48.1	
48.2	
48.3	
48.4	
58.4.1	
58.4.2	

Fishing technique: □ Conventional trawl
□ Continuous fishing system
□ Pumping to clear codend
□ Other method: Please specify _____

Product types and methods for direct estimation of green weight of krill caught

Product type	Method for direct estimation of green weight of krill caught, where relevant (refer to Annex 21-03/B)[1]
Whole frozen	
Boiled	
Meal	
Oil	
Other product, please specify	

[1] If the method is not listed in Annex 21-03/B, then please describe in detail _____

Net configuration

Net measurements	Net 1		Net 2		Other net(s)	
Net opening (mouth)						
Maximum vertical opening (m)						
Maximum horizontal opening (m)						
Net circumference at mouth (m)						
Mouth area (m^2)						
Panel average mesh size[1] (mm)	Outer[2]	Inner[2]	Outer[2]	Inner[2]	Outer[2]	Inner[2]
1st panel						
2nd panel						
3rd panel						
…						
Final panel (Codend)						

[1] Inside measurement of stretched mesh based on the procedure in Conservation Measure 22-01.
[2] Size of outer mesh, and inner mesh where a liner is used.

Net diagram(s): _____

For each net used, refer to the relevant net diagram in the CCAMLR fishing gear library if available (www.ccamlr.org/node/74407), or submit a detailed diagram and description to the forthcoming meeting of WG-EMM.

Marine mammal exclusion device

Device diagram(s): _____

For each type of device used, refer to the relevant diagram in the CCAMLR fishing gear library if available (www.ccamlr.org/node/74407), or submit a detailed diagram and description to the forthcoming meeting of WG-EMM.

Collection of acoustic data

Provide information on the echosounders and sonars used by the vessel.

Type (e.g. echosounder, sonar)			
Manufacturer			
Model			
Transducer frequencies (KHz)			

Collection of acoustic data (detailed description): _____

Outline steps which will be taken to collect acoustic data to provide information on the distribution and abundance of E. superba *and other pelagic species such as myctophiids and salps (SC-CAMLR-XXX, paragraph 2.10).*

Vessel information

Conservation Measure 10-02, paragraph 3*

(i)	Name of fishing vessel Previous names (if known) Registration number IMO number (where relevant) External markings Port of registry	
(iii)	Previous flag (if any)	
(iv)	International radio call sign	
(v)	Name of vessel owner(s) Address of vessel owner(s) Name of beneficial owner(s) (if different from vessel owner(s)) Address of beneficial owner(s)	
(vi)	Name of licence owner (if different from vessel owner(s)) Address of licence owner	
(vii)	Type of vessel	
(viii)	Where was vessel built When was vessel built	
(ix)	Vessel length overall LOA (m)	
(x)	12 × 7 cm colour photographs • 1 × starboard side of the vessel • 1 × port side of the vessel • 1 × stern view	*Ensure side photographs display the full overall length and complete structural features of the vessel and the stern photograph is taken directly from astern; include these in the section 'Supporting Documentation'*
(xi)	Details of the implementation of the tamper-proof requirements of the satellite monitoring device installed on board	

* Information referred to in paragraph 3(ii) is not required (CM 21-03, paragraph 2)

Conservation Measure 10-02, paragraph 4 (to the extent practicable)

(i)	Name of operator (if different from vessel owner(s)) Address of operator
(ii)	Names and nationality of master and, where relevant, of fishing master
(iii)	Type of fishing method(s)
(iv)	Vessel beam (m)
(v)	Vessel gross registered tonnage
(vi)	Vessel communication types and numbers (INMARSAT A, B and C)
(vii)	Normal crew complement
(viii)	Power of main engine(s) (kW)
(ix)	Carrying capacity (tonne) Number of fish holds Capacity of all holds (tonne)
(x)	Any other information in respect of each licensed vessel that is considered appropriate (e.g. ice classification) for the purposes of the implementation of the conservation measures adopted by the Commission

GUIDELINES FOR ESTIMATING THE GREEN WEIGHT OF KRILL CAUGHT

Method	Equation (kg)	Parameter			
		Description	Type	Estimation method	Unit
Holding tank volume	$W*L*H*\rho*1\ 000$	W = tank width	Constant	Measure prior to fishing	m
		L = tank length	Constant	Measure prior to fishing	m
		ρ = density of the sample	Variable	Volume-to-mass conversion	kg/litre
		H = depth of krill in tank	Haul-specific	Direct observation	m
Flow meter	$V*F_{krill}*\rho$	V = volume of krill and water combined	Haul[1]-specific	Direct observation	litre
		F_{krill} = fraction of krill in the sample	Haul[1]-specific	Flow meter volume correction	-
		ρ = density of krill in the sample	Variable	Volume-to-mass conversion	kg/litre
Flow scale	$M*(1–F)$	M = mass of krill and water combined	Haul[1]-specific	Direct observation	kg
		F = fraction of water in the sample	Variable	Flow scale mass correction	-
Plate tray	$(M–M_{tray})*N$	M_{tray} = mass of empty tray	Constant	Direct observation prior to fishing	kg
		M = mean mass of krill and tray combined	Variable	Direct observation, prior to freezing with water drained	kg
		N = number of trays	Haul-specific	Direct observation	-
Meal conversion	$M_{meal}*MCF$	M_{meal} = mass of meal produced	Haul-specific	Direct observation	kg
		MCF = meal conversion factor	Variable	Meal to whole krill conversion	-
Codend volume	$W*H*L*\rho*\pi/4*1\ 000$	W = codend width	Constant	Measure prior to fishing	m
		H = codend height	Constant	Measure prior to fishing	m
		ρ = density of the sample	Variable	Volume-to-mass conversion	kg/litre
		L = codend length	Haul-specific	Direct observation	m
Other	*Please specify*				

[1] Individual haul when using a conventional trawl, or two-hour period when using the continuous fishing system

Observation steps and frequency

Holding tank volume	
Prior to fishing	Measure the width and length of the holding tank (if the tank is not rectangular in shape, then additional measurements may be required)
Every month[1]	Estimate the volume-to-mass conversion derived from the drained mass of krill in a known volume (e.g. 10 litres) taken from the holding tank
Every haul	Measure the depth of krill in the tank (if krill are held in the tank between hauls, then measure the difference in depth)
	Estimate the green weight of krill caught (using equation)
Flow meter	
Prior to fishing	Ensure that the flow meter is measuring whole krill (i.e. prior to processing)
Every month[1]	Estimate the volume-to-mass conversion derived from the drained mass of krill in a known volume (e.g. 10 litres) taken from the flow meter
Every haul[2]	Obtain a sample from the flow meter and: measure the volume of krill and water combined estimate the flow meter volume correction derived from the drained volume of krill
	Estimate the green weight of krill caught (using equation)
Flow scale	
Prior to fishing	Ensure that the flow scale is measuring whole krill (i.e. prior to processing)
Every haul[2]	Obtain a sample from the flow scale and: measure the mass of krill and water combined estimate the flow scale mass correction derived from the drained mass of krill
	Estimate the green weight of krill caught (using equation)
Plate tray	
Prior to fishing	Measure the mass of the tray (if trays vary in design, then measure the mass of each type)
Every haul	Measure the mass of krill and tray combined
	Count the number of trays used (if trays vary in design, then count the number of trays of each type)
	Estimate the green weight of krill caught (using equation)
Meal conversion	
Every month[1]	Estimate the meal to whole krill conversion by processing 1 000 kg (drained mass) of whole krill
Every haul	Measure the mass of meal produced
	Estimate the green weight of krill caught (using equation)
Codend volume	
Prior to fishing	Measure the width and height of the codend
Every month[1]	Estimate the volume-to-mass conversion derived from the drained mass of krill in a known volume (e.g. 10 litres) taken from the codend
Every haul	Measure the length of codend containing krill
	Estimate the green weight of krill caught (using equation)

[1] Measured monthly; a new monthly period will commence when the vessel moves to a new subarea or division

[2] Individual haul when using a conventional trawl, or two-hour period when using the continuous fishing system

Annex 6

Report of the Working Group
on Fish Stock Assessment
(Hobart, Australia, 7 to 18 October 2013)

CONTENTS

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 7 to 18 October 2013)

OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 7 to 18 October 2013. The Convener, Dr M. Belchier (UK), opened the meeting and welcomed participants (Appendix A).

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 This year's agenda of WG-FSA focused on the assessment of finfish fisheries in the Convention Area, including the biennial assessments for the fisheries for Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 and Division 58.5.2 and the fisheries for *Dissostichus* spp. in Subareas 88.1 and 88.2, the annual assessments for mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.3 and Division 58.5.2, and the development of advice on precautionary catch limits and other issues relevant to management of CCAMLR fisheries. The agenda of the meeting was discussed and adopted without change (Appendix B).

2.2 Documents submitted to the meeting are listed in Appendix C. While the report has few references to the contributions of individuals and co-authors, the Working Group thanked all the authors for their valuable contributions to the work presented to the meeting.

2.3 Components of WG-FSA's work were developed during the meeting by the following subgroups:

- Subgroup on Assessments (coordinator: Dr C. Darby, UK)
- Subgroup on Research to Inform Current or Future Assessments (coordinator: Dr S. Hanchet, New Zealand).

2.4 In this report, paragraphs dealing with advice to the Scientific Committee and other working groups have been highlighted. These paragraphs are listed under Item 13. In addition, the information used in developing assessments and other aspects of the Working Group's work is included in the Report on Bottom Fisheries and VMEs and the Fishery Reports.

2.5 The Working Group discussed the procedure for updating and publishing the Report on Bottom Fisheries and VMEs and the Fishery Reports. In the past, these reports had been appended to the Working Group's report. The Working Group agreed to revise this procedure, such that the reports would be updated during the meeting, and then finalised and published by the Secretariat as separate reports which would include the management advice and conservation measures agreed by the Commission. The Working Group agreed that edits to the Fishery Reports should be supplied to the Secretariat by 10 December 2013, the interim versions should be made available on the CCAMLR website by 20 January 2014 (but only viewable by accredited users), and the final versions made publically available by 20 February 2014.

2.6 The report was prepared by Dr Darby, Dr J. Ellis (UK), Mr J. Fenaughty (New Zealand), Mr N. Gasco (France), Drs Hanchet, T. Ichii (Japan), K.-H. Kock (Germany), R. Leslie (South Africa), E. Marschoff (Argentina), S. Parker (New Zealand), D. Ramm and K. Reid (Secretariat), Mr R. Sarralde (Spain), Dr B. Sharp (New Zealand), Mr R. Scott (UK), Drs D. Welsford (Australia), R. Wiff (Chile), S. Thanassekos (Secretariat) and P. Ziegler (Australia).

REVIEW OF AVAILABLE INFORMATION

Data requirements

3.1 The Working Group reviewed data submitted to the Secretariat from commercial fisheries and fishery-based research in 2012/13, including information relevant to stock assessments. This information is briefly described in this section, noting that the data have been used in assessments described in Item 6.

3.2 The Working Group noted the total catches in the CCAMLR *Dissostichus* spp., *D. eleginoides*, *C. gunnari* and Antarctic krill (*Euphausia superba*) fisheries (Table 1) and *Dissostichus* spp. captured outside the Convention Area in FAO areas adjacent to the Convention Area (Table 2).

3.3 It noted that WG-SAM-13 discussed a framework by which proposed research plans to develop *Dissostichus* spp. assessments in data-poor areas could be evaluated and guided (Annex 4, paragraphs 2.5 to 2.7). A draft flowchart describing the stages of the research leading towards a stock assessment was developed during the intersessional period. The Working Group agreed that the flowchart was useful to develop research plans and to prioritise research as data and assessments are reviewed. The Working Group recommended that it be further discussed under Item 6.1 for inclusion in the Working Group report (paragraphs 6.4 to 6.6).

IUU fishing

3.4 The Secretariat provided an overview of the spatial and temporal distribution of IUU activity within the Convention Area in recent years (CCAMLR-XXXII/BG/09 Rev. 1). The objective of the analysis was not to estimate area-specific IUU catch amounts, but to spatially characterise observed IUU activity, including IUU fishing gear recoveries in the CAMLR Convention Area. This evidence, along with surveillance data from France, suggests that IUU detection is concentrated in the Indian Ocean sector at both high and low latitudes (i.e. Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4, and outside EEZs in Divisions 58.5.1, 58.5.2 and Subareas 58.6 and 58.7). Using all available data, rather than concentrating on vessel sightings, suggests that observed IUU fishing is more persistent in the northern part of the Indian Ocean and has also occurred in Subarea 48.6 (where there have been no IUU vessel sightings reported).

3.5 Evidence of IUU fishing appears to occur in both open and closed SSRUs, and suggests that in some instances even the presence of licensed vessels in an SSRU may not deter, or result in the reporting of, unidentified vessel activity. The Working Group noted that

under CM 10-02, vessels were required to report all other vessels sighted in the Convention Area to their Flag State, and that analysis of this data would assist with analysing the likelihood of detection of vessels operating in the same area.

3.6 The Working Group considered that haul position data from licensed vessels may inform the potential for vessel sighting reports in instances where IUU vessels were known to be in the vicinity of licensed vessels. The Working Group also requested that, rather than WG-FSA, SCIC should undertake to examine VMS and C2 data to further clarify the potential proximity of licensed vessels to other vessels during steaming and fishing operations. Some Members felt that this should be done in SSRU 5841E for January and February of 2011 where an IUU vessel (formerly *Paloma V*) was apparently fishing in a similar area to CCAMLR Member vessels.

3.7 The Working Group agreed that the spatial and temporal characterisation of potential IUU activity presented in CCAMLR-XXXII/BG/09 Rev. 1 was useful and that the Secretariat should continue to collect, check for accuracy and report these data through time. The Working Group agreed that IUU fishing is still a problem in several areas and that it causes difficulties for developing stock assessments and should be examined in sensitivity analyses (e.g. paragraph 6.93).

3.8 Dr A. Petrov (Russia) noted that there is no information on IUU vessels from closed SSRUs, especially from the Indian Ocean sector of Antarctica. Dr Petrov believed that the opening of closed SSRUs will contribute to the fight against IUU fishing.

Anomalous catch data

3.9 The Working Group noted the discussion by WG-SAM-13 on potential hypotheses to account for the anomalous pattern in observed catch data provided from three Insung Corporation vessels fishing in Divisions 58.4.1 and 58.4.2 and Subarea 48.6 from 2009 to 2011, including the results of a Korean Government workshop held in Busan, Republic of Korea (Annex 4, paragraphs 4.17 to 4.24). In particular it noted the request by WG-SAM-13 for Members to consider ways to evaluate hypotheses or propose alternative hypotheses to help understand the patterns of catch and effort reported.

3.10 WG-FSA-13/57 Rev. 1 presented an evaluation of two additional hypotheses regarding how to explain the anomalous pattern in observed CPUE data, namely:

(i) 'area misreporting': catches may be underreported initially and later assigned to other areas subsequently fished on a trip (i.e. a spatial reallocation); or

(ii) 'catch misreporting': catches may be reported incorrectly both in space and also with respect to total catches on a trip (i.e. a total catch adjustment).

3.11 Some Members agreed that standardised catch modelling such as that provided in WG-FSA-13/57 Rev. 1 was useful and could be used to provide alternate catch histories as a sensitivity in stock assessments where data indicative of total fisheries removals are unavailable or where available data are judged to be unsuitable for scientific analysis. They considered that the combination of factors, including:

(i) rapid changes in catch rates corresponding to the vessels' passage between areas with different catch limits

(ii) the temporal and spatial sequence of high catch rates always preceded by low catch rates

(iii) the fact that all vessels showing such patterns were from the same company

(iv) that the unlikely pattern has occurred three times,

made it unlikely that all the catch rates observed occurred by chance encounter with areas of high fish density. They therefore considered that the hypotheses presented in WG-FSA-13/57 Rev. 1 were the more likely explanations. They recommended that examination of the correspondence between VMS data and reported fishing locations for the vessels in question would be useful in evaluating the patterns reported in this regard, and that this should be undertaken by the Secretariat for further review by the Scientific Committee and/or by SCIC.

3.12 Other Members considered that the methods described in WG-FSA-13/57 Rev. 1 ignored important factors that affected the CPUE fluctuations such as population density, sea-ice conditions, development of fishing gears, and captains' and crews' skills. Particularly, sea-ice condition plays a large part in the CPUE fluctuations in Divisions 58.4.1 and 58.4.2 and Subarea 48.6. In addition, few vessels were able to operate in that period due to harsh sea conditions. Therefore, sufficient data are not available for comparison of CPUE patterns between vessels. Reanalysed catch data, therefore, could not fully reflect the population density in each SSRU. Furthermore, similar CPUE patterns appeared in Subarea 88.1.

3.13 An extreme value analysis of anomalous CPUE patterns by vessels in Subarea 48.6 (WG-FSA-13/63) indicated that the probability of these high CPUE values arising by chance was very low.

3.14 The Working Group noted that it was difficult to determine which of the various hypotheses proposed to account for anomalous reported CPUE was most likely to be correct.

3.15 Dr Petrov said that he did not change his opinion and stance on the issue of high CPUE presented in the Russian paper WG-SAM-13/16 and that WG-FSA-13/57 Rev. 1 is based on two hypotheses and speculative opinion.

Ross Sea data

3.16 Several papers provided updated data inputs for the Ross Sea and Subarea 88.2 stock assessments and provided ancillary analyses to better interpret assessment results. WG-FSA-13/48 repeated a standardised CPUE analysis, last presented in 2006, suggesting that in Subarea 88.1, the standardised CPUE trend was stable with a slight decline since 2008. Although highly variable, there was some evidence of an initial decline in CPUE in Subarea 88.2 followed by a more stable recent period.

3.17 A time series of standardised age structure showed a decrease in median age with a concurrent increase in the proportion of males in the catch in the north of Subarea 88.1. The change arises from a combination of two factors: the increasing prevalence in the catch of a

mode of smaller fish on the Ross Sea slope and age truncation in the right-hand limb of the age distribution on the slope and in the north. The mode of smaller fish may reflect abundant age cohorts of smaller fish or a shift in fishing effort to shallower water on the slope. Right-hand limb truncation is expected as the stock is reduced to the target biomass. The latter change is not apparent in the annual length distributions because with an asymptotic growth curve and variability in size at age, as old fish are removed from the population, the median age may decrease with no corresponding change in length.

3.18 The Working Group further noted that the depth distribution of fishing effort in Subarea 88.1 has become increasingly bimodal in recent years, and suggested that the median depth of fishing may not be a useful descriptor of the depth distribution.

3.19 It was noted that in Subarea 88.2 otoliths from some years where fishing by non–New Zealand flagged vessels occurred have not been aged, so year-specific age–length keys (ALKs) are not available. However, the estimated ALKs do show interannual variability in catch-at-age estimates. The Working Group recommended that Members age fish collected from Subarea 88.2 following agreed protocols (SC-CAMLR-XXXI, Annex 7, paragraphs 10.4 to 10.13) to increase the sample sizes for annual ALKs. Further discussion of this issue occurred under Item 4 (paragraph 4.92).

3.20 The process by which data used in the Ross Sea and Subarea 88.2 assessments (C2, observer and tagging databases) were processed and prepared for input into CASAL was described in WG-FSA-13/56; the R scripts used in the processing have been provided to the Secretariat. The Working Group welcomed the description of data preparation for assessments and encouraged other Members conducting assessments to provide similar documentation.

3.21 The tagging program in the Ross Sea and Subarea 88.2 is now approaching 40 000 tagged fish released and 2 000 recaptured fish (WG-FSA-13/49). The size distribution of tagged fish closely matched the size distribution of the catch since 2011.

3.22 The Working Group noted that recaptures of fish that have moved long distances are influential in understanding potential stock dynamics and that a high level of scrutiny is needed to verify the correct tag linking. It further noted that analysis of recaptures in the north of the Ross Sea and their associated biological characteristics suggests that residence time may vary by sex and condition, and welcomed the proposal by New Zealand to analyse residence times for presentation at a future meeting. The Working Group also recalled that the routine collection of gonad weight from biologically sampled fish would aid in understanding the biological factors that may influence stock movement patterns in exploratory fisheries (SC-CAMLR-XXIX, Annex 8, paragraph 8.14 and Table 16).

3.23 The use of tagging data has been integral to the parameterisation of spatial population models (SPMs) for the Ross Sea. Previous models presented to CCAMLR (WG-SAM-13/35) used medium-scale–resolution model space restricted to either fished cells or all cells in the region. WG-SAM-13 suggested a third intermediate model be developed which restricted the stock to cells where at least 5% of the depth is deemed suitable as habitat for toothfish.

3.24 The resulting model (WG-FSA-13/53) fits the data equally well because the model utilises fishery-dependent data and therefore has no information about the distribution of toothfish in areas where no fishing has occurred. The Working Group agreed that further

research would be useful to improve the parameterisation of the model, especially research informing the timing and location of spawning or ontogenetic movements and the distribution and abundance of fish in unfished areas.

3.25 Key uncertainties in the stock assessment and in SPMs of Antarctic toothfish (*D. mawsoni*) in Subareas 88.1 and 88.2 were identified by WG-FSA-13/55. These included understanding movement patterns associated with spawning, developing toothfish distribution and abundance information in unfished areas and providing better estimates of tagging mortality. Research to address these uncertainties could include making collection of gonad weight measurements routine on all fishing vessels, surveying likely spawning grounds during winter, monitoring tagged fish for survival using electronic tags and obtaining fishery or survey data from areas not fished to date. The Working Group recommended that these uncertainties be prioritised, so that the Scientific Committee can consider how best to develop coordinated proposals to address these research needs.

3.26 Tagging data to be used in the Ross Sea and Subarea 88.2 stock assessments were selected using a case-control data comparison method of tag-detection and tag-mortality rates (Annex 4, paragraph 4.7; WG-FSA-13/50). The Working Group noted that the method was shown to be responsive to the tag-detection rate as many thousands of fish were scanned, but not sensitive to the tag-mortality rate due to the small numbers of tags released and very small numbers of tags recovered. The decision of which index to use in selecting high-quality data for inclusion in the assessments was addressed along with the assessment under Item 5.

3.27 The tagging program in the Ross Sea and Subarea 88.2 was further reviewed given changes implemented in 2012 (WG-FSA-13/54). The recording of observer or crew for tag releases and recoveries showed that overall observers tag nearly 75% of released fish, and about 40% of recaptured tags are reported by observers (whilst 60% are reported by crew). The actual proportion of tags released and recovered varied substantially by vessel and suggests that both observers and crew should be provided training associated with tagging and recovering tags. The Working Group noted that on vessels where most tags are recovered by observers, it is not clear if the actual detection rate may vary depending on the time observers spent actually examining fish for tags. New Zealand has also provided custom toothfish rulers (2 m long, incremented in cm with an adhesive backing) to aid in accurate length measurements, as there was some evidence that vessels may use two 1 m rulers incremented in mm which could result in measurement translation errors. These rulers will be provided in the tagging kits provided by CCAMLR.

3.28 In 2012, the Working Group recommended that diagrams be developed to aid in communicating the tagging suitability criteria without the heavy reliance on text or jargon. The Working Group agreed that the diagrams should be included in the tagging protocol and that the use of tagging release data sheets provided in WG-FSA-13/54 and an easy-to-read tagging ruler should improve data quality. The Working Group welcomed a draft tagging training module and recommended that upon review it be made available to vessels electronically, as part of the tagging kits, to Members' observer programs and, potentially, on the CCAMLR website. The Working Group noted the positive feedback from South Africa on the usefulness of an earlier draft of the tagging training manual.

Research surveys

3.29 The Working Group noted the results of the 2013 demersal fish survey conducted in Subarea 48.3 (WG-FSA-13/17). Notably, the biomass for *C. gunnari* was the highest since 1990, with large aggregations observed to the northwest of South Georgia. The Working Group noted that successful sampling of the area to the southeast of the island was rarely possible and recommended that this be considered in stratification of future surveys. It also noted that there was no evidence of strong recruitment of 1+ or 2+ toothfish observed in the survey. These data were included in the preliminary assessments for *C. gunnari* (WG-FSA-13/27) and *D. eleginoides* (WG-FSA-13/30) in Subarea 48.3.

3.30 The Working Group noted that Australia had undertaken a random stratified trawl survey in Division 58.5.2 during April–May 2013 (WG-FSA-13/21). It noted that total catches of most finfish species were within 95% confidence intervals derived from the seven equivalent surveys undertaken between 2006 and 2012, with the exception of *C. gunnari*, which was seven times more abundant than the long-term mean. These data were included in the preliminary assessments for *C. gunnari* (WG-FSA-13/23) and *D. eleginoides* (WG-FSA-13/24) in Division 58.5.2.

Catch and effort analysis

3.31 The Working Group noted that WG-FSA-13/63 presented an analysis of catch and effort data for Subarea 48.6, updated from that presented in WG-SAM-13/29. The Working Group noted that comparisons between standardised CPUE using a generalised linear model (GLM), as opposed to a generalised additive model (GAM), showed a similar overall pattern, but different results in *D. eleginoides* for the 2010/11 data. The Working Group thanked the authors for their thorough analysis, and agreed with the conclusions that for Subarea 48.6, standardised CPUE was unlikely to be useful as an index of stock dynamics or abundance, but rather that the current tag-recapture program was more likely to result in a robust assessment.

3.32 Some Members considered that when the data used in standardised CPUE were limited, i.e. from one or two vessels for each year, it may not reflect reality (WG-SAM-13/16 and 13/39).

Tagging data analysis

3.33 The Working Group noted that WG-SAM had requested the Secretariat provide an analysis of within-season recaptures of tagged toothfish (Annex 4, paragraph 2.11). WG-FSA-13/01 presented this analysis, indicating that within-season recaptures were distributed heterogeneously across *Dissostichus* spp. fisheries, with high levels of within-season recaptures in the northern SSRUs in Subarea 48.6 and in SSRU 882H. The Working Group noted that there appears to be a relationship between the amount of habitat at fishable depths and rates of within-season recaptures, with high rates observed on seamounts. The Working Group noted that locations with high within-season recaptures may provide data enabling comparison between biomass estimated by local depletion and Petersen tag-recapture analysis, and requested that such analyses be conducted by the Secretariat for presentation at the next meeting of WG-SAM.

3.34 The Working Group noted the analysis of tag recaptures in Subarea 48.3 presented in WG-FSA-13/29, including an application of the 'select' method (Mormede and Dunn, 2013), to determine consistency in tag releases and reporting across the fleet. The Working Group welcomed the application of the select method for the first time outside Subareas 88.1 and 88.2 and noted that the analysis showed relatively high consistency in relative tag-detection indices across the fleet in this subarea. It also noted that apparently tag movements between releases and recaptures had increased in recent seasons, with some tag recaptures exceeding 100 n mile movements within a season. It recommended that UK scientists continue to investigate whether this pattern is due to data errors or a change in toothfish behaviour in recent years.

STOCK ASSESSMENTS

C. gunnari South Georgia (Subarea 48.3)

4.1 The fishery for *C. gunnari* in Subarea 48.3 operated in accordance with CM 42-01 and associated measures. In 2012/13, the catch limit for *C. gunnari* was 2 933 tonnes. Fishing early in the season was conducted by two vessels using midwater trawls and the total reported catch was 1 354 tonnes as of 20 September 2013. The fishery resumed at the time of the WG-FSA meeting. Details of this fishery and the stock assessment of *C. gunnari* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.2 WG-FSA-13/27 presented a preliminary assessment of *C. gunnari* in Subarea 48.3. The assessment was based on a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves that the UK undertook in January 2013 as part of its regular monitoring program (WG-FSA-13/29; paragraph 3.29). A total catch of 42.9 tonnes was reported from the research survey, with an exceptionally large catch of 22 tonnes of *C. gunnari* taken in a single haul in the northwest stratum.

4.3 A bootstrap procedure was applied to the survey data to estimate the demersal biomass of *C. gunnari* in this subarea. Since the results of the bootstrap procedure were highly sensitive to the treatment of the single high-abundance station, the station with the exceptionally large catch was omitted from the analysis as a precautionary approach to biomass estimation.

4.4 The Working Group agreed that the length-based assessment for icefish should be used in Subarea 48.3, following the methodology presented in WG-FSA-13/27. The bootstrap procedure estimated the median demersal biomass at 106 548 tonnes, with a one-sided lower 95% confidence interval of 49 640 tonnes. The harvest control rule, which ensures 75% biomass escapement after a two-year projection period, yielded a catch limit of 4 635 tonnes for 2013/14 and 2 659 tonnes for 2014/15.

4.5 The Working Group reflected on the analysis in WG-SAM-13/31 Rev. 1 which showed that the projected catch into the next year has been consistently lower than the catch estimates from that year's survey, when surveys were conducted within the same season. This analysis, enabled by a time series of annual surveys, was considered to be very valuable.

Together with WG-FSA-12/26, it indicated that the current harvest control rule can be considered to be precautionary in accounting for uncertainty at several steps of the stock- and catch-estimation process.

4.6 To reduce the risk of depletion when biomass levels are estimated to be very low, the Working Group agreed that it would be valuable to implement additional limit reference points, such as the ones in Division 58.5.2 (WG-FSA-11/34; SC-CAMLR-XXX, paragraph 3.69). The Working Group discussed ways to scientifically determine appropriate biomass and catch-limit reference points, and suggested that the biomass reference level would likely be below the lowest biomass estimated from past surveys that did not appear to have substantially reduced recruitment in subsequent years. The Working Group agreed that an evaluation of the utility of candidate limits should be presented for consideration by WG-SAM before the next assessment of the stock.

Management advice

4.7 The Working Group recommended that the catch limit for *C. gunnari* should be set at 4 635 tonnes for 2013/14 and 2 659 tonnes for 2014/15 based on the outcome of the short-term assessment and forecast (see Table 3 for summary of catch limits).

C. gunnari Heard Island (Division 58.5.2)

4.8 The fishery for *C. gunnari* in Division 58.5.2 operated in accordance with CM 42-02 and associated measures. In 2012/13, the catch limit for *C. gunnari* was 679 tonnes. Fishing was conducted by one vessel using a semipelagic trawl and the total reported catch up to 20 September 2013 was 644 tonnes. Details of this fishery and the stock assessment of *C. gunnari* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.9 The results of the bottom trawl survey undertaken in April 2013 were summarised in WG-FSA-13/21 (see also paragraph 3.30). The Working Group noted that *C. gunnari* were very abundant in 2013, with catches four times higher than those of 2012 and seven times the long-term average.

4.10 A short-term assessment was conducted in the generalised yield model (GYM), using the one-sided bootstrap lower 95% confidence bound of total biomass of 6 098 tonnes from the 2013 survey and fixed model parameters. The length–weight relationship was updated using the survey data; other parameters were unchanged from previous assessments. The best fit of CMIX to the data was achieved when the population was estimated to consist of four year classes from 1+ to 4+, with the large 2+ cohort observed in 2012 still dominating the population as the 3+ cohort.

4.11 The 2013 survey indicates that the stock in Division 58.5.2 is sufficiently abundant to support a fishery in 2013/14. However, older fish in the 4+ and 5+ cohorts, which were detected in the 2011 and 2012 surveys, have not survived to be recorded in 2013. A regime of a single abundant cohort dominating the population in Division 58.5.2 appears to be returning.

4.12 Two catch scenarios were examined. In scenario 1, the initial biomass estimate of 6 098 tonnes was apportioned across the 1+, 2+ and 3+ year classes according to their length density and projections for two years of catch, which resulted in 75% escapement of the biomass calculated. For scenario 2, the biomass contribution due to the 3+ cohort (5 610 tonnes, 92% of 6 098 tonnes) was projected for one year assuming no survival thereafter, and the biomass of the 1+ and 2+ cohorts (488 tonnes, 8% of 6 098 tonnes) were projected separately for two years. Fishery catches of 400 tonnes after the survey were also included in the model, assumed to have been taken from the 2+ and 3+ cohort in proportion to their relative abundance in the survey.

4.13 Estimates of yield under scenario 1 indicate that 764 tonnes of icefish could be taken in 2013/14 and 571 tonnes in 2014/15 allowing 75% escapement of biomass over two years.

4.14 However, as has been seen in previous years, the abundant 3+ year class is unlikely to be present in 2014/15, and therefore under scenario 2, a catch of 1 267 tonnes could be taken in 2013/14 (less than the aggregate catch across the two-year projection of 1 335 tonnes), ensuring 75% escapement of the 3+ cohort prior to them disappearing, with the expectation that there will be no commercial fishery in 2014/15.

4.15 Allowing the catch to be taken in a single season has the benefit of enabling the fishery to have access to an abundant cohort while it is still present. Further, this harvest strategy would reduce potential impacts on the current 1+ and 2+ cohorts, which the survey indicates are insufficiently abundant to support the 598 tonnes of catch estimate under scenario 1 in 2014/15.

Management advice

4.16 The Working Group recommended that the Scientific Committee consider a catch limit for *C. gunnari* in 2013/14 of 1 267 tonnes, with a 30-tonne research and by-catch limit in 2014/15, unless revised advice from the Working Group following the 2014 survey indicates that a fishery is viable.

D. eleginoides South Georgia (Subarea 48.3)

4.17 The fishery for *D. eleginoides* in Subarea 48.3 operated in accordance with CM 41-02 and associated measures. In 2012/13, the catch limit for *D. eleginoides* was 2 600 tonnes. Fishing was conducted by six vessels using longlines and the total reported catch up to 20 September 2013 was 2 098 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.18 WG-FSA-13/30 presented the preliminary assessment of *D. eleginoides* in Subarea 48.3. The CASAL assessment model was fitted to catch-at-age, catch rates, tag-recapture and survey abundance data. Despite removing a survey station with an exceptionally large catch in the 1990 survey, the survey indices data were not fitted well, in particular the most recent years of low abundances. The Working Group recommended investigating the

re-estimation of process error for the survey separately for the next assessment. The Working Group also recommended that otoliths collected from the survey be aged to estimate annual ALKs for the survey length-composition data.

4.19 The Working Group considered two alternate model specifications for the fleet structure, with the commercial catch information and standardised CPUE either split into two time periods in a '2-fleet model' or into three time periods in a '3-fleet model'. Model estimates from the 2-fleet and 3-fleet models were similar, with the exception of year–class strength (YCS) estimates which differ markedly in 1990 but follow similar trends in all other years. The 3-fleet model provided overall better fits to the observations, however, some model diagnostics indicated that this model structure was inferior, with MCMC chains showing poor convergence and having a higher level of autocorrelation. There was also a slightly larger, albeit overall small, discrepancy between the B_0 estimates from the MCMC and MPD estimation compared to the 2-fleet model. The Working Group recommended that the 2-fleet model should be used to provide management advice.

4.20 The assessment results from this year's analyses are consistent with those of 2011. The 2-fleet model estimated B_0 at 87 665 tonnes, with the SSB status in 2013 at 0.52 of B_0.

4.21 The Working Group discussed how to proceed with the projections undertaken to determine the precautionary yield that would satisfy the CCAMLR decision rules. The estimated recruitment pattern indicated a period up to 1995 with overall higher recruitment, followed by years with overall lower recruitment that were interspersed with single years of higher recruitment. Based on this observed recruitment pattern, WG-FSA agreed to use the average recruitment and CV from 1992 to 2006 for the stock projections with a lognormal empirical randomisation method of recruitment. This resulted in a precautionary catch limit of 2 400 tonnes.

4.22 The Working Group discussed potential stock linkages between *D. eleginoides* in Subareas 48.3 and 48.4. Following the general recommendation for assessed fisheries, the Working Group recommended that a paper on stock structure in these subareas be submitted for discussion during the next WG-SAM meeting.

Management advice

4.23 The Working Group recommended that the catch limit for *D. eleginoides* in Subarea 48.3 should be set at 2 400 tonnes for 2013/14 and 2014/15 based on the outcome of this assessment.

4.24 Following previous management agreements, the catch limit would be further subdivided between the Management Areas A–C:

Management Area A: 0 tonnes
Management Area B: 720 tonnes in each season
Management Area C: 1 680 tonnes in each season.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

4.25 The fishery for *Dissostichus* spp. in Subarea 48.4 operated in accordance with CM 41-03 and associated measures. In 2012/13, fishing was conducted by two vessels using longlines. In the Northern Area, the catch limit for *D. eleginoides* was 63 tonnes and the management area was closed on 4 April 2013; the total reported catch of *D. eleginoides* was 62 tonnes. In the Southern Area, the catch limit for *Dissostichus* spp. was 52 tonnes and the total reported catch up to 20 September 2013 was 50 tonnes. Details of this fishery and the stock assessment of *Dissostichus* spp. are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.26 The assessment and management of *Dissostichus* spp. fisheries in Subarea 48.4 has, to date, been based on separate assessments for the north and south of the management area. The assessment for the Northern Area comprised a single-species integrated assessment for *D. eleginoides*, using CASAL, whilst for the Southern Area a Petersen biomass estimate was calculated for both *D. eleginoides* and *D. mawsoni* combined. WG-FSA-12 (SC-CAMLR-XXXI, Annex 7, paragraph 5.32) recommended that species-specific assessments should be developed for the subarea to provide more appropriate assessment and management of the fisheries.

D. eleginoides South Sandwich Islands (Subarea 48.4)

4.27 A preliminary CASAL assessment for *D. eleginoides* (WG-SAM-13/24) was updated with data for 2013 and further developed to incorporate the recommendations of WG-SAM-13 (Annex 4) which included the investigation of the removal of catch-at-age data for 2009 and the investigation of alternative data-weighting approaches.

4.28 The 2009 age-composition data indicated the catch in that year to be dominated by just two or three age classes and was inconsistent with other years for which age data indicated a broader spread of ages. Additional analyses were conducted during the meeting to investigate both the individual and combined effects on the assessment of removing the 2009 age data and of alternative data-weighting approaches.

4.29 The assessment presented to the Working Group employed an alternative data-weighting approach based on the methods described in Francis (2011a, 2011b). Point estimates of the assessment results were largely unchanged by the revised approach. However, the Working Group noted that, in contrast to other instances in which these data-weighting approaches had been applied, the method produced reduced variability in MCMC posterior distributions of biomass leading to more constrained estimates of future biomass in the projections. The Working Group considered that the existing data-weighting procedures, as applied in previous assessments of this stock, should be retained pending further investigation of data weighting and its effects on the stock assessment.

4.30 The assessment described in WG-FSA-13/31 was re-run using the previous data-weighting approaches and revised projections conducted. The resulting long-term catch that satisfied the CCAMLR harvest control rules was 45 tonnes. Model results and figures are provided in the Fishery Report.

4.31 *Dissostichus eleginoides* biomass estimates using CASAL and the Petersen method were compared. The application of CASAL estimated a total biomass of 1 600 tonnes while the Petersen method estimated 1 400 tonnes. The Working Group highlighted the similarities in the results from both these methods.

4.32 The Working Group noted that the maturity ogive used in the assessment was based on the assumption that fish of stage II and above were fully mature. The Working Group considered that fish of at least stage III were a more appropriate indication of full maturity and recommended that the maturity ogive be re-estimated for future assessments.

4.33 In addition, the Working Group made a number of recommendations for future work. These included the incorporation of size-dependent tag mortality, as currently applied in Subarea 48.3, estimation of growth parameters externally to the model, and revision of the maturity data available to estimate a maturity ogive in this area. Special attention should be paid to the maturity stage chosen as the cut-off for considering maturity and also to the GSI index to identify the main reproductive season.

Management advice

4.34 The Working Group recommended that the catch limit for *D. eleginoides* in Subarea 48.4 should be set at 45 tonnes for 2013/14 based on the outcome of the assessment.

D. mawsoni South Sandwich Islands (Subarea 48.4)

4.35 WG-FSA-13/64 implemented a tag-based Petersen estimator to provide the first species-specific biomass estimates for *D. mawsoni* in Subarea 48.4. The catch limit for 2013/14 was estimated by applying the same catch rate as in previous years, which is based on the harvest rate of *D. eleginoides* in Subarea 48.3 ($\gamma = 0.038$). Accordingly, a total catch limit of 24 tonnes was recommended for 2013/14.

4.36 The Working Group recalled the analysis in WG-FSA-13/01 which suggested that high within-season recaptures in some areas are related to seamounts. This should also be considered in Subarea 48.4. It also recommended that γ be estimated using biological parameters for *D. mawsoni* from this area in the future.

Management advice

4.37 The Working Group recommended that the catch limit for *D. mawsoni* in Subarea 48.4 should be set at 24 tonnes for 2013/14 based on the outcome of the assessment.

D. eleginoides Heard Island (Division 58.5.2)

4.38 The fishery for *D. eleginoides* in Division 58.5.2 operated in accordance with CM 41-08 and associated measures. In 2012/13, the catch limit for *D. eleginoides* was

2 730 tonnes. Fishing was conducted by four vessels using bottom trawls, longlines and pots and the total reported catch up to 20 September 2013 was 2 413 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.39 WG-FSA-13/24 presented an updated assessment for *D. eleginoides* in Division 58.5.2 with data until the start of August 2013. Compared to the last assessment in 2011, the assessment updated the growth model and compared the effects of a range of alternative fishery structures and model assumptions for YCS on stock assessment estimates and projected catch limits that satisfy the CCAMLR decision rules.

4.40 The new fishery structure was based on a method in WG-SAM-13/18 that suggested a simplification of the longline hauls into two sub-fisheries that were depth-stratified but not regionally explicit. Alternative trawl sub-fisheries were evaluated within the assessment model in different scenarios. All evaluated scenarios with alternative trawl sub-fishery structures produced similar SSB patterns and estimates of current status, however, the selectivity functions for the different trawl sub-fisheries varied substantially, indicating that a separation of the trawl sub-fisheries was appropriate. The preferred model from WG-FSA-13/24 included estimation of selectivity functions to the observations of three separate trawl sub-fisheries and estimated YCS from 1992 to 2009 (Figure 1). Using the CCAMLR decision rules, this model recommended a catch limit of 3 005 tonnes for 2013/14 and 2014/15 (Figure 2).

4.41 The Working Group noted that the recommendations from WG-FSA in 2009 and 2011 (SC-CAMLR-XXVIII, Annex 5, paragraph 5.151; SC-CAMLR-XXX, Annex 7, paragraph 6.41) to provide an updated model including tag-recapture data in the assessment model in order to characterise the abundance and dynamics of the larger adult fish had not been presented. It reiterated the importance of progressing this work as the fishery is changing from trawl to longline and there is an increasing need to directly monitor the adult stock. The Working Group also noted that age data for the commercial fleets for the years 2009 to 2013, and for the survey for the years 2012 and 2013, had not been available for the assessment; the absence of age data is increasing uncertainty in the assessment estimates, particularly in recent YCS. The Working Group noted that Australia is about to start a research program to analyse and incorporate tagging data into the stock assessment, and to conduct high throughput ageing of otoliths from 2012 to 2013 and forthcoming seasons.

4.42 The Working Group noted that, while the catch advice of 3 005 tonnes was consistent with the CCAMLR decision rules, SSB is projected to drop below 50% B_0 in 2017 and remain below 50% B_0 for the remaining projection period before increasing to above the target reference point of 50% SSB_0 in the last year of the projection period (Figure 2). Median SSB was projected to be around 40% B_0 for around 10 years between 2020 and 2030.

4.43 These projections were run with the assumption that the future catch will be taken entirely by longline, due to the retirement of the only remaining trawler of this fishery in 2013/14. Sensitivity analyses, for which the projected catch was evenly split between trawl and longline, indicated that the projected SSB pattern was largely the result of the change from trawl to longline fishing in which cohorts that were exploited at the smallest size by trawls are exploited again at the larger sizes by the longlines, with an eventual improvement resulting from the increase in yield-per-recruit through longline fishing.

4.44 The Working Group noted that maintaining a catch level in the long term that results in this pattern may be less precautionary than a catch level that results in a less steep decline and/or a prolonged period below the target level.

4.45 When evaluating the stock assessment model structure, the Working Group noted that two trawl sub-fisheries were fished only sporadically and in varied locations between years. The likelihood profiles of these sub-fisheries presented in WG-FSA-13/24 indicated that they did not appear to contribute substantially to the estimation of parameters, but rather were likely to be increasing uncertainty in the estimates of B_0 and current status. Removing their observations and setting their selectivity equal to that of the trawl 1 sub-fishery improved the fits to the remaining datasets in a revised model.

4.46 A review of the YCS estimates from the fit of the revised model indicated that there was no information on the YCS of the 2009 year class (Figure 1a). This was likely to result from the lack of recent age data. Consequently, the 2009 year class was excluded from the estimation and set to the average value R_0 in further model fits (Figure 1b).

4.47 The Working Group noted that the model was fitted and projections made without a stock-recruitment relationship; consequently, average recruitment was assumed to remain constant at all stock levels projected by the model scenario of WG-FSA-13/24. The Working Group noted that in a circumstance where status is estimated to remain below 50% for a prolonged period, this may not result in catch limits that sufficiently account for uncertainty in future recruitments. The Working Group noted that no stock-recruitment relationship had been directly estimated for *Dissostichus* spp., however, it requested a model fit in which a stock-recruitment relationship was fitted with a steepness of 0.75, based on WG-FSA-SAM-06/08 and the relationship also used in projections.

4.48 The final model agreed by the Working Group removed observations of the two sporadic trawl sub-fisheries, estimated YCS from 1992 to 2008 and included a stock-recruitment relationship with a steepness of 0.75.

4.49 Fits and projections of this final model, applying the CCAMLR decision rules, resulted in a higher minimum median spawning biomass and slower projected increase in biomass from the year 2020 characterised by a flattening of the SSB trajectory when compared to that presented in WG-FSA-13/24.

4.50 Estimates of B_0 and catch limits that satisfy the CCAMLR decision rules varied between CASAL version 2.22 v3982 and version 2.30 v4982 (Table 4). In order to evaluate the uncertainty resulting from the version of CASAL applied, the Working Group conducted sensitivity tests of the estimated values of B_0 and stock status when initialising runs of the two CASAL versions at two initial B_0 estimates. Table 3 presented the B_0 estimates resulting from the model runs. It was noted that CASAL version 2.22 v3982 resulted in a 7.6% difference in the estimates of B_0, version 2.30 v4982 in a 0.2% difference.

4.51 In these instances, the long-term catch limits that satisfied the CCAMLR decision rules were estimated at 2 770 tonnes when using CASAL version 2.22 v3982, and 2 500 tonnes when using CASAL version 2.30 v4982 (Figures 3 and 4). Using the latter CASAL version, the projected yield of 2 770 tonnes did not satisfy the CCAMLR decision rules (Figure 5). Sensitivity runs requested by the Working Group at constant projected catch levels of 1 000 and 2 000 tonnes are shown in Figures 6 and 7.

4.52 The Working Group agreed that in order to provide advice on the dynamics of the stock in Division 58.5.2, the assessment results from the fit of the most recent CASAL version with the lowest objective function and more stable estimates could be used as a basis for advice. However, the Working Group expressed concern at the potential for differing versions of the CASAL model to produce such variable estimates (see also paragraphs 4.93 to 4.98 which discuss CASAL version control).

4.53 WG-FSA requested the following further work to refine the assessment and expand data inputs into the assessment during the intersessional period between assessments in order of priority and present a report on progress at WG-SAM-14:

(i) update the age data used in the assessment to include all recent years for which the information is available

(ii) review the tagging data available for inclusion on the assessment, including:

  (a) an analysis of the spatial and temporal patterns of releases and recaptures, including linkage with other stocks

  (b) localised and stock-based estimates of abundance using Petersen estimators

  (c) sensitivity tests when including tag-recapture information in the CASAL stock assessment

(iii) compare MCMC runs with covariance matrix resampling for stock projections for this stock

(iv) evaluate the consequence, including information from ALKs and externally estimated growth functions that account for length-based selectivity in the model.

Management advice

4.54 Dr Welsford noted the difficulty in understanding and explaining the differences in the results of the scenarios developed during WG-FSA-13. He considered that the Working Group had had insufficient time to review and select a single scenario upon which to provide management advice for the *D. eleginoides* fishery in Division 58.5.2.

4.55 Drs S. Hanchet and S. Mormede (New Zealand) were concerned that even at a catch limit of 2 500 tonnes the biomass drops to 45% for at least 10 years. The subsequent recovery of the stock relies on the assumption that future recruitment will be at the long-term median level subject to the stock-recruit relationship, but eight out of the last 11 YCS estimates were below average, and it is unknown whether future YCS will return to the long-term average. Furthermore, there is currently no index of SSB so the estimate of current SSB is uncertain and this uncertainty will increase into the future as the fishery completes its transition to a 100% longline fishery. A precautionary catch limit of between 2 000 and 2 500 tonnes should be set for 2013/14 and a revised assessment tabled together with a method for developing an index of SSB at WG-SAM-14.

4.56 Dr Darby noted that the catch estimate of 2 500 tonnes was consistent with the CCAMLR decision rule and is based on an estimate derived from a converged run of the CASAL model. The catch estimate of 2 770 tonnes was derived from a CASAL version which failed to reach a unique solution when initiated at different starting estimates of B_0.

D. eleginoides Kerguelen Islands (Division 58.5.1)

4.57 The fishery for *D. eleginoides* in Division 58.5.1 is conducted in the French EEZ. In 2012/13, the catch limit for *D. eleginoides* was 5 100 tonnes. Fishing was conducted by seven vessels using longlines and the total reported catch up to 20 September 2013 was 3 239 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.58 There were no papers presented this year on the stock assessment of *D. eleginoides* at Kerguelen (national EEZ in Division 58.5.1). Mr R. Sinegre (France) noted that France has just finished the POKER 3 survey, and is in the process of updating the stock assessment in the coming year. Mr Sinegre presented some preliminary results on the stock assessment. Updated work included reducing the number of fisheries and seasons, updating data weighting to the Francis method and including a biomass estimate and length-frequency distributions from the latest POKER survey (2013).

4.59 The Working Group welcomed the update and recommended that the updated stock assessment be presented at WG-SAM-14. The Working Group also recalled last year's WG-FSA recommendations (SC-CAMLR-XXXI, Annex 7, paragraphs 4.24 to 4.27) to provide a more robust assessment, in particular specific recommendations on the stock assessment model (SC-CAMLR-XXXI, Annex 7, paragraph 4.24), and noted that some have already been addressed. It made the following recommendations:

(i) investigate parameters at bounds and contributions to the penalties

(ii) investigate sensitivities using YCS fixed at 1, YCS estimated to 2009 only, and/or excluding CPUE data to the base case

(iii) age fish from POKER surveys and fisheries catches and include them in the model as they become available (as per WG-FSA-11 advice (SC-CAMLR-XXX, Annex 7))

(iv) explore IUU fishing effects on unfished biomass estimate (as per WG-FSA-11 advice (SC-CAMLR-XXX, Annex 7)).

Management advice

4.60 In the absence of a new stock assessment, the Working Group recalled last year's WG-FSA recommendation that 'until a more robust stock assessment is undertaken, the model described in WG-FSA-12/09 could be used to provide management advice for the 2012/13 season, and that the current catch limit of 5 100 tonnes could be used as management advice for 2012/13' (SC-CAMLR-XXXI, Annex 7, paragraph 4.25).

4.61 No new information was available on the state of fish stocks in Division 58.5.1 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-02, remain in force.

D. eleginoides Crozet Islands (Subarea 58.6)

4.62 The fishery for *D. eleginoides* at Crozet Islands is conducted in the French EEZ which includes parts of Subarea 58.6 and Area 51 outside the Convention Area. In 2012/13, the catch limit for *D. eleginoides* was 700 tonnes. Fishing was conducted by six vessels using longlines and the total reported catch up to 20 September 2013 was 504 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.63 WG-FSA-13/05 presented the results of a first stock assessment of *D. eleginoides* at Crozet Islands (Subarea 58.6 inside the French EEZ). The Working Group welcomed this new stock assessment and thanked the authors for bringing it to CCAMLR. The data included in the model were commercial catches, commercial catch-at-length, tag releases and recaptures. Sensitivity runs were carried out with estimations of IUU and killer whale (*Orcinus orca*) depredation, as well as the impact of data weighting on model results. The Working Group noted issues with data weighting in the model, the model fits, and some parameters estimated at bounds. These issues were investigated by a subgroup and a more stable model run was obtained by applying the data-weighting methods described in Francis (2011a, 2011b) to model run 3.2 of the Crozet stock assessment. MCMCs were carried out and the potential yield that would satisfy the CCAMLR decision rules was calculated as 2 500 tonnes (including 10% killer whale depredation). The current catch limit applied is 700 tonnes. The Working Group suggested that it could be useful to compare the results from the model with a calculation of biomass through CPUE analogy method.

4.64 The Working Group recommended that the reasons driving the changes in sampled trawl length frequencies between years be investigated further, and a sensitivity be run without trawl length-frequency data. The Working Group also questioned how the estimates of initial and current biomass were influenced by the IUU catch and killer whale depredation assumptions, and recommended that this be investigated further with the updated model. It also recommended, as for other stocks, that fish be aged to include annual ALKs and age frequencies in the model, preferably spanning the period of the fishery.

Management advice

4.65 No new information was available on the state of fish stocks in Subarea 58.6 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-02, remain in force in 2013/14.

D. eleginoides Prince Edward and Marion Islands

4.66 The Fishery Report for the fishery in the South African EEZ in Subareas 58.7, 58.6 and Area 51 was updated. Dr Leslie informed the Working Group that the operational management procedure (OMP) used to provide management advice is in the process of being updated, and will then be used as the basis for management advice for the fishery in this area in 2013/14.

Exploratory fisheries

Dissostichus spp. (Subarea 88.1)

4.67 The exploratory fishery for *Dissostichus* spp. in Subarea 88.1 operated in accordance with CM 41-09 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 3 282 tonnes. Fishing was conducted by 18 vessels using longlines. The fishery closed on 25 January 2013 and the total reported catch was 3 155 tonnes (see also paragraph 5.2). Details of this fishery and the stock assessment of *Dissostichus* spp. are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.68 An update of the Bayesian sex- and age-structured stock assessment model for *D. mawsoni* in the Ross Sea region (Subarea 88.1 and SSRUs 882A–B) was presented in WG-FSA-13/51. The assessment was based on that of 2011 but updated with data for 2012 and 2013, and incorporated a revised maturity ogive for males and revised data-weighting procedures based on the methods described in Francis (2011a, 2011b). In addition, an alternative data selection method, as described in WG-SAM-13/34, had been employed. The alternative method resulted in fewer tag data being selected for input to the assessment and provided a more precautionary estimate of stock abundance.

4.69 A sub-adult survey (WG-SAM-13/32) has operated in the Ross Sea since 2011 and now has two years of data. Sensitivity analyses conducted to incorporate the sub-adult survey index in the assessment indicated that estimates of recruitment were more stable when the survey was included in the assessment. The Working Group noted the contribution to the assessment of this survey series and recommended that it be continued in future years.

4.70 CASAL provides the option to apply an annual shift to the fitted selection patterns depending on the mean annual depth of fishing. The Working Group noted that MCMC diagnostics for the depth-shift parameters showed they were poorly fitted by the model. Comparative assessment runs for which the depth-shift parameters were removed provided almost identical results with a substantial reduction in the number of parameters estimated.

4.71 The Working Group supported the advice of WG-SAM-13 (Annex 4, paragraphs 3.25 and 3.26) and recommended that the sub-adult survey be continued, with a catch limit of 43 tonnes allocated from the Ross Sea shelf catch limit in 2013/14. The Working Group further recommended that the depth-shift parameters should be omitted from future assessments, and that length-based tag mortality, as applied for *D. eleginoides* in Subarea 48.3, be investigated as a sensitivity.

4.72 The constant catch for which there was median escapement of 50% of the median pre-exploitation spawning biomass level at the end of the 35-year projection period for the Ross Sea (Subarea 88.1 and SSRUs 882A–B) was 3 044 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass.

Management advice

4.73 The Working Group recommended that the catch limit for *D. mawsoni* in Subarea 88.1 should be set at 3 044 tonnes for 2013/14 and 2014/15, based on the outcome of the assessment.

Dissostichus spp. (SSRU 882A)

4.74 SC-CAMLR-XXXI (paragraph 9.30) agreed that SSRU 882A could potentially be opened and managed as part of the Ross Sea fishery so that additional information could be collected to further inform stock assessments and management advice for this region. WG-FSA-13/55 identified a number of research priorities for the Ross Sea region to directly inform gaps in current understanding of the biology and dynamics of toothfish stocks in this region. One of the priority areas identified by the Working Group was research in the south of SSRU 882A to better understand toothfish distribution and movement on the Ross Sea slope and the potential implications for stock structure and potential bias in the stock assessment.

4.75 WG-FSA-13/13 proposed a mechanism to determine catch limits for this area within the scope of CM 41-10.

4.76 The Working Group recommended the following as an appropriate basis for research fishing in SSRU 882A.

(i) A maximum catch of 60 tonnes would apply inside a research block (76.647S–75.790S and 169.660W–166.967W) that bounds an area in which around 146 tagged fish were released during research in 2010/11 and 2011/12. Fish should be tagged at a rate of three fish per tonne. No limit on the spatial separation of sets would apply.

(ii) A maximum catch of 226 tonnes could be taken from the remaining area of SSRU 882A south (i.e. south of 73°S). All lines should be separated by a minimum of 5 n miles (for each individual vessel) and fish should be tagged at a rate of three fish per tonne.

(iii) All catches taken both inside and outside the research block are part of the Ross Sea slope catch limit (SSRUs 881H, I, K). Uncaught portions of catch limits in SSRU 882A south can be taken from elsewhere in SSRUs 881H, I, K.

(iv) The research design and associated maximum catches should apply for two years. The results will be evaluated and further research will be conditional on the results of the evaluation and on the suitability of the data for inclusion in the 2015 stock assessment and management advice.

4.77 A primary aim of fishing within the research block is to recapture tagged fish that were released in 2010/11 and 2011/12, as well as other tags potentially indicative of fish movements from other areas. It is estimated that 95 tagged fish from the research in 2010/11 and 2011/12 will be available for recapture. The Working Group agreed the maximum catch would be 60 tonnes.

4.78 The primary aim of fishing outside of the research block is to provide information on the distribution and movement of fish in the Ross Sea region, in particular the movement from SSRU 881K where more than 6 500 fish have been tagged since 2001. The maximum catch outside the research block would be 226 tonnes.

4.79 The Working Group noted that the stated objective of research in this area was to provide additional data to improve stock assessment and management and emphasised the importance of achieving a high tag overlap and conducting the tagging of fish in accordance with the guidelines described in WG-FSA-13/49. The Working Group also encouraged all Members to undertake biological sampling at a higher frequency in these areas, including toothfish otoliths and to contribute to the development of annual ALKs and to ensure that data are of the highest quality.

4.80 The Working Group noted that catch limits for the Ross Sea region are managed under two conservation measures (CMs 41-09 and 41-10). The Working Group recommended that the Scientific Committee consider revising the boundary between Subareas 88.1 and 88.2. Alternatively, the scope of CMs 41-09 and 41-10 could be revised such that the Ross Sea (Subarea 88.1 and SSRU 882A–B) is managed within a single conservation measure.

4.81 The Working Group further noted that 23 vessels have notified to fish in Subarea 88.2 in 2013/14, and that a maximum catch of 60 tonnes might be difficult to manage where a large number of vessels may be competing for catch in an Olympic fishery.

Dissostichus spp. (Subarea 88.2)

4.82 The exploratory fishery for *Dissostichus* spp. in Subarea 88.2 operated in accordance with CM 41-10 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 530 tonnes. Fishing was conducted by 16 vessels using longlines. The fishery closed on 13 February 2013 and the total reported catch was 476 tonnes (see also paragraph 5.2). Details of this fishery and the stock assessment of *Dissostichus* spp. are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.83 WG-FSA-11 (SC-CAMLR-XXX, Annex 7) noted that until 2011 assessments for SSRUs 882C–G and 882H were undertaken independently. In 2011 the Working Group adopted the combined assessment on the basis that the hypothetical life history and ocean circulation in this region indicate links between these areas.

4.84 WG-FSA-13/52 presented an updated combined assessment across the shelf region (SSRUs 882C–G) and the north region (SSRU 882H) from 2002/03 to 2012/13. The revised data selection method (WG-SAM-13/34) was used to select the data used in the assessment.

4.85 The Working Group noted that age data for this area were based on limited information (WG-FSA-13/48) and the recommendation in the paper that age compositions be

given a low weighting in the assessment. The results of alternative assessment options, which included down-weighting of the age composition data, the use of alternative data selection methods and the application of annual ALKs, where available, were presented.

4.86 The proposed final assessment was based on the model configuration with down-weighted age-composition data and annual ALKs. B_0 was estimated at 6 590 tonnes and the ratio of $B_{current}$ to B_0 was 65%. The estimated value of B_0 was lower than that estimated in previous assessments. The reduction was due in part to the addition of the last two years of tag release and recapture data and in part to the down-weighting of the catch-at-age data. The precautionary yield that satisfied the CCAMLR decision rules was 266 tonnes.

4.87 The Working Group noted that all the tag data included in the assessment come from the north and that exploitation of the stock in this region has been concentrated around specific seamounts. As a consequence, recent changes in biomass as estimated in the model may represent only the localised biomass and dynamics of the stock at these locations in the northern area and may not be representative of the population over the whole region (SSRUs 882C–G). WG-FSA-13/01 noted the high incidences of within-season recaptures for this area which would be consistent with fishing effort being restricted to a small area.

4.88 The Working Group acknowledged that recent changes in biomass as estimated in the assessment are likely to be representative of biomass in the north only where tagged fish have been recaptured at a higher rate in recent years. Only limited data are available for the shelf and slope areas where fishing has been conducted on an intermittent basis. The Working Group also noted that there had been a decline in CPUE and truncation in the age structure in the north (paragraph 3.16; WG-FSA-13/48).

4.89 The proposed catch limit of 266 tonnes in 2013/14 implies a reduction in catch limit of around 50%. The Working Group was unable to reach consensus on the most appropriate approach to determine catch limits for 2013/14 and identified three options:

Option 1 – To apply a catch limit of 266 tonnes across all SSRUs (882C–H).

Option 2 – To apply the catch limit of 266 tonnes to the northern area alone and to determine an appropriate level of catch for the shelf through some other approach.

Option 3 – to reapply the management measures that had applied in 2012/13.

4.90 Dr Petrov noted that at WG-SAM-13 some Members expressed doubt about the need to use the method (WG-SAM-13/34) presented for stock assessment in 2013 due to a lack of representativeness of the data (Annex 4, paragraph 4.8). However, the method and calculations for assessment of stocks were presented in WG-FSA-13/52.

4.91 Some Members felt that under the current conservation measure, stock depletion in the north is occurring at a faster rate than would be considered acceptable, as indicated by the increase in tag recaptures in recent years, and that a catch in excess of 266 tonnes in the north would not be sufficiently precautionary to prevent overexploitation of the stock.

4.92 The Working Group recommended that this assessment be reconsidered by WG-SAM-14 with specific consideration of the potential for localised depletion and tag mixing and stock identity. The Working Group also recommended that all Members

contribute, where possible, to the development of annual ALKs. In particular, Norway, Russia and the UK were identified as nations that may have historic otolith samples that could be aged. The Working Group recalled the recommendation of the Ageing Workshop for *D. eleginoides* and *D. mawsoni* (SC-CAMLR-XXXI, Annex 7, paragraph 10.13) that intercalibration of otolith readings should be conducted.

Generic issues

CASAL version control and validation

4.93 The Secretariat routinely verifies that stock assessments using CASAL are reproducible, after the deadline for the submission of WG-FSA meeting papers and prior to the meeting (WG-FSA-06/08, paragraph 6.1). The verification is performed in two steps:

(i) Parameter files verification: the files population.csl, estimation.csl and output.csl used in each assessment reported in meeting papers are used as inputs to a CASAL run performed by the Secretariat. If no errors are reported during the process, the files are considered as verified.

(ii) MPD estimate verification: the 'B_0' estimate produced by a given model run is compared to that reported in the accompanying meeting paper.

4.94 Verifications were performed for input parameter files, output files and initial assessment results from the CASAL assessments submitted to WG-FSA in 2013 (Table 5). Estimates of B_0 were computed for each assessment and each configuration for which files were provided to the Secretariat (Table 6).

4.95 The B_0 estimates of the verification runs were usually identical or within 1.3% of the reported B_0, with the exception of one scenario run for *D. eleginoides* in Division 58.4.4 (Table 6) and the reported model run of scenario 2.4 for *D. eleginoides* in Division 58.5.2 (WG-FSA-13/24) and the final model adopted during the Working Group meeting for this division.

4.96 The Working Group was concerned about these differences in B_0 estimates between CASAL versions and failed to find reasonable explanations in its discussions. The CASAL Manual (Bull et al., 2012) in Chapters 15.6 and 15.7 lists all changes since CASAL v2.20-2008/02/14, however, none of these changes addressed issues that were relevant to the examined model runs and could explain the observed difference in B_0 estimates.

4.97 The Working Group discussed CASAL version control and recommended that the Secretariat define by 1 April of a given year which CASAL version be used for the *Dissostichus* spp. stock assessments presented for consideration by the Working Group later in the same year; a webpage detailing the version number that Members should be using could be used to facilitate this.

4.98 The Working Group also recommended that the Secretariat should hold stock assessment test datasets that are used to check new CASAL versions as described in SC-CAMLR-XXVII, paragraph 2.1, and report its finding to WG-FSA before a new CASAL version is adopted for use.

Stock structure

4.99 The Working Group noted that with the increasing number of tagged fish recaptured from the fisheries exploiting toothfish, evidence of tag movement between 'stocks' has been increasingly observed.

4.100 In order to consider the impact of this on individual stocks, the Working Group requested more information be provided to WG-SAM on areas with potential stock linkages, in particular Subareas 48.3 and 48.4; 88.1, 88.2 and 88.3; 58.6 and 58.7; and Divisions 58.5.1 and 58.5.2. This information will allow WG-FSA to review the current structure of the stocks for which it is providing management advice.

4.101 Reviews should consider, inter alia, three types of information:

(i) biological characteristics of toothfish located in each of the areas, including their length distributions, life-history parameter, genetics, parasites and otolith microchemistry

(ii) a review of release and recapture locations of tagged fish within and across stocks

(iii) an evaluation of the consequences of (i) and (ii) on management advice. This evaluation would consider the impact of joining stocks or maintaining separate assessments on sustainable and precautionary management.

Data weighting

4.102 A range of data-weighting approaches have been applied in the assessments submitted to WG-FSA. These include external and iterative re-estimation of process error associated with individual data sources (e.g. Hillary et al., 2006; Candy, 2008), and application of the Francis methodology (Francis, 2011a, 2011b). In general, the Working Group considered that the iterative reweighting and the Francis method may provide suitable approaches for use in the CASAL assessments conducted at WG-FSA, however, they can result in variable levels of variance within the MCMC uncertainty analysis with no consistent pattern between assessments.

4.103 The Working Group recommended that a review of weighting and screening of assessment data be considered as a special topic for WG-SAM, and for WG-SAM to provide guidance on a standardised approach. It would be also useful to combine such a review with a comparison of MCMC and covariance resampling projection methods used in generating uncertainty when determining catch levels consistent with the CCAMLR decision rules.

Cryptic biomass

4.104 The Working Group noted that in previous years WG-SAM had requested that all assessments in which dome-shaped fishing selectivity curves were fitted should be run with sigmoid fishing selectivity functions in order to investigate the impact of cryptic biomass on

management advice. However, analyses conducted during the Working Group meeting indicated that this method confounds the estimation of cryptic biomass with changes in the estimation of other assessment parameters.

4.105 The Working Group recommended that WG-SAM should evaluate (i) appropriate methods for the estimation of cryptic biomass, and (ii) its consequences on stock assessment results and decision rules.

Research surveys in the Ross Sea

4.106 The Working Group considered WG-FSA-13/55, and discussed possible research surveys or experiments to address priority research questions in the Ross Sea region fishery to reduce uncertainty in the stock assessment. WG-FSA-13/53 described how data collected from properly designed research fishing will directly inform gaps in current understanding, particularly in the context of the existing stock assessment and the further development of the spatial population model for *D. mawsoni*. The Working Group agreed that the following research ideas were particularly important:

(i) research fishing in the northern Ross Sea region during winter, to address current uncertainties in toothfish life-cycle movements and spawning dynamics

(ii) research in the south of SSRU 882A (on the slope) to better understand toothfish distribution and movements on the Ross Sea slope and potential implications for stock structure and potential bias in the stock assessment

(iii) spatially stratified longline surveys in previously unfished SSRUs (e.g. 882A–B north, 881D and 881F) to inform the parameterisation of the SPM and reduce potential bias in the stock assessment.

4.107 The Working Group requested that the Scientific Committee endorse the importance of these research priorities for the Ross Sea region and request research proposals be developed by Members for consideration by the Scientific Committee.

NEW AND EXPLORATORY FISHERIES

5.1 Exploratory longline fisheries for *Dissostichus* spp. were conducted in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2 and 58.4.3a in 2012/13, and the season's catches from these fisheries are summarised in Table 1 (see also Table 7 for a list of participating Members and vessels). Detailed information is provided in the Fishery Reports. No new fishery was conducted.

5.2 The Secretariat monitored all fisheries in 2012/13 using the catch and effort reporting system and notifications of vessel movements (CCAMLR-XXXII/BG/06 Rev. 1). During that season, the exploratory fisheries in Subareas 88.1 and 88.2 were closed by the Secretariat when the catches of *Dissostichus* spp. approached the relevant catch limits:

(i) in Subarea 88.1, SSRUs B, C, G closed on 11 December 2012, and SSRUs H, I, J, K, L and the whole fishery closed on 25 January 2013; the total catch of *Dissostichus* spp. in these management areas ranged from 93 to 99% of the catch limits

(ii) in Subarea 88.2, SSRU H closed on 2 February 2013, and SSRUs C, D, E, F, G and the whole fishery closed on 13 February 2013; the total catch of *Dissostichus* spp. in these management areas ranged from 88 to 95% of the catch limits.

5.3 All vessels fishing in exploratory fisheries are required to tag and release *Dissostichus* spp. in accordance with the tagging protocol and requirements (CM 41-01) and rates specified in CMs 41-04 to 41-07 and 41-09 to 41-11. In 2012/13, all vessels met the required tagging rates (Table 7), and all but one vessel achieved, or exceeded, the required tag-overlap statistic (Table 8). The vessel which did not achieve the required tag-overlap statistic in 2012/13 (*Simeiz* in Subarea 88.1) had tagged predominantly small-sized fish (Figure 8). The Working Group noted that tagging was carried out continuously during fishing as per CM 41-01 (Figure 9).

5.4 The Working Group expressed concern at the low tag-overlap statistic achieved by the *Simeiz* in Subarea 88.1, and the impact of low overlap statistics in assessments. The importance of tagging fish in proportion to the lengths of fish caught has been discussed extensively (e.g. SC-CAMLR-XXVIII, Annex 5, paragraph 5.16; SC-CAMLR-XXXI, Annex 7, paragraphs 5.133 to 5.143). Procedures for tagging large fish have also been discussed previously (e.g. SC-CAMLR-XXVIII, Annex 5, paragraph 5.17; WG-FSA-07/36). The Working Group noted the *Simeiz* is the vessel proposed for conducting research fishing in Subarea 48.2 in 2013/14 (paragraphs 6.70 to 6.79).

5.5 A total of 6 016 *Dissostichus* spp. were tagged and released in these fisheries in 2012/13, and 307 tagged fish were recovered during that season. The time series of numbers of *Dissostichus* spp. tagged and released, and subsequently recaptured, in these fisheries is summarised in Table 9.

5.6 Vessels engaged in exploratory fisheries in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a were required to undertake research fishing (CM 21-02, paragraph 6). Research in 2012/13 was reviewed by WG-SAM in June 2013 (Annex 4, paragraphs 2.1 to 2.37). Updated information was reviewed by WG-FSA (see Item 6).

New and exploratory fisheries notified for 2013/14

5.7 Ten Members submitted notifications for a total of 26 vessels for exploratory fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2 and 58.4.3a in 2013/14 (Table 10; CCAMLR-XXXII/11 to XXXII/20); there were no notifications submitted for the exploratory fishery in Division 58.4.3b, or for new fisheries.

5.8 The research plans associated with the notifications for exploratory fisheries in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a were submitted to WG-SAM

(WG-SAM-13/08 to 13/13 Rev. 1). WG-SAM's consideration of these plans is reported in Annex 4, paragraphs 2.1 to 2.37. Revised research plans were reviewed by WG-FSA (see Item 6).

DATA-POOR FISHERIES

6.1 The Working Group considered general progress on research in data-poor exploratory fisheries reported by WG-SAM (Annex 4, paragraphs 2.1 to 2.8). The Working Group agreed with the recommendation that research plans currently submitted as a part of a notification to fish in a data-poor exploratory fishery should be submitted as stand-alone papers to WG-SAM. It also recognised that research plans were subject to a number of changes during the course of discussions at WG-SAM, WG-FSA, the Scientific Committee and the Commission, as well as bilateral arrangements between Members fishing in the research area and agreed that a mechanism needed to be developed so that the final research plans were fully documented. The Working Group requested the Scientific Committee develop such a mechanism.

6.2 The Working Group also agreed that it was important to document the development of research in the various data-poor fisheries over time. It considered that a report of the research conducted in each research block of a data-poor fishery could be included as an annex to the fishery report for that area. A summary of research carried out in each research block for each year to date, including details such as seabed area, CPUE, catch, tags released, tags recaptured and available tags, is given in the appendices to the data-poor Fishery Reports.

6.3 The Working Group also advised the Scientific Committee that the research plans being evaluated under CMs 21-02 and 24-01 represent a wide range of fisheries and statistical areas within the Convention Area, including open and closed SSRUs, new and exploratory fisheries, closed areas, and depleted and recovering fisheries. It noted that all research plans for *Dissostichus* spp. have benefited from the process identified in the data-poor exploratory fisheries. It also noted that although the standard of research plans had been substantially improved since last year, that there were still a minority of Members submitting proposals which did not include a fully developed research plan, or were not in the correct format and lacked the details necessary for evaluation. In addition, there were several instances where the advice of WG-SAM had not been included in the revised research proposal submitted to WG-FSA.

6.4 Through discussion among research plan proponents, the Working Group developed an annotated flowchart to show the different stages of research leading to an assessment following the recommendations from WG-SAM (Annex 4, paragraphs 2.1 to 2.8) for research on *Dissostichus* spp. The flowchart outlined the framework for research plan development and process for progress towards an integrated stock assessment. The flowchart is comprised of three phases: a prospecting phase, biomass estimation phase and an assessment development phase (Figure 10). A summary of the research proposals, Members, and research blocks and the current phase of research in each area are indicated in Table 11 and location of research blocks in Figure 11.

6.5 The Working Group supported the advice of WG-SAM-13 (Annex 4, paragraph 2.7) regarding the framework for research plans in data-poor fisheries. Detailed descriptions of the

phases of the framework and advice concerning analytical approaches for research plan development can be found in working group reports (e.g. WG-SAM-13 (Annex 4, paragraph 2.7) and WG-SAM-11) and the important characteristics of each phase of the plan are provided in Figure 10. The main decision criteria for a research block to advance between phases are listed as questions, but the flowchart recognises that as information accumulates for each research block, information on local biomass may be available and should be considered simultaneously from several sources, including a preliminary stock assessment. Therefore, the phase of the research can, for example, be considered as intermediate between the biomass estimation phase and the assessment development phase.

6.6 The flowchart also makes explicit the annual review process within each phase, indicating that individual research blocks may remain in a single phase for more than one year.

6.7 Several Members requested a relaxation of by-catch rules in their research plans. The Working Group noted that this had been discussed by WG-SAM in 2013 in the context of research fishing in Subarea 48.6 (Annex 4, paragraph 2.17). The Working Group agreed that by-catch issues should not unduly affect the research plans, but that vessels should still be encouraged to avoid areas of high by-catch by the use of a move-on rule. Therefore, the Working Group recommended that paragraph 6 of CM 33-03 should not apply to research in the data-poor fisheries.

6.8 The Working Group also recommended that paragraph 5 of CM 33-03 should continue to apply to all the data-poor fisheries with a 1 tonne threshold – except for research plans where another threshold had already been agreed (e.g. France in Division 58.4.3a). The Working Group also requested the Secretariat examine the distribution of by-catch rates for rajids, macrourids and other species, for each of the research blocks and research proposals so that appropriate thresholds for the trigger rule can be determined for presentation at the next meeting of WG-SAM.

6.9 Several Members requested a relaxation of the minimum separation distance between lines in their research plans. The Working Group noted that this had been discussed by WG-SAM in 2013 in the context of research fishing in Subarea 48.6 (Annex 4, paragraph 2.13). The Working Group agreed that some spreading mechanism was desirable in the biomass estimation phase to ensure that the research covered the spatial extent of tags that had previously been released in the research area. The Working Group recalled that the minimum separation rule had been reduced over time from a separation of 5 n miles to 3 n miles, to the current rule which was for a separation of 3 n miles for only 50% of the lines. The Working Group recommended that the current rule remain in place and that the skippers of the vessels denote the research lines which meet the 3 n mile separation rule in the C2 logbook by the code R1 and the remaining lines by the code R2.

6.10 The Working Group also agreed that the current rule should be vessel specific (i.e. vessels do not have to keep track of where other vessels have set their lines in a particular season) but not trip specific (i.e. if a vessel returns to a research block in a subsequent trip within the same season, the sets from the earlier trip apply with respect to the line-spacing requirements specified in CM 41-01). The Working Group considered that the current rule would help reduce the likelihood of within-season recaptures, which are not currently used in the stock assessment models. The Working Group also agreed that in the initial prospecting phase a wider separation between lines (e.g. 5 n miles) was generally more desirable to

provide survey-relative density. The Working Group agreed with the advice of WG-SAM that research proponents could propose an alternative method of ensuring spatial coverage of the research blocks in their research plans.

6.11 The Working Group noted that seabed area calculations used by research proponents are currently based on a planimetric projection (i.e. assume the world is flat). The Working Group discussed the extent to which estimating biomass using the CPUE analogy method would more appropriately utilise a projection which incorporates the seabed topography. The Working Group noted that estimates based on seabed topography would vary depending on the spatial scale at which topographic variability is represented, and that the effect on fish abundance of increased seabed area arising from topographic variability is not known. The Working Group further noted that in the few instances examined, the difference between planimetric versus seabed area measurements was very small (less than 1%) and that biomass estimates using the CPUE analogy method are subject to much higher levels of uncertainty. The Working Group agreed that using planimetric estimates is likely to be adequate. The Working Group requested the Secretariat recalculate seabed areas for the 600–1 800 m depth zone for all subareas, divisions, SSRUs and research blocks for the next meeting of WG-SAM.

6.12 The Working Group agreed that the estimates of biomass provided in research proposals submitted to WG-FSA-13 appeared to be excessively high for some SSRUs and research blocks from the Petersen estimator and the CPUE analogy method. For example, the vulnerable toothfish biomass in four research blocks in Subarea 48.6 was calculated to be 75 000 tonnes (WG-FSA-13/37), which is higher than the total vulnerable biomass of *D. mawsoni* in the Ross Sea region.

6.13 The Working Group recalled the discussion of tags available for recapture at WG-SAM (Annex 4, paragraph 2.7iv) and agreed that many tags which had been released in the years when the tag-overlap statistic was low were unlikely to be available for recapture. It also noted that there could be other reasons why tags from some vessels have never been recaptured, such as inexperienced taggers and fish in poor condition for tagging etc. It agreed that, as a minimum threshold to data selection, only tags from vessels from which at least one of their tags had subsequently been recaptured (effective tag releases) should be used for the estimation of local abundance using the Petersen estimator and for subsequent calculations on expected recaptures under different catch limits, and in stock assessments. This method was used for the purposes of estimation of research catch limits for 2013/14 pending development of alternative methods.

6.14 The Working Group noted the development of the data select method by New Zealand for the Ross Sea region (WG-FSA-13/50) and agreed that alternative methods for identifying which tags should be used for biomass estimation in the data-poor fisheries be evaluated. It requested that the Secretariat carry out a meta-analysis of tag-recapture data to determine a more appropriate method for selecting tags available for recapture in the data-poor fisheries. This could include a meta-analysis of all tag-recapture data across the exploratory fisheries using the data select method.

6.15 The Working Group also discussed the very high biomass estimates which had been obtained using the CPUE analogy method. Several Members had used SSRU 882H as the reference area as advised at a previous WG-SAM meeting (SC-CAMLR-XXX, Annex 5, Table 2). However, the Working Group noted that this was a seamount fishery based on large

adult *D. mawsoni*, and that biomass estimates for this fishery had changed considerably in the 2013 update of the Subarea 88.2 stock assessment (WG-FSA-13/52). The Working Group agreed that estimates of biomass and CPUE from this fishery were unsuitable as a reference for other *D. mawsoni* fisheries on the Antarctic continental slope but may be appropriate as a reference area for *D. mawsoni* in SSRUs or research blocks comprising only seamounts.

6.16 The Working Group agreed that the Ross Sea region comprised a more appropriate reference area for any research blocks on the slope of the Antarctic continent and recommended that it be used for research proposals for *D. mawsoni* in slope fisheries in Subarea 48.6S, in Subarea 48.5 and in Divisions 58.4.1 and 58.4.2. The Working Group agreed that research survey proponents should use *D. mawsoni* in Subarea 48.4S and/or *D. mawsoni* in SSRU 882H as a reference area for analogy with the seamount fisheries for *D. mawsoni* in Subarea 48.6. The Working Group also agreed that research survey proponents should continue to use *D. eleginoides* in Subarea 48.4N as a reference area for analogy with other *D. eleginoides* fisheries in Subarea 48.6N and Divisions 58.4.3a and 58.4.4.

6.17 For the current calculations, the Working Group agreed to use the median CPUE (kg/km) from all vessels and gear methods from the past three years in the reference and research areas. It also noted that there were problems in standardising the measure of effort between trotlines and other gear types. It also agreed to use estimates of seabed area from WG-SAM-11 (SC-CAMLR-XXX, Annex 5, Table 2) and 2012 estimates of vulnerable biomass from the reference areas. A summary of these values for each of the reference areas is given in Table 12.

6.18 The Working Group reiterated its advice from previous years that estimates of biomass arising from the use of this method were highly uncertain. However, it is currently unable to provide estimates of variance associated with this approach. Instead, the Working Group recommended that research catches should be evaluated in the context of multiple median biomass estimates arising from different methods (e.g. Petersen estimator or using alternate plausible reference areas for the CPUE analogy method), and that precautionary exploitation rates at the scale of the stock or SSRU should use the most plausible biomass estimate, or reflect uncertainty by considering multiple alternate biomass estimates. The Working Group recommended Members review the methodology and endeavour to provide estimates of variance which could be used in future years. In developing such estimates of biomass and variance, the Members should consider the advice of WG-SAM-11 (SC-CAMLR-XXX, Annex 5, paragraphs 2.1 to 2.44).

6.19 Several Members requested some flexibility in their research for situations when ice restricted access to research blocks. The Working Group noted that this had been discussed by the Commission in 2012 (CCAMLR-XXXI, paragraph 5.35). The Working Group agreed that research in Antarctic waters was always challenging and that contingencies for bad ice years are a necessary part of any research plan. However, it also noted that ice charts included in the research proposals indicated that the research blocks were ice free in most years, and that there were several research blocks in each of the areas where research was being proposed which should allow for some variation in ice conditions between years.

6.20 Some Members requested that flexibility in the research due to bad ice conditions should be discussed from a point of view of operation at the Commission.

6.21 The Working Group noted that research fishing conducted outside the research blocks would provide little useful additional information on stock abundance. However, it also noted that if ice covered part of the research block, then research fishing could be extended to include those fine-scale rectangles immediately adjacent to the existing research block.

6.22 The Working Group noted that the numbers of research blocks spread across the Convention Area, and the overall increase in research catch limits, meant there was a high likelihood that Members' vessels would be unable to access all research blocks in 2013/14. It agreed that the development of multi-Member research plans would increase the likelihood that data would be collected and provided in time for consideration by the Working Group in 2014 and requested that the Scientific Committee consider mechanisms for facilitating multi-Member multi-vessel research plans.

Development of advice on catch limits

6.23 The Working Group discussed appropriate catch limits for research proposals confined to research blocks, i.e. in phase 2 of the data-poor fisheries research planning framework (biomass estimation phase) as illustrated in Figure 10. Consistent with the advice of WG-SAM-13 (Annex 4, paragraph 2.7), catch limits are intended to provide sufficient tag recaptures to achieve a stock assessment within a reasonable time period (3–5 years) while providing reasonable certainty that exploitation rates at the scale of the stock or SSRU will not exceed appropriate levels as estimated in areas with assessed fisheries (e.g. 3–4%) (Welsford, 2011; WG-SAM-13/37).

6.24 To provide catch limit advice, the Working Group first estimated local biomass within each research block using all available methods, including the CPUE analogy method, Petersen estimates arising from tag recaptures and stock assessment outputs where these were available (Tables 13 and 14). For Petersen estimates, those derived from higher numbers of recaptures and from more recent tag recaptures were judged to be more reliable than those derived from older and fewer recaptures. Estimates arising from stock assessment outputs were used in areas where stock assessments are under development, recognising that these are still data-poor fisheries and that utilising a stock assessment for interim advice does not imply that the assessment has been approved as robust to provide precautionary yields consistent with CCAMLR decision rules.

6.25 The Working Group then estimated the number of tags available for recapture within each research block in 2013 (using only 'effective tag releases' as defined above (paragraph 6.13)) and compared the number of observed recaptures in 2013 with the number that would be expected under different assumptions of local biomass estimated using alternate methods. The Working Group agreed that where alternate methods yielded conflicting estimates of local biomass, comparing expected versus observed recaptures may inform selection of the more plausible biomass estimate.

6.26 The Working Group examined the effects of different catch levels on local exploitation rates and on the expected number of tag recaptures in 2013/14. Wherever possible, the Working Group attempted to define catch limits that would achieve 10 or more recaptures in

2013/14 without exceeding local exploitation rates of around 4%. Where multiple plausible local biomass estimates were available, the more precautionary option was selected unless other evidence supported a higher local biomass.

6.27 The Working Group recalled the advice of WG-SAM that precautionary exploitation rates should be evaluated at the scale of the stock or SSRU (Annex 4, paragraph 2.7vii), such that where research blocks contain only a small proportion of the total fishable area in the SSRU (as shown in Table 13) this provides higher levels of precaution.

6.28 The Working Group agreed that the catch limits in Table 13 are appropriate to achieve the aims of this research and recommended that these be considered as management advice by the Scientific Committee for catch limits for the 2014 season.

Subarea 48.6

6.29 The exploratory fishery for *Dissostichus* spp. in Subarea 48.6 operated in accordance with CM 41-04 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 200 tonnes to the north of 60°S and 200 tonnes to the south of 60°S. Research fishing was conducted in four research blocks by two vessels using longlines and the total reported catch up to 20 September 2013 was 237 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.30 WG-FSA-13/37 and 13/47 described proposals for fishing in Subarea 48.6 by one Japanese and one South African vessel. Both proponents of this research incorporated the following modifications recommended during WG-SAM-13 (Annex 4, paragraphs 2.9 to 2.21):

(i) incorporated uncertainties into the estimates of biomass in *Dissostichus* spp.

(ii) included an additional research block (48.6e), where tagged fish have also been released in the past

(iii) introduced species-specific toothfish catch limits to reduce the risk of overcatch of *D. eleginoides*

(iv) discussed the minimum line separation

(v) revisited the *Macrourus* spp. by-catch rules.

6.31 WG-FSA-13/37 and 13/47 provided revised versions of previous papers presented at WG-SAM-13 (13/09 and 13/11) incorporating all those recommendations listed above. WG-FSA-13/37 provided a re-estimated biomass for *Dissostichus* spp. incorporating uncertainty. This paper also noted that the incorporation of an additional area (48.6e) is feasible, given the analysis of summer ice conditions. Both papers proposed a catch limit for *D. eleginoides* in Subarea 48.6N. Both research proposals agreed that the *Macrourus* spp. by-catch move-on rule should be relaxed in order to make the fishing operation possible in this area. This issue was discussed earlier (paragraphs 6.7 to 6.10).

6.32 The Working Group noted the need for the determination of threshold catch limits for *D. eleginoides* in Subarea 48.6N. A lack of catch limits for *D. eleginoides* in this area has the potential to lead to overexploitation. Thus, research fishing should be conducted in areas where the probability of having by-catch of *D. eleginoides* is low, or at greater depths where *D. mawsoni* predominates in the catch.

6.33 The Working Group recommended avoiding the use of standardised CPUE indices for monitoring the abundance of *Dissostichus* spp. in Subarea 48.6. Estimates of abundance for these species in this area should be based on tag data where available, because standardised CPUE does not provide an adequate index of abundance (WG-FSA-13/63).

6.34 The Working Group discussed the incorporation of an additional research block (48.6e) into the research plan. It noted that tags had been released in this research block in 2011, and that 352 tags are estimated to be available for recapture at present (Table 13). The Working Group agreed that the usefulness of these initial tag releases will decline over time as the fish die from natural mortality and the fish move out of the release area. It also agreed that this provided a second research block in Subarea 48.6S which provided an alternative location for research in bad ice years. It therefore recommended that this research block be included in the research plan for 2013/14.

6.35 Ukraine submitted a proposal for exploratory fishing in Subarea 48.6 to WG-SAM-13 (WG-SAM-13/13). WG-SAM recommended that a revised version of this paper be resubmitted to WG-FSA-13. This paper was not resubmitted, thus the Working Group was not able to provide any recommendation about this proposal. The Working Group agreed that proposals for participation in data-poor fisheries must have a research plan.

6.36 The Working Group re-estimated catch limits for *D. eleginoides* in research blocks 48.6a and 48.6b and for *D. mawsoni* in research blocks 48.6b, 48.6c, 48.6d and 48.6e. These catch limits in each research block were estimated considering a minimum of 10 tags expected to be recaptured during the next fishing season and to achieve a maximum local exploitation rate of 4% (Table 13).

6.37 The Working Group recognised that South Africa and Japan had applied species-specific catch limits as described in WG-FSA-12/60 Rev. 1, Table 9, to facilitate their collaborative research in this subarea in 2012/13.

6.38 The Working Group gave regard to the catch limits agreed by South Africa and Japan last year. The Working Group evaluated the appropriateness of last year's catch limit, using the CPUE analogy method from Subarea 88.2, and recommended a catch limit of 170 tonnes for *D. mawsoni* in research block 48.6b, consistent with last year. This catch limit corresponds to an expected exploitation rate of 2.5% and an expectation of 27 recaptures of tagged fish during the next fishing season.

6.39 The Working Group recommended a catch limit of 50 tonnes for *D. mawsoni* in research block 48.6c, using the CPUE analogy method from Subarea 88.2. This catch limit corresponds to an expected exploitation rate of 1.4% and an expectation of 10 recaptures of tagged fish during the next fishing season.

6.40 The Working Group recommended a catch limit of 190 tonnes for *D. mawsoni* in research block 48.6e, using the CPUE analogy method from the Ross Sea. This catch limit corresponds to an expected exploitation rate of 2.9% and an expectation of 10 recaptures of tagged fish during the next fishing season.

6.41 Provisional catch limits for *D. eleginoides* in research blocks 48.6a and 48.6b were based on a reanalysis of Petersen estimates presented in WG-FSA-13/37 and on the CPUE analogy method as presented in WG-FSA-13/63. Some Members recommended a catch limit of 14 tonnes (expected exploitation rate of 4% and 15 expected recaptures) based on a Petersen estimator.

6.42 Drs K. Taki (Japan) and Leslie argued this catch limit was too low and it has the potential to compromise the completion of the proposed research. They noted this catch limit may be underestimated because of the high tagging rate and the restricted area fished could have led to a positively biased number of tag returns. They considered that application of the CPUE analogy method with Subarea 48.4N as the reference area should form the basis for setting the catch limit using the method outlined in WG-FSA-13/63 to determine CPUE for *D. eleginoides*. Application of this biomass estimate yields a catch limit of 28 tonnes which corresponds to an expected exploitation rate of 4% and an expectation of 15 recaptures of tagged fish (Table 13).

6.43 The Working Group did not reach consensus on the catch limit for *D. eleginoides* in research blocks 48.6a and 48.6b and recommended a catch limit of 14 to 28 tonnes.

6.44 The Working Group noted that coordination between the Japanese and the South African vessels will be important to accomplish *D. eleginoides* by-catch limits. The Working Group also noted that an upper threshold on the number of *D. eleginoides* tagged on one line may be desirable in order to ensure that tagging is carried out in a kind and careful manner that helps to achieve high survival rates and also avoids a high proportion of the tags in an area being in one location and therefore avoids excessive spatial bias (clumping) of tag releases.

6.45 The Working Group did not reach consensus on the catch limit for *D. mawsoni* in research block 48.6d. The Working Group recommended a catch limit of 100–150 tonnes.

6.46 Some Members recommended a catch limit of 100 tonnes based on the CPUE from the Ross Sea analogy method, corresponding to an expected local exploitation rate of 4% and an expected tag recapture of 30 fish in 2013/14.

6.47 Drs Taki and Leslie noted there have been no tag recoveries from this area to date despite an estimated 743 tags available for recapture resulting in an expectation of a high number of tag recoveries. The lack of tag recoveries could indicate large stock size and/or movement between research blocks and that the local exploitation rate may be overestimated leading to an underestimated catch limit. Dr Taki therefore proposed that the status quo catch limit of 150 tonnes be maintained.

6.48 The Working Group requested the Scientific Committee consider how advice on catch limits for *Dissostichus* spp. be developed where the spatial distribution of the two species overlap and one species essentially forms a by-catch of a fishery that is targeting the other

species. This is a particular issue for the mixed *D. mawsoni* and *D. eleginoides* fishery in the north of Subarea 48.6, but also applies to other areas where the two species overlap (e.g. Subarea 48.4, Division 58.4.3b and the north of Subarea 88.1).

Divisions 58.4.1 and 58.4.2

6.49 The exploratory fishery for *Dissostichus* spp. in Division 58.4.1 operated in accordance with CM 41-11 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 210 tonnes. Research fishing was conducted in two research blocks and other areas (designated for a depletion experiment) by two vessels using longlines and the total reported catch up to 20 September 2013 was 48 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.50 The exploratory fishery for *Dissostichus* spp. in Division 58.4.2 operated in accordance with CM 41-05 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 70 tonnes. Research fishing was conducted in the research block by one vessel using longlines and the total reported catch up to 20 September 2013 was 4 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.51 The Working Group considered WG-FSA-13/15, describing a proposal by Spain to continue a fishing experiment in Division 58.4.1 in 2013/14 using a combined depletion experiment and tag-recapture design. The Working Group noted that the updated paper had provided detailed diagrams of set sequence and locations as requested by WG-SAM-13 (Annex 4, paragraph 2.30), but that subsequent sets should be more constrained to where the high catch rates were originally encountered. The Working Group agreed that the characterisation of historical ice conditions and definition of potential future research blocks was also useful. The Working Group endorsed the advice of WG-SAM-13 (Annex 4, paragraph 2.29) that in 2013/14, returning to the two locations at which depletion experiments were conducted in 2012/13 was a high priority in order to recapture tags. The Working Group agreed that if tags are recaptured, then it should be possible in 2013/14 to compare the results of depletion-based, tag-based and CPUE-analogy-method-based estimates of local biomass for these locations, informing a useful review of how extending this experimental approach might lead to advice on stock status in these SSRUs. The Working Group also endorsed the advice of WG-SAM-13 (Annex 4, paragraph 2.29) regarding appropriate line stratification in the prospecting phase.

6.52 The Working Group supported the continuation of this research in 2013/14 and recommended that the following catches be set aside for this research in each of the following SSRUs in 2013/14 (see also Table 13):

5841C: 42 tonnes
5842D: 42 tonnes
5841G: 42 tonnes
5841H: 42 tonnes.

6.53 The Working Group considered WG-FSA-13/44, describing a proposal by the Republic of Korea to continue research in Division 58.4.1, research blocks C-a, C-b, E-a and E-b (WG-FSA-13/44, Figure 2 – research block map). The Working Group noted that the

planned research in 2012/13 had been largely unsuccessful due to adverse ice conditions, but that biological information described in WG-FSA-13/42, 13/43 and 13/45 was useful. The Working Group thanked Korea for providing analysis of fish condition affecting suitability for tagging, and thanked Korea for submitting details of its trotline and Spanish line gear configurations to the CCAMLR gear library. The Working Group also encouraged Korea to develop its capacity to age toothfish otoliths so that age-based assessments can be developed as the research proceeds.

6.54 The Working Group agreed that the proposed design to set paired trotline and Spanish line sets (each of half the normally prescribed length) in the same location was useful to enable gear standardisation and estimate potential differences in selectivity. The Working Group agreed that in the context of this experiment each pair of half-length lines would only count as a single set for purposes of the line separation rule in CM 41-01.

6.55 The Working Group noted that information presented in WG-FSA-13/44 included 'anomalous' CPUE data that had been flagged as being unsuitable for analysis (SC-CAMLR-XXXI, Annex 7, paragraph 5.11), and that interpretation of the information of this paper may be affected by the inclusion of these anomalous data.

6.56 The Working Group considered WG-FSA-13/38 and 13/39 describing a proposal by Japan to conduct research in Division 58.4.1, research blocks C-a, C-b, E-a, E-b and G and Division 58.4.2 block E (Figure 11). The Working Group recalled that these research blocks were originally defined and approved based on the comparable Japanese proposal in 2012 (WG-FSA-12/60) and that the approved methods and recommendations of WG-SAM (Annex 4, paragraph 2.7) were largely based on the approach utilised in these proposals (e.g. WG-SAM-13/37). The Working Group noted that additional analyses of historical ice conditions in these research blocks (see also WG-FSA-13/37) and of likely CVs of local biomass estimates associated with different numbers of recaptures, were informative.

6.57 The Working Group recommended that the following catch limits be endorsed for research blocks in Divisions 58.4.1 and 58.4.2 (noting that these should be separate from the catches set aside for research described in WG-FSA-13/15; see also Table 13):

58.4.1 C-a:	125 tonnes
58.4.1 C-b:	90 tonnes
58.4.1 E-a:	280 tonnes
58.4.1 E-b:	35 tonnes
58.4.1 G:	26 tonnes
58.4.2 E:	35 tonnes.

Division 58.4.3a

58.4.3a Elan Bank

6.58 The exploratory fishery for *Dissostichus* spp. in Division 58.4.3a operated in accordance with CM 41-06 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 32 tonnes. Research fishing was conducted in the research block by two vessels using longlines and the total reported catch up to 20 September 2013 was 16 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.59 The Working Group noted that two vessels, the *Shinsei Maru No. 3* (Japan, WG-FSA-13/40) and the *Saint André* (France, WG-FSA-13/04), undertook research on *D. eleginoides* on Elan Bank (Division 58.4.3a) during 2012/13, with a research catch limit of 32 tonnes shared between vessels.

6.60 The Working Group noted that the *Saint André* had conducted research after the deadline for submission of WG-FSA papers, and so Dr A. Relot (France) presented results from the *Saint André*. Due to the high levels of skate by-catch and mortality, the *Saint André* was required to fish within a restricted area in the west of Elan Bank, as well as being required to release all live skates, implement a skate by-catch move-on rule and a maximum soak time.

6.61 The Working Group noted that the *Saint André* caught a total of 6.5 tonnes of *D. eleginoides* and recaptured 11 tagged fish. The *Shinsei Maru No. 3* caught 10 tonnes of *D. eleginoides*, and recaptured one tagged fish. It also noted that the research proponents had conducted preliminary biomass estimates based on the CPUE analogy method, Petersen tag-recapture and CASAL integrated assessment methods. Each method produced substantially different answers, and noting that a more complete dataset was available at the meeting than when WG-FSA-13/04 and 13/40 were submitted, the Working Group requested that these estimates be updated during the meeting, including consideration of the numbers of tags available for recapture, and more appropriate reference areas for the CPUE analogy method.

6.62 The Working Group noted that the strategy for limiting the *Saint André* to areas of historically lower skate by-catch had resulted in ~30% lower catch rates of skates, as well as a greater than 50% reduction in total numbers of skates caught. It also noted that the reported condition of skates had changed from 100% dead in 2011/12 to 100% in 'average' condition and all released alive in 2012/13. It requested that France provide details on what operational changes made on board the *Saint André* may assist with reducing skate mortality across the Convention Area.

6.63 The Working Group also recommended that the move-on rule and requirement to release all skates with a high likelihood of survival continue to apply to research fishing by the *Saint André* in 2013/14.

6.64 The Working Group noted that a maximum soak time of 30 hours had also applied to the *Saint André* to attempt to increase the survivorship of skates. It noted that the data collected in 2012/13 indicated that there was no obvious relationship between depth, soak time or number of skates caught, apart from the overall decrease in numbers of skates noted above.

6.65 The Working Group agreed that the same restrictions for maximum soak time apply in 2013/14. The Working Group also requested that, to provide a basis for evaluating the effect of soak time on skate condition, France consider conducting an experiment to collect data on the condition of skates across a range of depths and soak times in an analogous area such as in Subarea 58.6, and provide an analysis to the next meeting of WG-FSA.

6.66 The Working Group noted that the alternative biomass estimates for this division were uncertain, with the CPUE analogy method indicating a substantially higher biomass than the Petersen estimate (Table 12). However, it agreed that as the Petersen estimate was based on tags relased and recaptured only on the western end of Elan Bank, the total research catch

limit of 32 tonnes agreed last year was likely to result in sufficient tag recaptures to substantially refine the stock assessment next year, as well as constituting a sufficiently low-risk harvest rate for the coming season. The Working Group further recommended that Japan and France age otoliths from planned and past research catches to facilitate the development of season specific ALKs.

6.67 The Working Group recommended a total research catch limit of 32 tonnes for Division 58.4.3a for 2013/14 and presentation of updated biomass estimation and integrated assessment at WG-FSA-14 by the research proponents.

6.68 The Working Group noted that due to the constraints on the locations on research fishing agreed in the Commission last year, effort was mainly concentrated in the west of Division 58.4.3a. Recalling the positive example of research on Ob and Lena Banks (Divisions 58.4.4a and 58.4.4b) using a spatial grid design, it agreed that spreading effort across the relatively small fishable area in this division was likely to provide more robust data for stock assessment. Therefore it recommended that a minimum of five research sets, separated by at least 3 n miles, be conducted by each vessel east of the 70°E meridian. Thereafter research sets, as defined in CM 41-01, could continue within the research block defined in 2012.

6.69 The Working Group recommended that at least 10 tonnes of catch be available to each Member fishing in Division 58.4.3a to maximise the opportunity that both vessels are able to complete the minimum number of research sets in 2013/14.

Subarea 48.2

6.70 The Working Group considered a proposal by Ukraine to undertake exploratory fishing on *Dissostichus* spp. in the depth range 600 to 2 000 m in Subarea 48.2 in 2013/14, 2014/15 and 2015/16 in accordance with CMs 24-01 and 41-01 (WG-FSA-13/46). The aim of the program is to provide CCAMLR with the data necessary to estimate biomass of *Dissostichus* spp. in Subarea 48.2.

6.71 An earlier proposal had been reviewed at the meeting of WG-SAM (WG-SAM-13/15). A number of suggestions for improving the survey were made and resubmission was encouraged (Annex 4, paragraphs 3.14 to 3.21). However, the revised proposal was virtually unchanged.

6.72 The Working Group noted that the proposed research plan did not follow the CCAMLR template, was incomplete and was therefore difficult to assess, and recommended that future research plans should closely follow the standard format.

6.73 The proposal was revised at the WG-FSA meeting taking into account some of the concerns raised by WG-SAM. Dr L. Pshenichnov (Ukraine) explained that in the revised proposal:

(i) fishing would be conducted on two oceanic banks north of the South Orkney Islands

(ii) the extension of the western bank is 5 893 km^2; that of the eastern bank, 12 735 km^2

(iii) the type of longline would be trotline

(iv) distance between sets would be at least 5 n miles

(v) each line would carry 2 500 hooks

(vi) in the rare cases that the rough bottom topography may require shorter lines, 2 000 hooks or less will be used.

6.74 He also explained that the tagging rate would be five fish per one tonne of fish caught and the tag-overlap statistic would be >60%, preferable higher. The weighted line has a sink rate large enough to minimise risk of seabirds to become attracted to the baited line. In addition to the CCAMLR scientific observer, a national observer will also be on board the vessel. The survey will be conducted in north–south direction in 2014 and west–east direction in 2015. Experience obtained during the 2014 survey may lead to alterations in the conduct of the survey in 2015. The direction of the survey in 2016 is yet to be decided. The catch will be limited to 25 sets and 50 tonnes.

6.75 The Working Group considered that it was still unclear as to exactly what research is to be undertaken in the course of the surveys and noted that no reference had been made to a previous survey by Chile in 1998 (Arana and Vega, 1999).

6.76 The Working Group recommended:

(i) The target tag-overlap statistic be increased to at least 80%. The reason was that the vessel proposed for the survey had a poor record with respect to tag-overlap statistics in the Ross Sea in the previous season. Ukraine related the problem of poor tag-overlap statistics to an inexperienced observer present during the cruise and his difficulty to tag large fish. The Working Group stressed (again) that tagging is the responsibility of the vessel and not of the scientific observer.

(ii) A risk assessment be conducted with respect to potential impacts on VMEs and other components of the ecosystem (Annex 4, paragraph 3.20) while by-catch of seabirds is minimised by a fast sinking rate of the weighted line.

6.77 Some Members noted that the papers and information provided by Ukraine did not constitute a research plan as required by CM 24-01, Annex 24-01/A, format 2. They considered that providing research proposals in the format which is detailed in CM 24-01/A, format 2, was essential to enable a proper evaluation of the merit of the research on *Dissostichus* spp. by WG-SAM and WG-FSA, so that the Scientific Committee had a basis for approving any research plans.

6.78 Dr Pshenichnov stated that the scientific research plan proposed by Ukraine for Subarea 48.2 fully meets the requirements of CMs 24-02 and 21-02 and was submitted using the format (CM 24-01, Annex 24-01/A, format 2) conforming with the review procedure at WG-SAM-13, and subsequent to recommendations made by WG-SAM, the revised proposal was submitted to WG-FSA. He clarified that:

(i) the area of proposed research was reduced and potential catches to be taken during the research were identified

(ii) all recommendations were included in the research plan

(iii) Ukraine's proposed fishing effort amounts to 25 sets (trotline), and the catch to be taken in this area, which is more than two times smaller than first proposed, would be less than 50 tonnes

(iv) the catch limit is calculated according to the recommendation contained in SC-CAMLR-XXX, Annex 5, Table 2

(v) Ukrainian scientists expect that the research could be carried out over three seasons (three years) with a further increase in the size of the study area, which would make it possible to obtain data from a previously unstudied area and estimate the biomass of *Dissostichus* spp. and their anticipated depth distribution in the proposed study area

(vi) the research goals contained in the Ukrainian research plan and the expected results are priorities for the work of the Scientific Committee and the Commission.

6.79 Some Members recommended that a complete proposal for research by Ukraine be submitted for review by WG-SAM and WG-FSA next year, taking account of the advice provided in WG-SAM-13 and WG-FSA-13, and in the correct format as described in CM 24-01, Annex 24-01/A, format 2, before any Ukrainian fishing vessel is approved to conduct research on *Dissostichus* spp. in Subarea 48.2.

Subarea 48.5

6.80 Research fishing for *Dissostichus* spp. in Subarea 48.5 was conducted by Russia using longlines (WG-FSA-13/11). A total reported catch of 60 tonnes was taken in eight research sets.

6.81 The Working Group noted that the research plan for Subarea 48.5 (WG-FSA-13/09) incorporated the advice from WG-SAM (Annex 4, paragraphs 3.6 and 3.7).

6.82 The research plan presents three options for 2013/14 to give flexibility depending on ice cover. Options 2 and 3 are unchanged from WG-FSA-12/12, whereas Option 1 is revised on the basis of the research conducted during 2012/13.

6.83 There was some discussion on the suitability of the survey area specified in Option 3 due to concerns of vessel safety and the perceived limited opportunity to undertake multi-year research. The Working Group recalled advice with respect of ice conditions contained in the report of WG-FSA-12 (SC-CAMLR-XXXI, Annex 7, paragraphs 5.105 and 5.106).

6.84 The survey area proposed under Option 1 in WG-FSA-13/09 included a small area of the slope to the east of the fast-ice and adjacent to the survey area for Option 2 and a larger area to the west of the fast-ice. The Working Group recommended that the area adjacent to Option 2 be combined with the survey area proposed for Option 2.

6.85 The Working Group supported the proposal to define a research block encompassing the area surveyed during 2012/13 which would be in the biomass estimation phase (Figure 10). The remainder of the survey area under Option 1 is still in the prospecting phase (Figure 10).

6.86 The Working Group recommended that that research block be bounded by 74°42'S–74°32'S and 27°15'W–28°40'W with a catch limit of 60 tonnes, which corresponds to an estimated exploitation rate of 2.3% and an expectation of 5–6 recaptures of tagged fish (Table 13). To ensure a spread of effort within the research block, 50% of the longlines must be separated by a minimum of 3 n miles and the remaining 50% can be set anywhere within the research block (CM 41-01).

6.87 The remaining area under Option 1 in the Prospecting Phase will be effort limited. The Working Group recommended a maximum of 40 longline sets of not more than 3 600 hooks per set and sets should be separated by a minimum of 5 n miles. In addition, a maximum catch limit of 213 tonnes shall apply (Table 13).

6.88 Options 2 and 3 are both effort-limited prospecting surveys and shall use longline sets of not more than 3 600 hooks per set and sets should be separated by a minimum of five (5) n miles. Option 2 shall have a maximum of 40 sets and a catch limit of 48 tonnes. Option 3 shall have a maximum of 80 sets and a catch limit of 112 tonnes.

6.89 The Working Group stressed the importance of collecting more than the standard requirement of biological data (length frequency, sex ratio, maturity and age) from research in areas such as this that are in a relatively pristine state as this will enable the tracking and documentation of future population changes in response to exploitation. The Working Group noted that the requirement for a minimum tag overlap of 60% was the minimum under the conservation measure, but recommended that research vessels should attempt to achieve a considerably higher tag-overlap statistic.

Division 58.4.4

6.90 Research fishing for *Dissostichus* spp. in Division 58.4.4 was conducted by Japan using longlines and the total reported catch in 2012/13 was 31 tonnes taken in the allocated research blocks (SC-CAMLR-XXXII/BG/01).

6.91 Three papers were submitted for review regarding the research plan in Division 58.4.4 by Japan (WG-FSA-13/34, 13/35 and 13/36). WG-FSA-13/34 described the biological data collected during 2013 in SSRUs C and D, including CPUE, length, weight, condition and suitability to tag. Overall, 30% of fish were single hooked and in good condition to tag across the size distribution. Three tagged fish were recaptured in 31 tonnes of landed catch and all three fish had been at liberty for at least two years. There were no instances of cetacean depredation.

6.92 WG-FSA-13/35 presented an update on the stock assessment of *D. eleginoides* in Division 58.4.4 SSRU C on Ob and Lena Banks. It followed advice of WG-SAM-13 (Annex 4, paragraphs 3.27 and 3.28). The Working Group noted that this model was still in development and showed evidence of lack of convergence, although the base-case 2013 MPD biomass estimate was similar to the raw Petersen biomass estimate. However, the MCMC traces were unstable and indicated much higher biomasses than the MPD runs, and the models including IUU catch provided conflicting information.

6.93 The Working Group carried out further sensitivities on the run with 25% of the assumed IUU fishing in Division 58.4.4 occurring in SSRU C. It concluded that the tag data suggested lower stock biomass than can be achieved with the assumed level of IUU fishing, that length frequencies were largely uninformative and that estimating the growth parameters inside the model was likely the cause of the instability in the MCMC trace. The Working Group concluded that this model (25% IUU) was unsuitable to provide advice at this stage. The Working Group recommended:

(i) the use of the biomass estimates derived from the base-case model

(ii) that the growth parameters be estimated outside the model in the future

(iii) that the amount of IUU fishing in this area and other areas be estimated within the model

(iv) the sensitivity of scenarios to alternative selectivities by the IUU fleet be evaluated, noting that gillnetting is thought to be the dominant catch method used by IUU vessels

(v) that fish be aged with the aim of providing annual ALKs and age frequencies in future models.

6.94 The Working Group also noted that as this stock assessment becomes more robust, the Working Group will need to consider the mechanism by which data-poor fisheries with research plans are transitioned into open exploratory fisheries with approved assessments. The Working Group noted that the Division 58.4.4 research plan is now catch-limited (biomass estimation – assessment development phase) (Table 11).

6.95 The Working Group noted the revised research plan and proposed local biomass estimates described in Table 13, using a revised number of tags released and available for a Petersen estimate (548 tonnes), and the base-case integrated model estimate of B_{2013} (635 tonnes).

6.96 The Working Group recommended the integrated model estimate be used to estimate the catch in SSRU C that would not exceed 4% exploitation rate. The Working Group recommended a catch limit of 25 tonnes for SSRU C with an expected recapture of nine tags.

6.97 The Working Group recommended the following catch limits. The catch limit for SSRU D, which has no stock assessment, was assigned by scaling up the biomass estimated in SSRU C by the seabed analogy method. This resulted in a recommended catch limit of 35 tonnes for SSRU D. Accordingly, the total catch limit for combined SSRUs C and D is 60 tonnes.

6.98 The Working Group agreed that in 2013/14, the *Shinsei Maru No. 3* would first complete research sets in each grid square as in 2012/13, and then be able to fish anywhere within the research block until the research catch limit is reached.

Subarea 88.3

6.99 The Working Group considered WG-FSA-13/12 which was a proposal by Russia to open Subarea 88.3 as an exploratory fishery. The Working Group recalled its discussion of this topic at its 2012 meeting (SC-CAMLR-XXXI, Annex 7, paragraphs 5.144 to 5.148). The Working Group agreed that any proposal to fish in this subarea should conform to the research plans identified in CM 24-01, Annex 24-01/A, format 2, and be considered within the data-poor fisheries framework. It encouraged Members to include Russian data when designing such research proposals.

VMEs

Ross Sea

7.1 WG-FSA-13/41 provided a revision of a paper submitted to WG-FSA in 2012 (WG-FSA-12/27). The original paper had been discussed at WG-FSA-12.

7.2 The paper compared the comparative catch rates of VME species by Spanish longlines and autolines in Subarea 88.1. The authors found that both the probability of observing by-catch and the weight of by-catch, when observed, declined with increasing depth for both gears, but at different rates. Within a series of large spatial blocks, the authors estimated the difference in rate at which the VME taxa were assumed to drop off the autoline gear compared to the Spanish gear while the gear was being retrieved. By using a Bayesian approach, the authors estimated that despite considerable uncertainty of the estimate, five times more VME indicator units were likely to have dropped off the autoline at 600 m depth compared to the Spanish system. The authors suggested that limiting the use of autolines might reduce the by-catch of VME taxa and might provide a precautionary approach to mitigating impact on VMEs.

7.3 The Working Group reiterated many of the criticisms it had expressed with respect to WG-FSA-12/27 in 2012 (SC-CAMLR-XXXI, Annex 7, paragraphs 6.1 to 6.3). Although the authors had addressed the Working Group's concerns about the modelling of zero values when estimating comparative catch rates, they had not addressed the main Working Group's criticism. Many Members of the Working Group felt that the model used as a basis of the analysis was inappropriate to estimate the impact of bottom longlines on VME taxa.

7.4 The analysis assumes that the observation of VME taxa by-catch at the surface (after a model adjustment) is indicative, or related to, the effects of the gear on the seabed. The Working Group disagreed with this assumption because the actual effects of any of these fishing gears on the benthic organisms encountered are unknown and are likely to require empirical (video) observations. The Working Group noted that theoretical models of drop-off rates cannot be used as a basis for advice on the impact of the gear without experimental data.

7.5 The Working Group noted that the analysis assumes that all fishing effort within the large areas defined (tens of thousands of square kilometres) encounters the same benthic communities. However, analyses to date (e.g. WG-FSA-10/30) have demonstrated that VME taxa are likely to be clustered and can vary dramatically at much smaller scales (tens of square kilometres). This was the rationale behind the previous Working Group suggestion that the authors consider using a spatial case-control study design (WG-FSA-12/47 Rev. 1; SC-CAMLR-XXXI, Annex 6, paragraph 6.3).

7.6 The Working Group further noted that more data (and perhaps more reliable data, as observers had become used to recording VME catches) exist from 2012 and 2013 that could be included in such an analysis. Catchability is likely to be different among different VME taxa so that combining weights (or volumes) of VME taxa is unlikely to be appropriate, especially as different taxa may have different spatial distribution patterns.

7.7 The model applied corrected by-catch observations across depth by applying a depth correction factor to inflate catches. The Working Group noted that the inflation factor and the formulation in which it was applied were based on a fixed depth but applied as a depth-related factor and could find no basis for this. In addition, the Working Group noted that the authors had not included the catches of the target fish species and/or by-catch species in the analysis which would impact haul times and potentially drop-off rates. The Working Group reiterated its opinion that experimental data is needed to condition such models.

7.8 The implications of this work also need to be evaluated relative to the already established CCAMLR bottom longline impact assessment method and conclusions of the Scientific Committee regarding cumulative impacts. The actual amount of by-catch CPUE (even resulting from the worst-case scenario of the model) is small. This should be contrasted with the known relative impacts on the ecosystem of the two gears. For instance, changes in gear type may have other implications for other parts of the ecosystem.

South Georgia

7.9 WG-FSA-13/58 identified six areas with relatively high densities of VME indicator taxa on the South Georgia shelf, during a demersal fish and ecosystem survey which deployed dredge sampling gear at depths of less than 500 m in April–May 2013. These areas were characterised by a high diversity of benthic organisms while being dominated by two VME indicator groups, Porifera and Ascidiaceae.

7.10 The Working Group recommended the authors forward the proposal for consideration by WG-EMM-14, noting that CMs 22-06 and 22-07 do not apply in Subarea 48.3 (CM 22-06, paragraph 1, and CM 22-07, paragraph 1).

Register of VMEs

7.11 The Secretariat presented information on registered VMEs and VME Risk Areas and fine-scale rectangles using a prototype web-based GIS which is being developed jointly with the British Antarctic Survey. This web-based GIS will provide state-of-the-art capacity for displaying geo-referenced data relevant to CCAMLR (WG-EMM-12/70). The prototype is

currently located at gis.ccamlr.org and contains basic data layers (e.g. management areas, bathymetry, sea-ice). The project is being implemented in two stages, with stage 1 nearing completion and stage 2 being implemented in 2014. The Working Group welcomed this development as it provided a standardised way to display spatial data both in publications and during working group meetings.

7.12 The Working Group noted that no new VME notification had been submitted under CM 22-06 in 2012/13. Since 2008, the Secretariat has received a total of 46 notifications of encounters with VMEs: 22 notifications in Subarea 48.1; 13 in Subarea 48.2; two in Division 58.4.1; and nine in Subarea 88.1 (see Report on Bottom Fisheries and VMEs at www.ccamlr.org/node/75667). All notified VMEs are currently afforded protection through specific area closures in Division 58.4.1 and Subarea 88.1 (CM 22-09), and general closures to bottom fishing activities in Subareas 48.1 and 48.2 (CMs 32-02 and 32-03).

7.13 The Working Group noted that five VME indicator notifications were submitted in accordance with CM 22-07 in 2012/13. These notifications were made in Subareas 88.1 (one) and 88.2 (four), and resulted in the declaration of a new VME Risk Area in Subarea 88.1. Since 2008, the Secretariat has received a total of 155 VME indicator notifications from exploratory bottom fisheries: one notification in Subarea 48.2, two in Subarea 48.6, 104 in Subarea 88.1 and 48 in Subarea 88.2. No notification has been received from exploratory fisheries in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b. These VME indicator notifications have led to the declaration of 64 VME Risk Areas: 48 risk areas in Subarea 88.1 and 16 risk areas in Subarea 88.2. In addition, six VME fine-scale rectangles in Subarea 88.1 and two in Subarea 88.2 have been identified.

7.14 Details of registered VMEs and VME Risk Areas and fine-scale rectangles, and analysis of the impact of bottom fishing on VMEs, are contained in the Report on Bottom Fisheries and VMEs (www.ccamlr.org/node/75667).

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

8.1 In accordance with CCAMLR's Scheme of International Scientific Observation (SISO), scientific observers were deployed on all vessels in all finfish fisheries in the Convention Area in 2012/13. Information collected by scientific observers was summarised in WG-FSA-13/68 Rev. 1.

SISO review

8.2 The Working Group reviewed recommendations from the external SISO review by an expert panel carried out intersessionally focusing on items that were WG-FSA issues or relevant to the work of WG-FSA. SC-CAMLR-XXXII/07 Rev. 1 summarised the findings of this review.

8.3 The Working Group noted that the review made recommendations across a range of topics in SISO, however, it primarily considered those recommendations that related to the work of WG-FSA, in particular ensuring that observer data are of the highest quality and consistent across the Convention Area.

8.4 Dr Petrov noted that the issue of state accreditation for scientific observer training programs, as recommended in SC-CAMLR-XXXII/07 Rev. 1, should be considered by the Commission and that, in his opinion, the proposal is in conflict with Article XXIV of the Convention, which emphasises that all Members may appoint a scientific observer or an inspector in the Convention Area.

8.5 The Working Group noted the recommendation to change the requirement for observer data to be submitted within one month of the last fishing day rather than within one month of return to port. The Working Group concluded that data could be submitted from the vessel while still at sea when the vessel exits a subarea, for preliminary checking and loading into the CCAMLR database with an embargo on release until approved by the Designating and Receiving Members. It noted that such a procedure would improve timely access to observer data, as well as ensuring that data-checking procedures that Members may conduct after a voyage are accommodated. The Working Group also recommended the use of a more compact format for data transmission from the vessels, such as XML, to facilitate timely data submission.

8.6 The Working Group noted recommendations to revise and update Annex 1 of the Text of the Scheme of International Scientific Observation and for CCAMLR to progressively reassess the tasks and functions for observers reflecting the contemporary status of the scheme. The Working Group recommended that such reviews take place biennially to alternate with the stock assessment cycle, and that WG-EMM and WG-FSA could consider these priorities in parallel. In addition, the Working Group agreed with the recommendation for more wide-ranging reviews of SISO on a five-yearly timescale.

8.7 The Working Group endorsed the recommendation that all sampling requirements additional to the 'standard' set of measurements be agreed by all parties prior to embarkation of an observer and that a summary of any additional sampling should be highlighted in the cruise report. It also noted a need to clearly define the role, responsibilities and priorities of the observer with respect to data collection.

8.8 The Working Group noted the recommendation to allow a longer period (until the next season after the changes are endorsed) between changes to observer sampling being included in documentation provided across all CCAMLR fisheries. However, the Working Group agreed that changes that do not require structural changes to the e-logbook (e.g. revised sampling targets for routine measurements in the observer sampling requirements document) should be able to be implemented in the season following their adoption. Other changes that may require substantive changes may require a longer time frame for implementation and change.

8.9 The Working Group agreed that the recommendations and solutions in Annex 1 of the Text of the Scheme of International Scientific Observation relating to observer tasking and workloads were constructive.

8.10 In respect to Appendix 2 of SC-CAMLR-XXXII/07 Rev. 1, the Working Group noted that although this was a good summary of priorities, there was a further need for an easily accessible document detailing sampling requirements on an annual basis. It also noted that paragraph 2(ii) of Appendix 2 of SC-CAMLR-XXXII/07 Rev. 1 should be altered to make it clear that observers are required to collect otoliths, but not age estimates.

8.11 The Working Group agreed with the recommendation from the review that a mechanism to implement the CCAMLR Observer Training Accreditation Scheme (COTPAS) would be of benefit to the work of WG-FSA, especially in providing greater confidence that all observer data was collected in a similar way.

8.12 The Working Group noted that it was unable to consider all the relevant recommendations in the SISO review, and requested that the Scientific Committee implement a suitable mechanism to ensure all the recommendations are evaluated.

Observer sampling requirements

8.13 To communicate the sampling requirements for longline fisheries, the Working Group developed a table of observer sampling requirements for *Dissostichus* spp. by division (Table 15) for 2013/14. The Working Group agreed that this table should be a stand-alone document accessible on the CCAMLR website and updated annually after the Scientific Committee and Commission advice is finalised, to facilitate revision of sampling targets in different fisheries and for measurements routinely collected by observers. The Working Group recalled that similar information was included in CM 41-01 until 2011.

8.14 The Working Group noted previous recommendations of the importance of gonad weight data (paragraphs 3.22 and 3.25; SC-CAMLR-XXIX, Annex 8, paragraph 8.14) and recommended that all Members with motion-compensating scales on board their vessels begin routine collection of gonad weight data as part of biological sampling in 2014, but that the Scientific Committee consider implementing a requirement for observers to collect gonad weight data in all exploratory fisheries and in research plans under CM 24-01 and that this requirement could be implemented through the observer sampling requirements document (Table 15). The Working Group also recommended that information about the use, reliability and cost of motion-compensating balances for measuring gonad weights would be useful in choosing appropriate equipment for this task and encouraged these data be submitted in a timely manner for consideration next year.

Tagging training

8.15 The tagging training module (paragraph 3.28; SC-CAMLR-XXXI, Annex 7, paragraphs 5.175 and 5.181) was updated during the meeting and the Working Group recommended that it be made available to Member technical coordinators electronically (perhaps via the Scientific Committee representatives) for trial and feedback from the various observer programs and from vessel crew. Feedback from Members after the main fisheries have occurred (e.g. April) would be useful to determine the translation need for this training product, especially for vessel crew, so that a final version can be made available in time for distribution with tagging supplies in 2014.

8.16 The Working Group noted that the diagrams requested for the assessment of tagging suitability have been added to the tagging checklist (SC-CAMLR-XXXI, Annex 7, paragraph 5.169), and recommended that this document be laminated and made available to vessels for display near tagging stations as part of the tagging supplies kit (translated versions available from SC-CAMLR-XXXI, Annex 7, Appendix D).

8.17 WG-FSA-13/54 reviewing CCAMLR tagging programs was presented and appears under paragraphs 3.27 and 3.28.

NON-TARGET CATCH IN CCAMLR FISHERIES

Fish

9.1 Skates (Rajiformes) are a frequent by-catch in some toothfish fisheries (see, for example, WG-FSA-13/04). Data for skates in the CCAMLR area are both limited and of variable quality. In the absence of sufficient data for reliable stock assessments for the various skate species, the Working Group noted that ecological risk assessments (ERA) and productivity susceptibility analyses (PSA) could usefully be investigated, especially using spatially explicit approaches. It was highlighted that assessing skates could be species-specific or for the complex as a whole. Such assessments could be used by CCAMLR to direct future conservation efforts at the by-catch species that are most at risk from fishing. Such methods would benefit from an improved knowledge of selected life-history parameters (e.g. fecundity, length/age-at-maturity) and more accurate knowledge of spatial and bathymetric distributions, and it was recommended that such information is collected.

9.2 WG-FSA-13/28 provided a literature review of the current knowledge of elasmobranchs in the Southern Ocean and additional data are available from the CCAMLR database. Appropriate data checks are required to maximise the utility of the latter, and there needs to be future consideration of which further data could usefully (and pragmatically) be collected.

9.3 Tagging programs for skates are one of the data sources held by CCAMLR, and WG-FSA-13/22 provided an up-to-date analysis of the Australian skate tagging program in Division 58.5.2. Similarly to previous studies reported to WG-FSA, the overall return rate for skates was low (<1%). There are several factors that could contribute to this low return rate, such as a high mortality of tagged fish, high rates of tag loss, low rates of tag detection/reporting, emigration, or large population size. WG-FSA-13/22 noted that 68% of skates double-tagged on release only had a single T-bar tag on recapture, suggesting tag loss may be an issue. Tag type and/or tagging protocols (which may affect both tag retention and post-tag survival) could usefully be re-evaluated. Skate tagging programs elsewhere in the world have often used dart tags, Petersen discs or Rototags (WG-FSA-13/33), and return rates in these studies have generally been higher, although return rates are a factor of both the exploitation rate and tag-loss rate. The Working Group recommended that: skate tag-return data are fully examined from across the Convention Area to better check data quality and to evaluate tag loss (shedding); studies to better examine the retention of the current T-bar tags in comparison to alternative tags for skates should be encouraged (with the Working Group also noting that such studies could be undertaken more effectively in less remote sea areas); and, further studies on post-tagging survival (short and longer term) could also be usefully undertaken. Australia noted that it intends to compare the performance of T-bar tags and Rototags in 2014.

9.4 Given the apparent negative growth noted from some recaptures in WG-FSA-13/22, the accuracy of length measurements for skates was discussed by the Working Group. The length data presented in WG-FSA-13/22 had no asymptote, suggesting that the fishery does

not sample the largest skates. Skates can be measured in various ways (total length, disc width, disc length, pelvic length) and recording multiple dimensions for tagged and recaptured fish may help improve data quality. Other approaches to ensure improved data collection and data checks should also be investigated.

9.5 WG-FSA-13/18 reported on accidental catches of *C. gunnari* taken in two hauls by a krill vessel operating off the northwestern slope of the South Orkney Islands shelf (Subarea 48.2) in April 2013. One tow contained 4.6 tonnes and another 0.4 tonnes.

Seabirds and marine mammals

9.6 WG-FSA-13/68 Rev. 1 summarised incidental mortality of seabirds and marine mammals in the CAMLR Convention Area during 2013. The total extrapolated incidental mortality of seabirds in all longline fisheries in the area during 2013 was 141 seabirds (the lowest ever recorded). There were two reported mortalities of southern elephant seals (*Mirounga leonina*) in longline fishing in Division 58.5.2 during 2013.

9.7 WG-FSA-13/06 examined the incidental catches of seabirds in the French EEZ of Kerguelen (Division 58.5.1) and Crozet (Subarea 58.6) and the Working Group noted that this data indicated that seabird mortality has decreased from 1 297 (2007/08) to 124 seabirds (2012/13, season ongoing), which is a decrease of c. 90%.

9.8 WG-FSA-13/19 proposed extending the fishing season in the Patagonian toothfish longline fishery in Division 58.5.2 by two weeks (so including the period 1–14 November) on a trial basis during 2013/14 and 2014/15. This document detailed that only 12 incidences of seabird by-catch had been reported in this division since 2003 (for the whole season including extensions), that current seabird by-catch mitigation measures would be continued, and that the season extension would still be subject to a total catch limit of three seabirds per vessel. WG-FSA-13/20 proposed extending the trial of daytime setting of longlines between 15 and 30 April in the same fishery to encompass the 2013/14 and 2014/15 fishing seasons. No seabird mortality has been observed during April longline fishing in either day or night sets. However, fishing effort has been low during the pre-season extension period to date and further trials are necessary to determine if mitigation is effective. The Working Group was supportive of these proposals.

9.9 WG-FSA-13/32 discussed season extensions in the Patagonian toothfish fishery in Subarea 48.3. No seabirds were killed during the extension in either 2012 or 2013, and it had been proposed that the start date of the main season be brought forward to 16 April, and that two further trial extensions (starting 6 April in 2014 and 1 April in 2015) be allowed. The extensions would have the same conditions as previous extensions, including a by-catch limit of three seabirds per vessel. The Working Group was supportive of these proposals.

BIOLOGY AND ECOLOGY

D. mawsoni

10.1 The Working Group welcomed the thorough presentation of the results of the first year of Russian research in the Weddell Sea (WG-FSA-13/11), including data on size frequency and diet, as well as details of the ageing of fish from that research (WG-FSA-13/16). In particular, the Working Group noted the importance of obtaining data on the age-structure of the unfished population of *D. mawsoni* in the Weddell Sea.

10.2 The Working Group noted the potential benefits of collaboration between Members undertaking age determination of *D. mawsoni* otoliths and encouraged those Members to collaborate to ensure comparability and repeatability between ageing studies.

10.3 Analysis of the genetics of *D. mawsoni* from an extensive geographic range, including from the Ross Sea, Indian Ocean and Atlantic sectors, was presented in WG-FSA-13/07. This revealed a lack of differentiation between stocks, in contrast to previous work that indicated that *D. mawsoni* in the Ross Sea showed genetic differentiation. The Working Group encouraged the use of genetic sampling to better understand the stock structure and evolutionary biology of *D. mawsoni*, particularly where genetic markers can reveal the time period through which a lack of genetic differentiation might arise.

10.4 The potential spawning areas and timing of *D. mawsoni* in the Pacific, Indian and Atlantic sectors were presented in WG-FSA-13/25 and indicated that spawning probably occurs over an extended period during winter with the exact timing varying by location. This analysis showed that:

(i) in the Pacific Antarctic sector, spawning could occur in SSRUs 882H and D in the Amundsen Sea and in SSRU 5841E in the Mawson Sea in the Indian Ocean sector

(ii) in the Ross Sea, spawning of *D. mawsoni* probably occurs from June to August, in the northern underwater rises and seamounts, located at 69°–75°S at a depth of 1 300–1 600 m, especially in SSRUs 881H and I.

10.5 An analysis of the reproductive potential of *D. mawsoni* in SSRU 5841C during 2013 (WG-FSA-13/43) provided broadly consistent results with those in WG-FSA-13/25, however, the Working Group noted that while there had been a large number of papers on fish maturity studies presented to the Working Group, a lack of common terminology and nomenclature for macroscopic and histological staging made an overall synthesis of maturity data problematic. The Working Group recalled that macroscopic staging had proved problematic and encouraged the routine measurement of gonad weight by observers which would be desirable, but would only be possible on vessels where motion-compensated scales are available.

10.6 The analysis of diet of *D. mawsoni* from the Indian Ocean and Weddell Sea was presented in WG-FSA-13/11, 13/42 and 13/43 and indicated a broadly consistent pattern of occurrence of by-catch species as well as squid and some invertebrates. The Working Group agreed that a combination of direct analysis of prey remains (WG-FSA-13/11 and 13/43), as well as the use of biochemical markers and isotopes (WG-FSA-13/42) was likely to provide the best understanding of diet and trophic interactions involving *D. mawsoni*.

Subarea 48.3

10.7 Ms A. Zavatteri (Argentina) and Dr Marschoff presented a series of papers describing the results of multidisciplinary research in Subarea 48.3, including bottom trawls, acoustics and oceanographic sampling conducted by Argentina (WG-FSA-13/58, 13/59, 13/60, 13/61, 13/62 and 13/65). The Working Group welcomed these papers and noted:

(i) the presence of a spatially restricted population of Pike icefish (*C. esox*), a species usually associated with the southern Patagonian shelf, on the inshore shelf area north of South Georgia

(ii) that comparison of the time series of length-frequency data of *C. gunnari* from the early 1990s to 2013 indicated a steady increase in the proportion of adult fish in the population, suggesting that the stock collapse in the early 1990s was due to recruitment failure, possibly due to overfishing

(iii) indications of a strong 0+ class (4–10 cm) of *C. gunnari* that was not evident in the UK trawl survey (WG-FSA-13/17) could indicate strong recruitment but might also be attributed to differences in timing of the surveys, selectivity of gear (including the use of a smaller mesh net liner on the Argentinian survey) and/or temporal changes in the vertical distribution of these small fish associated with low food availability in the water column (a shift from a pelagic to a benthic habitat in response to low plankton availability) meaning that they are more likely to be sampled with a bottom trawl

(iv) that details of the presence of VME indicator taxa presented in WG-FSA-13/58 should be forwarded to WG-EMM for further consideration.

10.8 The Working Group noted that a review of decadal trends in the fish assemblage from UK research surveys in Subarea 48.3 (WG-FSA-13/26) indicated that there was evidence of:

(i) a temporally consistent pattern of species diversity, including low species diversity at Shag Rocks compared to the South Georgia shelf and particular locations of higher diversity associated with fjords

(ii) little change in the species occurrence composition over the past three decades, however, *Patagonotothen ramsayi* (a Patagonian shelf species) had been noted at Shag Rocks in the last five years

(iii) an increasing trend in overall CPUE that was primarily driven by a steady increase in catches of marbled rockcod (*Notothenia rossii*), indicating a slow recovery of this species following overfishing in the 1970s.

10.9 The Working Group encouraged other Members with time series of surveys to provide similar reviews and to investigate comparison with the time series of fish assemblage data from other parts of the Convention Area. The Working Group also noted that temporal changes in fish assemblages could usefully be viewed in conjunction with the long time series of the fish diet of seals and penguins at South Georgia to provide insights into ecosystem dynamics of the region.

10.10 The Working Group agreed that, in addition to the effects of historic overfishing, consideration should be given to potential environmental/oceanographic changes that might be driving more recent changes in fish assemblages.

10.11 The Working Group thanked the authors of a whale photo-identification manual (WG-FSA-13/08), and noted that this provided a comprehensive and accessible guide that allowed the collection of photographs of whales by vessel crew and observers that could be cross-referenced with photo archives for the Convention Area and adjacent waters. The Working Group noted that collection of the identification data of individual whales associated with fishing vessels could provide insights into the patterns of depredation, as well as on the range and movements of individual whales, and requested that this guide be made available to observers via the CCAMLR website.

FUTURE WORK

11.1 The Working Group considered a proposal to hold a stock assessment training workshop in 2014 at the CCAMLR Secretariat in the week prior to the meeting of WG-FSA. The workshop would provide hands-on training in stock assessment with focus on CCAMLR fisheries and CASAL, and would be 2–3 days in duration. The workshop may include experts from outside the regular CCAMLR meetings.

11.2 The Working Group agreed to form a CCAMLR webgroup to explore the requirements for such training and develop the workshop arrangements.

11.3 The Working Group requested the Scientific Committee to consider its recommendation for the work of WG-SAM when determining the priorities for that working group in 2014.

Notification of scientific research

11.4 A revised proposal submitted by Chile (WG-FSA-13/10) for a three-year research study commencing in 2014 using a midwater trawl survey on finfish in Subareas 48.1 and 48.2 was reviewed by the Working Group. The Working Group noted that considerable progress has been made in the revised proposal and most of the requests made by WG-SAM-13 have been addressed. The sampling methodology will be a random stratified midwater trawl survey. The trawl will have a vertical opening of about 30 m and each tow will have a duration of 30 min. The acoustic transects will be made independently during the non-fishing periods.

11.5 The Working Group agreed that the plan to compare the fish assemblage sampled with bottom trawl versus a midwater trawl in a small area to the west of Elephant Island, where there is no evidence of VME occurrence, would be of great interest.

11.6 In response to a request from the Working Group for a clearer understanding of the distribution of the effort, Prof. P. Arana (Chile) indicated that area and distribution of hauls

will be similar to that of the *Polarstern*'s previous cruises in 2007 and 2012. He also informed the Working Group that invitations to participate have been offered to Drs C. Jones (USA) and Kock.

OTHER BUSINESS

Accessibility and availability of working group papers

12.1 The Working Group noted that the new CCAMLR website had delivered a greater awareness of the large archive of working group papers and welcomed the proposal in SC-CAMLR-XXXII/10 on how these papers might be made publically available. This paper provided a revision of WG-SAM-13/17 and incorporated the comments of both WG-SAM and WG-EMM, particularly in respect of (i) the issue of prior publication where making working group papers available in the public domain might compromise the subsequent publication in the peer-reviewed literature, and (ii) a disclaimer that makes it clear that the paper has not been reviewed by CCAMLR, that the content of the paper does not necessarily reflect the views of CCAMLR and that the paper should be considered in the context of the relevant meeting report.

12.2 The Working Group discussed a range of issues associated with this paper. However, the Working Group identified this as an important issue and agreed that a mechanism be developed to ensure the information on which the outcomes of the working groups are based are made more available to a wider audience. The Working Group could not agree on any recommendations on how to facilitate this and recommended that the Scientific Committee consider this issue that relates to all of its working groups.

CCAMLR response to WG-FSA-13/P02

12.3 The Working Group discussed WG-FSA-13/P02 regarding CCAMLR's management of toothfish stocks in the Southern Ocean, and in particular the Ross Sea. The paper focused on issues related to CCAMLR decision rules, population dynamics including estimates of population size and future uncertainty in stock status, and the ecosystem effects of fishing.

12.4 The Working Group identified a number of inconsistencies throughout the paper and an apparent lack of understanding of many of the issues discussed, including how CCAMLR decision rules are formulated and applied, misconceptions about CCAMLR's ecosystem approach to fishing and many incorrect assumptions about the workings of the Ross Sea stock assessment itself and the science supporting its application. A lack of engagement with CCAMLR Member scientists exacerbated these issues as it restricted the author's access to working group literature; much of the detail is only available in working group documents and reports.

12.5 The Working Group requested that appropriate experts develop a manuscript in the form of a background paper to the Scientific Committee for discussion. Following discussion at the Scientific Committee, the authors will seek to have it published in the same journal (*Antarctic Science*) as an informed perspective to the Abrams manuscript detailing the mechanisms CCAMLR has in place to manage fisheries: embracing the precautionary

approach through its decision rules, focus on the ecosystem effects of fishing, utilisation of robust peer review, proactive seabird and by-catch mitigation policies and binding conservation measures. In addition, the Working Group agreed that the paper should characterise the large volume of work underpinning the Ross Sea stock assessment, how it is implemented using the precautionary approach and how key uncertainties have been addressed or are planned to be addressed through active research programs, for example, the ongoing surveys of the sub-adult toothfish, structured tagging programs and the development of spatial population operating models.

12.6 Therefore, a brief background paper will be submitted to the Scientific Committee at its 2013 meeting addressing the key points raised in the paper pertaining to CCAMLR fisheries science in general, CCAMLR toothfish fisheries and, in particular, the Ross Sea toothfish fishery. The authors invite members of the Scientific Committee to discuss, contribute to and add their affiliation to the paper in order that it reflects the views of as many CCAMLR scientific experts as possible. The intention is to make this paper available to *Antarctic Science* immediately, so as to provide an informed alternative and balanced perspective on the Ross Sea stock assessment and the performance of CCAMLR's fishery management systems.

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

13.1 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.

13.2 The Working Group provided advice to the Scientific Committee and other working groups on the following topics.

(i) Fishery reports –

  (a) review of procedure for updating and publishing (paragraph 2.5).

(ii) IUU fishing activities –

  (a) request that SCIC examine VMS and C2 data to further clarify the proximity of vessels during steaming and fishing operations (paragraph 3.6).

(iii) Assessed fisheries –

  (a) *C. gunnari* in Subarea 48.3 (paragraph 4.7)

  (b) *C. gunnari* in Division 58.5.2 (paragraph 4.16)

  (c) *D. eleginoides* in Subarea 48.3 (paragraphs 4.23 and 4.24)

  (d) *Dissostichus* spp. in Subarea 48.4 (paragraphs 4.34 and 4.37)

  (e) *D. eleginoides* in Division 58.5.1 (paragraph 4.61)

(f) *D. eleginoides* in Division 58.5.2 (no advice, see paragraphs 4.54 to 4.56)

(g) *D. eleginoides* at Crozet Islands (paragraph 4.65)

(h) *D. eleginoides* at Prince Edward and Marion Islands (no advice, see paragraph 4.66)

(i) *Dissostichus* spp. in Subarea 88.1 and SSRUs 882A and 882B (paragraphs 4.71, 4.73, 4.76, 4.80 and 4.107)

(j) *Dissostichus* spp. in Subarea 88.2 (SSRUs 882C–G and 882H) (paragraphs 4.89 and 4.92)

(k) CASAL version control and validation (paragraphs 4.97 and 4.98)

(l) data weighting (paragraph 4.103)

(m) cryptic biomass (paragraph 4.105)

(n) summary of catch limits (Table 3).

(iv) Data-poor fisheries for *Dissostichus* spp. –

(a) submit research plans separately from the notifications (paragraph 6.1)

(b) development and revision of research plans (paragraph 6.3)

(c) by-catch in research blocks (paragraphs 6.7, 6.8, 6.63 and 6.65)

(d) minimum separation distance between research sets (paragraph 6.9)

(e) research fishing outside research blocks (paragraph 6.21)

(f) requirements for multi-Member, multi-vessel research plans (paragraph 6.22)

(g) catch limits for *Dissostichus* spp. (paragraphs 6.28, 6.39, 6.40, 6.43, 6.45, 6.48, 6.52, 6.57, 6.67 to 6.69 and Table 13).

(v) Research fishing in other areas –

(a) *Dissostichus* spp. in Subarea 48.2 (paragraph 6.76)

(b) *Dissostichus* spp. in Subarea 48.5 (paragraph 6.86 to 6.88)

(c) *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b (paragraphs 6.95 to 6.98)

(d) *Dissostichus* spp. in Subarea 88.3 (no advice, see paragraph 6.99).

(vi) Scheme of International Scientific Observation –

(a) sampling requirements (paragraph 8.13).

(vii) Other matters –

(a) future work (no advice, see paragraphs 11.1, 11.3, 11.4 and 11.5).

ADOPTION OF THE REPORT

14.1 The report of the meeting was adopted.

CLOSE OF MEETING

15.1 At the close of the meeting Dr Belchier thanked all the participants for their constructive engagement that had put in place a very valuable process to review and improve stock assessments and research proposals. He particularly thanked the two subgroup coordinators who had taken on a range of difficult issues and made tangible progress. He also thanked the rapporteurs and the Secretariat for their support to the work of WG-FSA.

15.2 On behalf of the Working Group, Dr Kock (the self-confessed 'dinosaur of WG-FSA') thanked Dr Belchier for the great job he had done in leading the Working Group through some difficult areas, which he acknowledged from his own experience was not always an easy task.

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Table 1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2012/13 (to 20 September 2013 unless otherwise indicated, refer to the *Statistical Bulletin* for previous years).

Target species	Region	CM	Catch (tonnes) of target species		Reported catch (% limit)
			Limit	Reported	
Champsocephalus gunnari	48.3	42-01	2 933	1 354	46
	58.5.2	42-02	679	644	95
Dissostichus eleginoides	48.3	41-02	2 600	2 098	81
	48.4 north of 57°20'S	41-03	63	62	98
	58.5.1 French EEZ[a]	n/a	5 100	3 239	-
	58.5.2	41-08	2 730	2 413	88
	58.6 French EEZ[a]	n/a	700	504	-
	58 South African EEZ[b]	n/a	320	211	-
Dissostichus spp.	48.4 south of 57°20'S	41-03	52	50	96
	48.6	41-04	400	237	59
	58.4.1	41-11	210	48	23
	58.4.2	41-05	70	4	6
	58.4.3a	41-06	32	16	50
	58.4.3b	41-07	0	No fishing	-
	88.1	41-09	3 282	3 155[c]	96
	88.2	41-10	530	476	90
Euphausia superba	48.1, 48.2, 48.3, 48.4	51-01	620 000	212 798	34
	58.4.1	51-02	440 000	No fishing	-
	58.4.2	51-03	452 000	No fishing	-

[a] Reported in fine-scale data to July 2013
[b] Whole EEZ
[c] Does not include the catch taken during the pre-recruit research survey
n/a Not specified by CCAMLR

Table 2: Landings of *Dissostichus eleginoides* (estimated live weight) reported in Catch Documentation Scheme (CDS) fisheries operating outside the Convention Area in the calendar years 2011 to 2013 (to 16 September 2013, refer to the *Statistical Bulletin* for previous years).

Ocean sector	FAO Area	Estimated live weight (tonnes)		
		2011	2012	2013
Southwest Atlantic	41	8 020	7 570	4 991
Southeast Atlantic	47	196	126	-
Western Indian	51	669	298	296
Eastern Indian	57	-	-	-
Southwest Pacific	81	412	377	419
Southeast Pacific	87	4 266	5 685	2 709
Total		13 563	14 057	8 415

Table 3: Recommended catch limits (tonnes) for target and by-catch species in finfish fisheries in Subareas 48.3, 48.4, 88.1 and 88.2 and Division 58.5.2 in 2013/14. ✓ – applicable; shaded area – closed.

Fishery for *Dissostichus eleginoides* in Subarea 48.3 (biennial assessment, advice carried forward to 2014/15)

Fishery area	Target species	By-catch species		
	D. eleginoides	Macrourids	Rajids	Move-on rule
Management area A	0			
Management area B	720	-	-	✓
Management area C	1 680	-	-	✓
Whole fishery	2 400	120	120	✓

Fishery for *Dissostichus eleginoides* in Division 58.5.2 (biennial assessment)

Fishery area	Target species	By-catch species	Move-on rule
	D. eleginoides		
Whole fishery	Refer paragraphs 4.54 to 4.56	Refer CM 33-02	✓

Fishery for *Champsocephalus gunnari* in Subarea 48.3

Fishery area	Target species	By-catch species	Move-on rule
	C. gunnari		
Whole fishery	4 635	Refer CM 33-01	✓

Fishery for *Champsocephalus gunnari* in Division 58.5.2

Fishery area	Target species	By-catch species	Move-on rule
	C. gunnari		
Whole fishery	1 267	Refer CM 33-02	✓

Fishery for *Dissostichus* spp. in Subarea 48.4

Fishery area	Target species		By-catch species		
	Dissostichus spp.		Macrourids	Rajids	Move-on rule
Whole fishery	*D. eleginoides*	45	11	3.5	✓
Whole fishery	*D. mawsoni*	24			

Exploratory fishery for *Dissostichus* spp. in Subarea 88.1

Fishery area	Target species	By-catch species			
	Dissostichus spp.	Macrourids	Rajids	Other species	Move-on rule
SSRUs A, D, E, F, M	0				
SSRUs B, C, G	397	40	50	60	✓
SSRUs H, I, K	2 247	320	112	60	✓
SSRUs J, L	357	70	50	40	✓
Whole fishery	3 044*	430	152	160	✓

* A research catch limit of 43 tonnes is set aside for the sub-adult research survey (paragraph 4.71).

Exploratory fishery for *Dissostichus* spp. in Subarea 88.2

Fishery area	Target species	By-catch species			
	Dissostichus spp.	Macrourids	Rajids	Other species	Move-on rule
SSRUs A, B, I	0				
SSRUs C, D, E, F, G	Refer		Refer CM 33-01		✓
SSRU H	paragraphs 4.89 and 4.92				✓
Whole fishery	266–530				✓

Table 4: MPD estimates of B_0 (tonnes), spawning biomass estimated in 2013 (B_{2013}) and objective functions for two initialisation B_0 and two CASAL versions (2.22 v3982 and 2.30 v4982) for the CASAL assessment of *Dissostichus eleginoides* in Division 58.5.2.

Initialisation B_0 (tonnes)	CASAL 2.22 v3982				CASAL 2.30 v4982			
	B_0	B_{2013}	B_{2013}/B_0	Objective function	B_0	B_{2013}	B_{2013}/B_0	Objective function
90 000	87 537	51 590	0.59	3 629	86 372[1]	50 028	0.58	3 389
120 000	94 794[1]	59 284	0.63	3 431	86 610	50 397	0.58	3 488

[1] Model fit with the lowest objective function.

Table 5: CASAL assessments reported to WG-FSA, Working Group paper reference and 'rev.' version of CASAL used by authors (Secretariat version: rev. 4982).

CASAL assessment		Paper number	CASAL rev.
Species	Area		
D. eleginoides	Division 58.4.3a	WG-FSA-13/04	3600
	Division 58.4.4	WG-FSA-13/35	4923
	Division 58.5.2[1]	WG-FSA-13/24	4982
	Subarea 48.3[2]	WG-FSA-13/30	4686
	Subarea 48.4[3]	WG-FSA-13/31	4686
	Subarea 58.6[4]	WG-FSA-13/05	4686
D. mawsoni	Subarea 88.2 (C–H)	WG-FSA-13/52	4923
	Ross Sea	WG-FSA-13/51	4923

[1] Scenario 2.4 was updated omitting observations for the sub-fisheries Trawl2 and Trawl3, limiting the period of fitting YCS to 1992–2008, and adding a Beverton-Holt stock-recruitment relationship with steepness $h = 0.75$.

[2] The final assessment was based on the '2-fleet' model with commercial catch-at-age and CPUE data separated into two time blocks (1988–1997, 1998–2013). Projections were conducted assuming a lognormal empirical distribution about a truncated time series of YCS (1992–2006).

[3] The final assessment included catch-at-age data for 2011 and 2012 and employed the data-weighting approaches described in Hillary et al. (2006).

[4] Model run 3.2 of WG-FSA-13/05 was updated using the weighting method of Francis (2011a, 2011b); all other parameters were left unchanged. MCMCs were subsequently run on the updated model.

Table 6: Final B_0 (tonnes) estimates reported to WG-FSA and comparison with Secretariat estimates.

Model run	Reported B_0	Secretariat B_0	Difference (%)
D. eleginoides			
Division 58.4.3a	1 403	1 404	0.1
Division 58.4.4			
Base	635	635	0.0
IUU 25%	4 852	4 852	0.0
IUU 100%	17 786	16 580	–6.8
YCS	810	810	0.0
Division 58.5.2	86 372	86 372	0.0
Subarea 48.3	87 665	87 665	0.0
Subarea 48.4	1 311	1 311	0.0
Subarea 58.6	68 323	68 323	0.0
D. mawsoni			
Subarea 88.2 (C–H)			
R1	10 510	10 599	0.8
R2	12 990	13 077	0.7
R3	7 570	7 665	1.3
R4	6 320	6 392	1.1
R5	7 190	7 279	1.2
Ross Sea			
R1	83 920	83 917	0.0
R2	68 820	68 818	0.0
R3	69 460	69 462	0.0

Table 7: Tagging rates (number of fish per tonne of green weight caught) for vessels in the exploratory fisheries for *Dissostichus* spp. in 2012/13 (to 20 September 2013). The minimum required tagging rates are listed in brackets. (Source: catch and effort data (C2) and observer data.)

Flag State	Vessel name	Subarea or division (minimum tagging rate)					
		48.6 (5)	58.4.1 (5)	58.4.2 (5)	58.4.3a (5)	88.1 (1)	88.2 (1)
France	*Saint André*				9.2		
Japan	*Shinsei Maru No. 3*	5.7		5.6	6.0		
Korea, Republic of	*Hong Jin No. 701*					1.1	1.3
	Hong Jin No. 707					1.0	
	Insung No. 3		9.5			1.5	
	Insung No. 5					1.6	
	Kostar					1.1	1.1
	Sunstar					1.2	1.1
New Zealand	*Antarctic Chieftain*						1.1
	Janas					1.0	1.1
	San Aotea II					1.8	
	San Aspiring					1.2	
Norway	*Seljevaer*					1.1	1.2
Russia	*Palmer*						1.0
	Sparta					1.1	1.2
	Ugulan					1.0	
	Yantar 31					1.1	2.1
	Yantar 35					1.1	1.6
South Africa	*Koryo Maru No. 11*	5.2					
Spain	*Tronio*		5.2			1.0	
UK	*Argos Froyanes*					1.0	1.1
	Argos Georgia					1.1	
Ukraine	*Simeiz*					1.2	1.7

Table 8: Tag-overlap statistic (%) (CM 41-01, Annex 41-01/C, paragraph 2ii) for vessels in the exploratory fisheries for *Dissostichus* spp. in 2012/13 (to 20 September 2013). The minimum required statistic was 60% for each species of *Dissostichus* with a catch >10 tonnes in a fishery. Catches of *D. mawsoni* ≤10 tonnes are indicated by an asterisk; catches of *D. eleginoides* did not exceed 10 tonnes. (Source: catch and effort data (C2) and observer data.)

Flag State	Vessel name	Subarea or division					
		48.6	58.4.1	58.4.2	58.4.3a	88.1	88.2
D. mawsoni							
France	*Saint André*				*		
Japan	*Shinsei Maru No. 3*	79		*			
Korea, Republic of	*Hong Jin No. 701*					82	*
	Hong Jin No. 707					82	
	Insung No. 3		*			91	
	Insung No. 5					91	
	Kostar					94	82
	Sunstar					85	*
New Zealand	*Antarctic Chieftain*						86
	Janas					91	82
	San Aotea II					80	
	San Aspiring					93	
Norway	*Seljevaer*					76	*
Russia	*Palmer*						75
	Sparta					*	75
	Ugulan					74	
	Yantar 31					83	*
	Yantar 35					78	*
South Africa	*Koryo Maru No. 11*	68					
Spain	*Tronio*		68			90	
UK	*Argos Froyanes*					91	100
	Argos Georgia					78	
Ukraine	*Simeiz*					43	*

Table 9: Number of *Dissostichus* spp. (a) tagged and released, and (b) recaptured in exploratory fisheries for *Dissostichus* spp. (Source: scientific observer data.)

(a) Number tagged and released

Subarea or division	Season													Total
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
48.6				4	62	171	129		941	1 213	1 308	1 948	1 359	7 135
58.4.1					462	469	1 507	1 134	1 127	627	747	812	260	7 145
58.4.2					342	136	248	673	277	291	408	269	21	2 665
58.4.3a					199	104	9	41	113		14	235	116	831
58.4.3b					231	175	289	417	356	60	62	51		1 641
88.1	326	960	1 068	2 250	3 209	2 972	3 608	2 574	2 943	3 066	3 073	3 751	3 752	33 552
88.2		12	94	433	355	444	278	389	603	325	667	543	508	4 651
Total	326	972	1 162	2 687	4 860	4 471	6 068	5 228	6 360	5 582	6 279	7 609	6 016	57 620

(b) Number recaptured

Subarea or division	Season													Total
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
48.6						3	2		2	10	2	34	18	71
58.4.1							4	6	8	4	5			27
58.4.2									1	1				2
58.4.3a						6		2	2			9	12	31
58.4.3b					1	6	1	1	1	1				11
88.1	1	4	13	32	59	71	206	216	103	250	218	147	223	1 543
88.2				18	17	28	33	36	56	44	60	88	54	434
Total	1	4	13	50	77	114	246	261	173	310	285	278	307	2 119

Table 10: Notifications for exploratory fisheries for *Dissostichus* spp. in 2013/14.

Member and vessel	Subarea/division where fishing has been notified						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
France							
Saint André				✓			
Japan							
Shinsei Maru No. 3	✓	✓	✓	✓		✓	
Korea, Republic of							
Hong Jin No. 701						✓	✓
Hong Jin No. 707						✓	✓
Insung No. 3		✓				✓	✓
Insung No. 5						✓	✓
Kostar						✓	✓
Sunstar						✓	✓
New Zealand							
Antarctic Chieftain						✓	✓
Janas						✓	✓
San Aotea II						✓	✓
San Aspiring						✓	✓
Norway							
Seljevaer						✓	✓
Russia							
Palmer						✓	✓
Sarbay						✓	✓
Sparta						✓	✓
Ugulan						✓	✓
Yantar 31						✓	✓
Yantar 35						✓	✓
South Africa							
Koryo Maru No. 11	✓						
Spain							
Tronio		✓	✓			✓	✓
Ukraine							
Belobog						✓	✓
Poseydon I	✓					✓	✓
Simeiz						✓	✓
UK							
Argos Froyanes						✓	✓
Argos Georgia						✓	✓
Total Members	3	3	2	2	0	8	7
Total vessels	3	3	2	2	0	24	23

Table 11: Research phase for each research block described in research plans for 2014. Phase refers to the phase in the research plan flowchart (Figure 10). TOA – *Dissostichus mawsoni*; TOP – *D. eleginoides*.

Area or SSRU	Block – species	Subarea or SSRU	Research phase
48.5	Option 1-a – TOA	48.5	Biomass estimation
	Option 1* – TOA	48.5	Prospecting
	Option 2* – TOA	48.5	Prospecting
	Option 3* – TOA	48.5	Prospecting
48.6	a-b – TOP	48.6N	Biomass estimation
	b – TOA	48.6N	Biomass estimation
	c – TOA	486D	Biomass estimation
	d – TOA	486E	Biomass estimation
	e – TOA	486BC	Biomass estimation
58.4.1	C-a – TOA	5841C	Biomass estimation
	C-b – TOA	5841C	Biomass estimation
	E-a – TOA	5841E	Biomass estimation
	E-b – TOA	5841E	Biomass estimation
	G – TOA	5841G	Biomass estimation
	C*	5841C	Prospecting
	D*	5841D	Prospecting
	G*	5841G	Biomass estimation – Prospecting
	H*	5841H	Biomass estimation – Prospecting
58.4.2	E – TOA	5842E	Biomass estimation
58.4.4	C – TOP	5844C	Biomass estimation – Assessment development
	D – TOP	5844D	Biomass estimation
58.4.3a	Whole area – TOP	58.4.3a	Biomass estimation – Assessment development

* Refers to research plans in the prospecting phase for which research blocks are not defined.

Table 12: CPUE, vulnerable biomass and seabed area for reference areas (with stock assessments) used in the meeting for CPUE comparison. For Subarea 48.5 the CPUE by analogy method was used only in the research block (Option 1-a, Table 13). TOA – *Dissostichus mawsoni*; TOP – *D. eleginoides*.

Reference area	Species	CPUE kg/km (years)	Vulnerable biomass (year)	Seabed area (km^2)	Targeted areas for comparison
Ross Sea	TOA	177 (2010–2013)	64 209 (2013)	115 000	48.5, 48.6S, 58.4.1, 58.4.2
882H	TOA	99 (2010–2013)	5 000 (2013)	5 227	48.6N
48.4S	TOA	34 (2011–2013)	640 (2013)	11 033	48.6N
48.4N	TOP	53 (2011–2013)	1 025 (2012)	7 710	48.6N, 58.4.3a, 58.4.4

Table 13: Estimates of local biomass, local exploitation rate and tag recaptures associated with recommended research catch limits within research blocks (recommended research catches associated with the Spanish depletion experiment described in WG-FSA-13/15 and the prospecting phase of research in Subarea 48.5 (WG-FSA-13/09) are also shown, denoted by *). With two exceptions, all research catches are recommended by WG-FSA as an appropriate basis by which to conduct research in particular blocks or areas, to be revised and updated on an annual basis. Associated catch limits recommended for 2013/14 are in Table 14. The research blocks for which consensus advice from WG-FSA was not achieved are as follows: (i) two catch limits are shown for *Dissostichus eleginoides* (TOP) in research blocks 48.6a and b, arising from alternate biomass estimation methods; and (ii) a range of catch limits is shown for *D. mawsoni* (TOA) in research block 48.6d, arising from different interpretations of the plausibility of the CPUE-based biomass estimate in this research block.

Area or SSRU	Block – species	SSRU	Biomass estimation method	Local biomass	2013 tags predicted	2013 tags observed	2014 recommended catch limit	2014 local exploitation rate	Proportion of fishable depths (600–1 800 m) in SSRU contained in research blocks	2014 tags available	2014 tag recaptures estimated
48.5	Option 1-a		CPUE RSR	2 562	0.0	0	60	0.023		233	5.5
	Option 1*		n/a	n/a	n/a	n/a	213	n/a	n/a	n/a	n/a
	Option 2*		n/a	n/a	n/a	n/a	48	n/a	n/a	n/a	n/a
	Option 3*		n/a	n/a	n/a	n/a	112	n/a	n/a	n/a	n/a
48.6A, G	a, b – TOP	486A, G	Petersen	351	2.9	0	14	0.040	[1.000]*	366	14.6
			CPUE 484N	697	1.5	0	28	0.040	[1.000]*	366	14.7
	b – TOA	486A, G	CPUE 882H	6 886	8.7	6	170	0.025		1 079	26.6
48.6	c – TOA	486D	CPUE 882H	3 624	8.4	2	50	0.014		752	10.4
	d – TOA		CPUE RSR	2 515	15.3	0	100–150	0.40–0.060	0.650	743	29.5–44.3
	e – TOA	486B, C	CPUE RSR	6 622			190	0.029	0.444	352	10.1
58.4.1	C-a – TOA		CPUE RSR	3 140			125	0.040	0.697	114	4.5
	C-b – TOA		CPUE RSR	2 337			90	0.039		598	23.0
	E-a – TOA	5841E	CPUE RSR	7 061			280	0.040	0.432	226	9.0
	E-b – TOA		CPUE RSR	930			35	0.038	0.432	72	2.7
	G – TOA	5841G	Petersen	674		0	26	0.039	0.206	369	14.2
	C*			n/a	n/a		42	n/a	n/a	n/a	n/a
	D*			n/a	n/a		42	n/a	n/a	n/a	n/a
	G*			n/a	n/a		42	n/a	n/a	n/a	n/a
	H*			n/a	n/a		42	n/a	n/a	n/a	n/a
58.4.2	E – TOA		CPUE RSR	877	1.0		35	0.040		214	8.5
58.4.4a, b	C – TOA		CASAL	635	6.8	3	25	0.039	1.000	215.5	8.5
	D – TOA		CPUE 5844-C	870	0.8	0	35	0.040	1.000	39.2	1.6
58.4.3a	Whole		Petersen	372	15.0	11	32	0.086	1.000	353	30.4
	Whole		CPUE 484N	2 798	2.0	11	32	0.011	1.000	353	4.0

* To be updated

Table 14: Recommended catch limits (tonnes) for *Dissostichus* spp. in Subareas 48.5 and 48.6 and Divisions 58.4.1, 58.4.2, 58.4.4 and 58.4.3a in 2013/14.

Subarea/division	SSRUs	Catch limit (tonne)	
		D. eleginoides	*D. mawsoni*
48.5	-	-	433
48.6	North A and G	14–28	170
	South B–F	-	340–390
58.4.1	C	-	257*
	D		42*
	E	-	315
	G	-	42*
	H		42*
58.4.2	E	-	35
58.4.4	C	25	-
58.4.3a	A	32–25	-

* Includes 42 tonnes for depletion experiments.

Table 15: Observer sampling requirements for *Dissostichus* spp. 2013/14.

1. Observer sampling requirements for *Dissostichus* spp. in longline fisheries based on the data collection plan described in WG-FSA-10/32 (SC-CAMLR-XXIX, Annex 8, paragraph 5.34; SC-CAMLR-XXIX, paragraph 3.187). These sampling requirements serve as the default sampling requirements by subarea or division, unless alternative sampling requirements are agreed through the research plan review process. General sampling requirements are listed in Annex 1 of the CCAMLR Scheme of International Scientific Observation.

2. Biological measurements Type I: includes species, total length, sex, and gonad stage as per CM 41-01, Annex 41-01/B, paragraph 6.

3. Biological measurements Type II: includes species, total length, sex, gonad stage and total weight as per CM 41-01, Annex 41-01/B, paragraph 6.

4. Biological measurements Type III: includes otolith samples and all Type II data.

5. All recaptured toothfish should be sampled as Type III in addition to the sample number in the table.

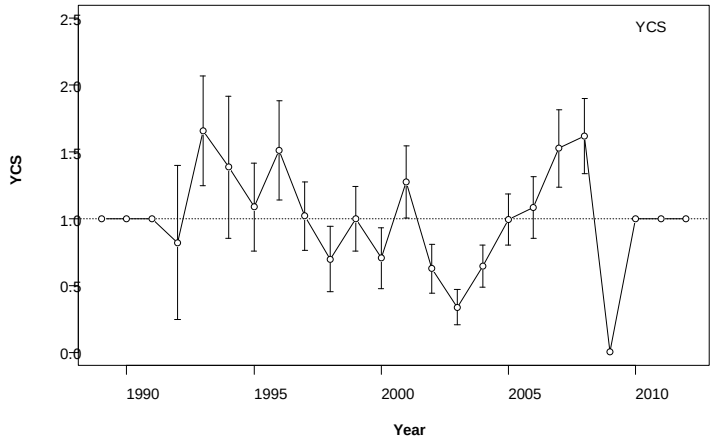
Sample numbers in the table below indicate sampling of all fish up to the number listed in the table.

Fisheries in subarea/division	Species/group	Type I	Type II	Type III
48.2, 48.5, 58.4.4a, 58.4.4b, 88.3	*D. mawsoni*	70	30	10
	D. eleginoides	70	30	10
48.6, 58.4.1, 58.4.2, 58.4.3a	*D. mawsoni*	70	30	10
	D. eleginoides	70	30	10
88.1, 88.2	*D. mawsoni*	n/a	35	10
	D. eleginoides	n/a	35	10

Biological measurements to be recorded for each sample type for *Dissostichus* spp.

Sample type	Total samples per set	Total length	Sex	Gonad stage	Weight	Otoliths
Type I	100	■	■	■		
Type II	30	■	■	■	■	
Type III	10	■	■	■	■	■

(a)



(b)

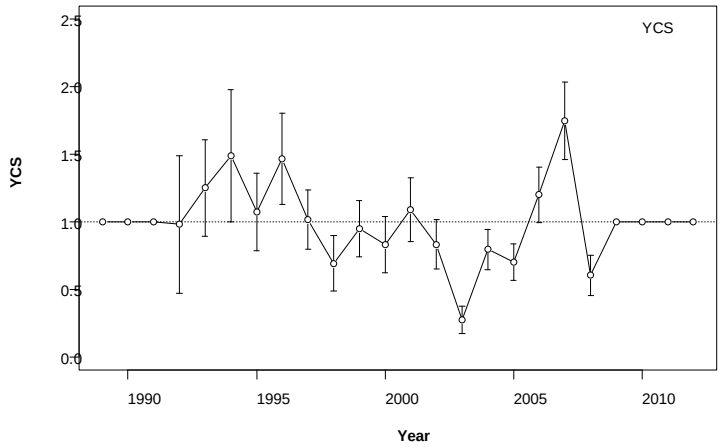


Figure 1: Estimated year-class strength (YCS) with SE (a) for preferred scenario in WG-FSA-13/24 with YCS estimated for 1992–2009; (b) for final model structure with YCS estimated for 1992–2008.

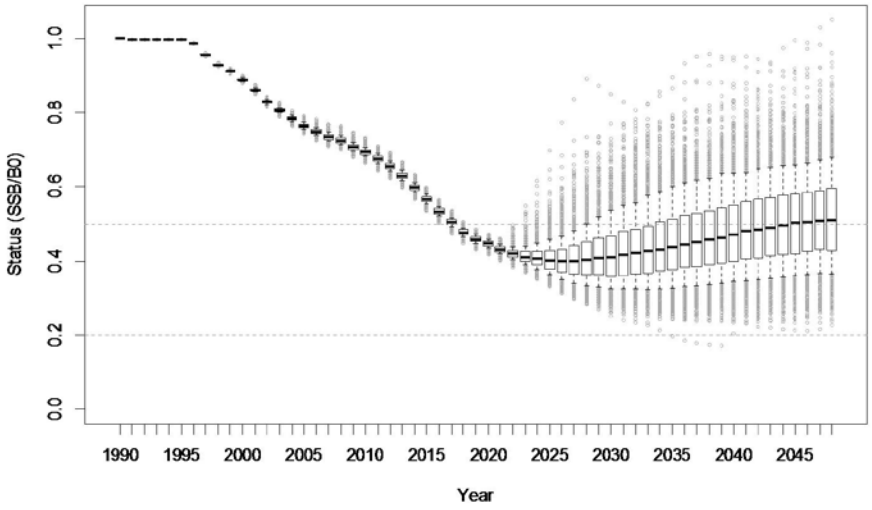


Figure 2: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 3 005 tonnes, for model structure of preferred scenario in WG-FSA-13/24.

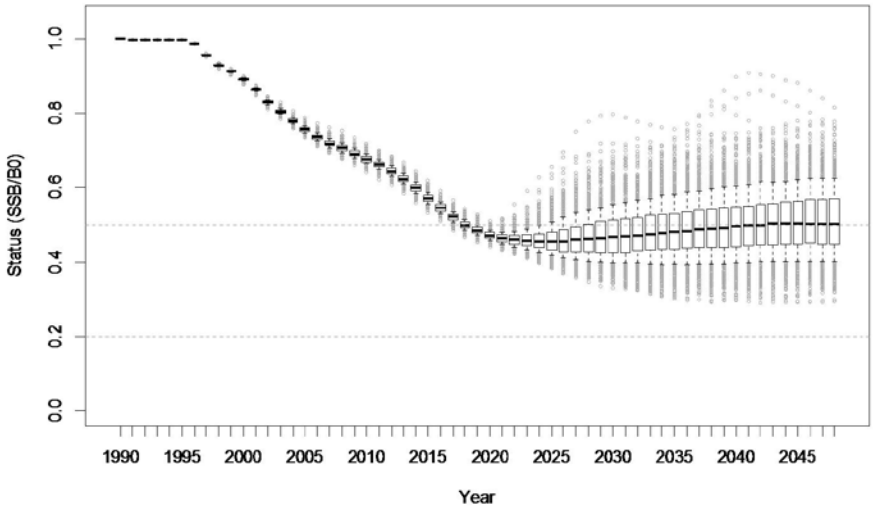


Figure 3: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 770 tonnes, for final model structure using CASAL version 2.22 v3982.

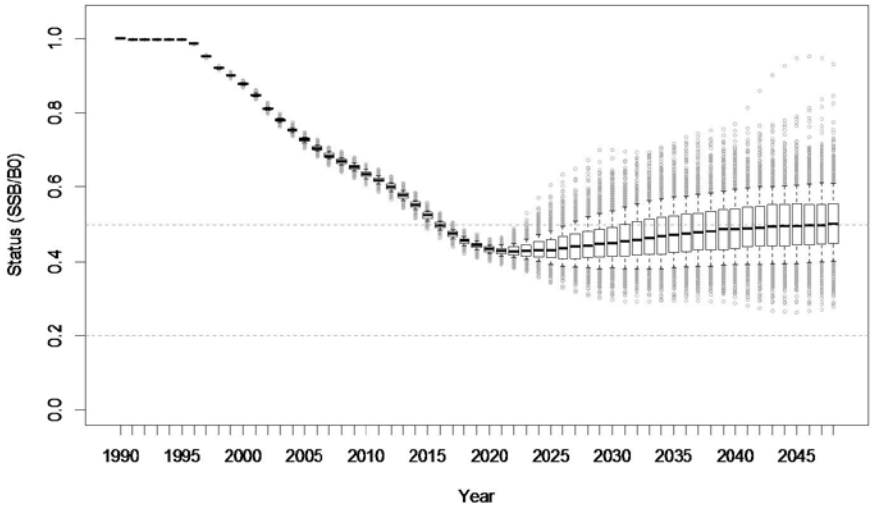


Figure 4: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 500 tonnes, for final model structure using CASAL version 2.30 v4982.

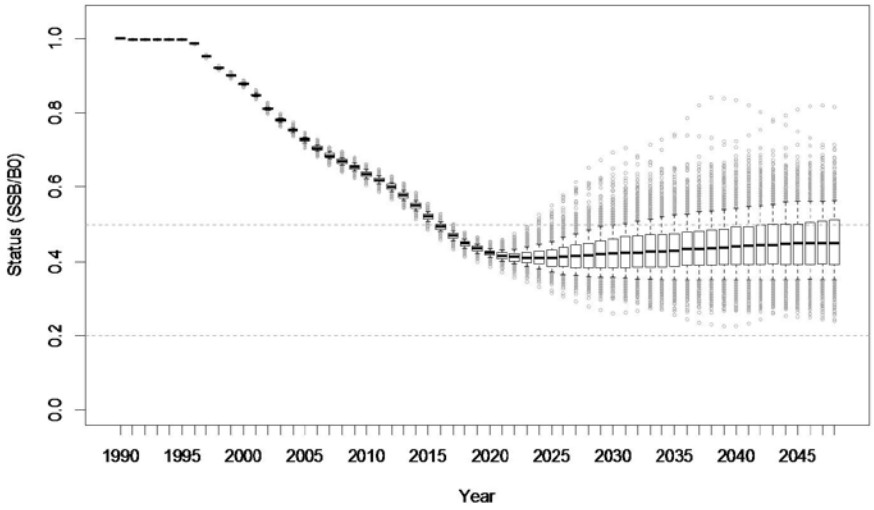


Figure 5: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 770 tonnes, for final model structure using CASAL version 2.30 v4982.

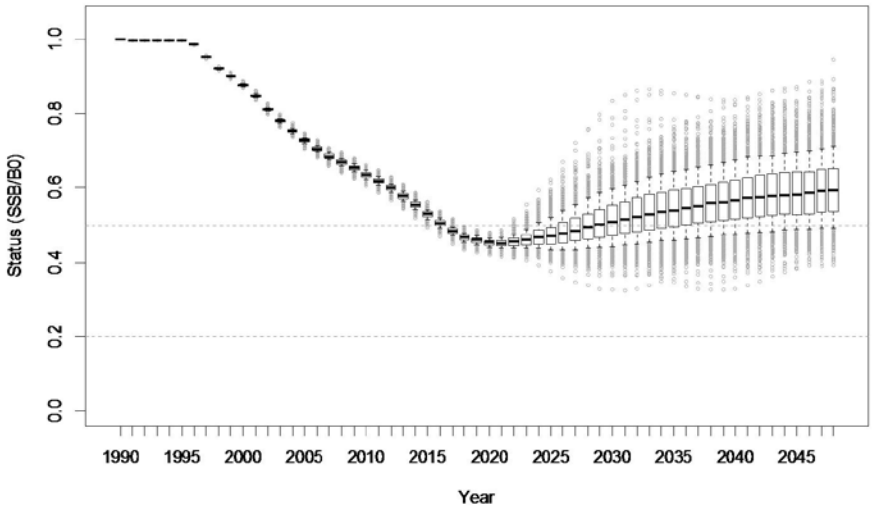


Figure 6: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 000 tonnes, for final model structure using CASAL version 2.30 v4982.

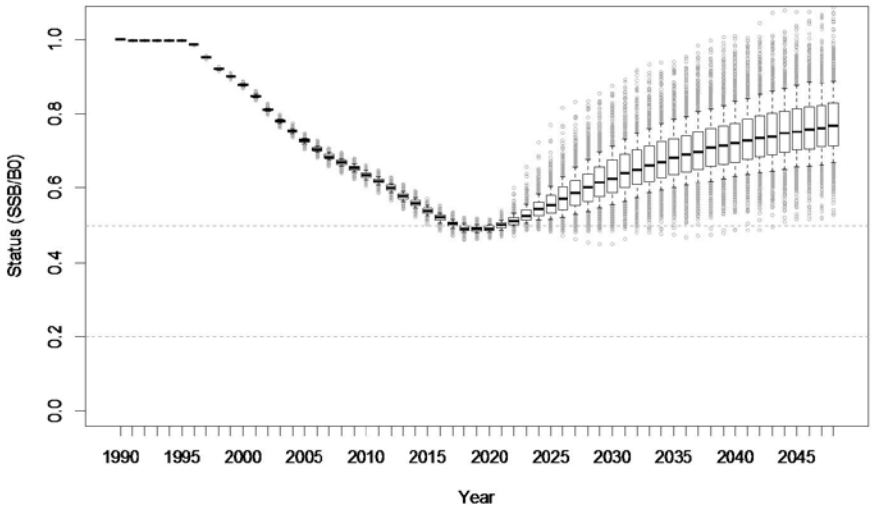


Figure 7: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 1 000 tonnes, for final model structure using CASAL version 2.30 v4982.

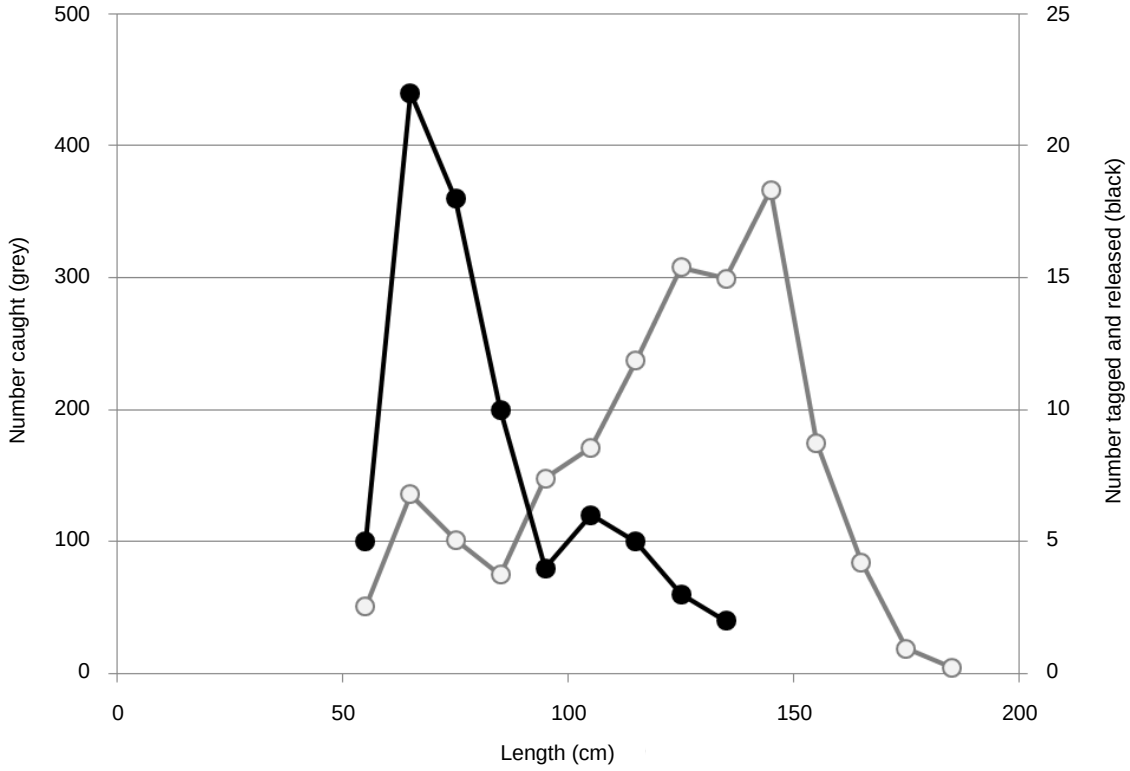


Figure 8: Length frequencies of *Dissostichus mawsoni* caught (grey line) and tagged and released (black line) by the *Simeiz* in Subarea 88.1 in 2012/13. The tag-overlap statistic is 43% (see Table 8).

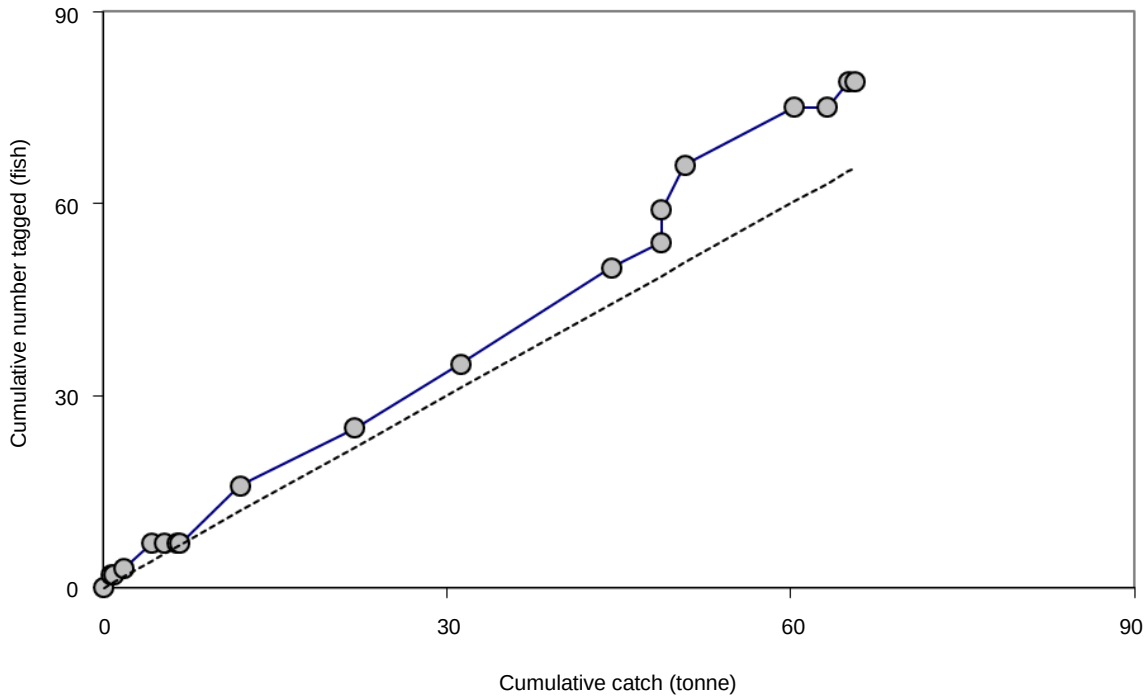
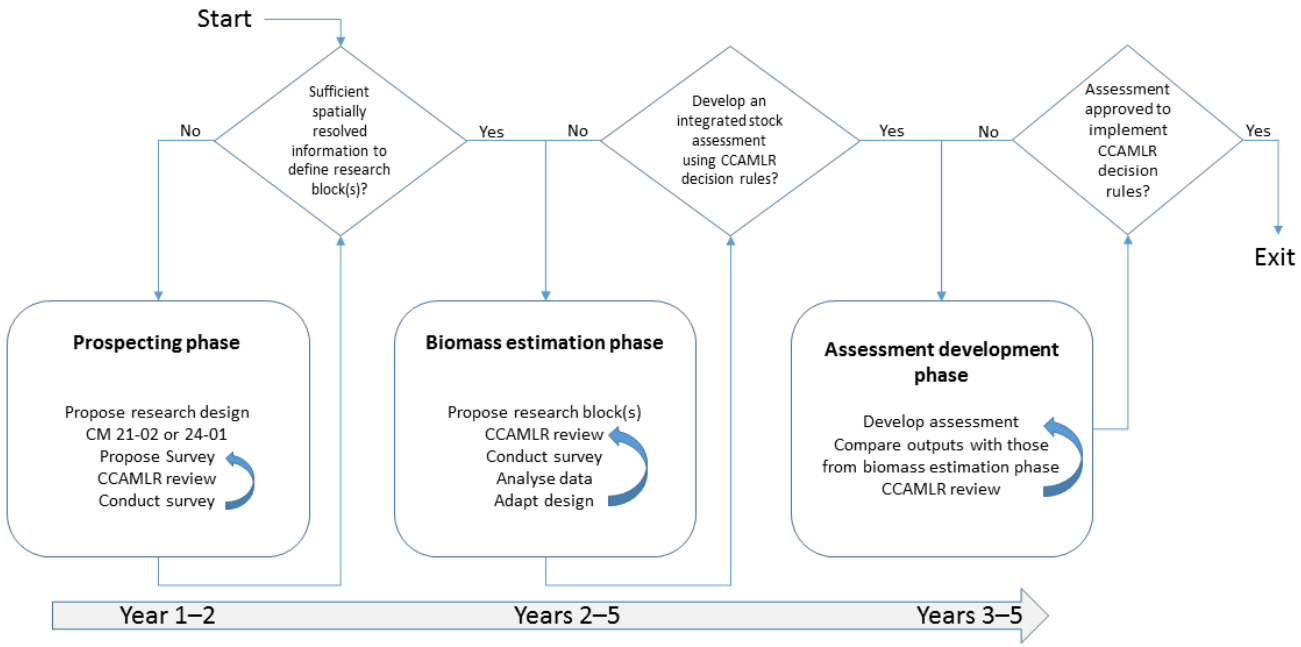


Figure 9: Cumulative catch of *Dissostichus mawsoni* versus cumulative number of fish tagged and released (grey line) by the *Simeiz* in Subarea 88.1 in 2012/13. The required minimum tagging rate was 1 fish per tonne of green weight caught (dashed line); the vessel exceeded the minimum rate throughout fishing and achieved an overall rate of 1.2 fish per tonne of green weight caught (see Table 7).



Prospecting phase

- See WG-SAM-11, paragraph 2.49, WG-SAM-13, paragraph 2.7.
- Research is effort limited, with a research catch limit based on an analogous high CPUE.
- Effort should be spatially distributed throughout the area (shorter line lengths and wider line spacing preferred) to characterise CPUE in the area.
- Tagging should be at a high rate
- Biological sampling should be at a high rate (length, weight, gonad weight, otoliths, diet).

Biomass estimation phase

- See WG-SAM-11, paragraph 2.49, WG-SAM-13, paragraph 2.7
- Each research block should be a defined area with fishable bathymetry 600–1 800 m, with locally high CPUE and likely annual access.
- Generate preliminary estimates of local biomass using CPUE x fishable area (WG-SAM-11, paragraph 2.49(ii)). Where tag recaptures are available also use the Chapman estimator.
- Research is catch limited. Catch based on the projection of at least six expected tag recaptures and not to exceed a precautionary exploitation rate at the scale of the stock or SSRU.
- Develop stock hypothesis and account for stock removals.
- Collect biological sampling to develop data for future stock assessment (length, weight, gonad weight, otoliths, diet).
- Conduct ancillary analyses to support stock assessment (e.g. length at age, IUU catch history, age at maturity, suitability of fish for tagging).

Assessment phase

- As a time series of biomass estimates is developed (e.g. from tagging data or depletion experiments), supporting data (e.g. length at age, IUU catch estimates) should be used in preliminary integrated stock assessments to estimate biomass and yield using CCAMLR decision rules.
- As these models are developed and reviewed, an increase in robustness of biomass and status estimates is expected between different estimation methods (e.g. CPUE x seabed area, Chapman estimator, CASAL stock status).

Figure 10: Research plan flowchart describing key aspects of the prospecting phase, biomass estimation phase and assessment phase, and the means of transiting between phases.

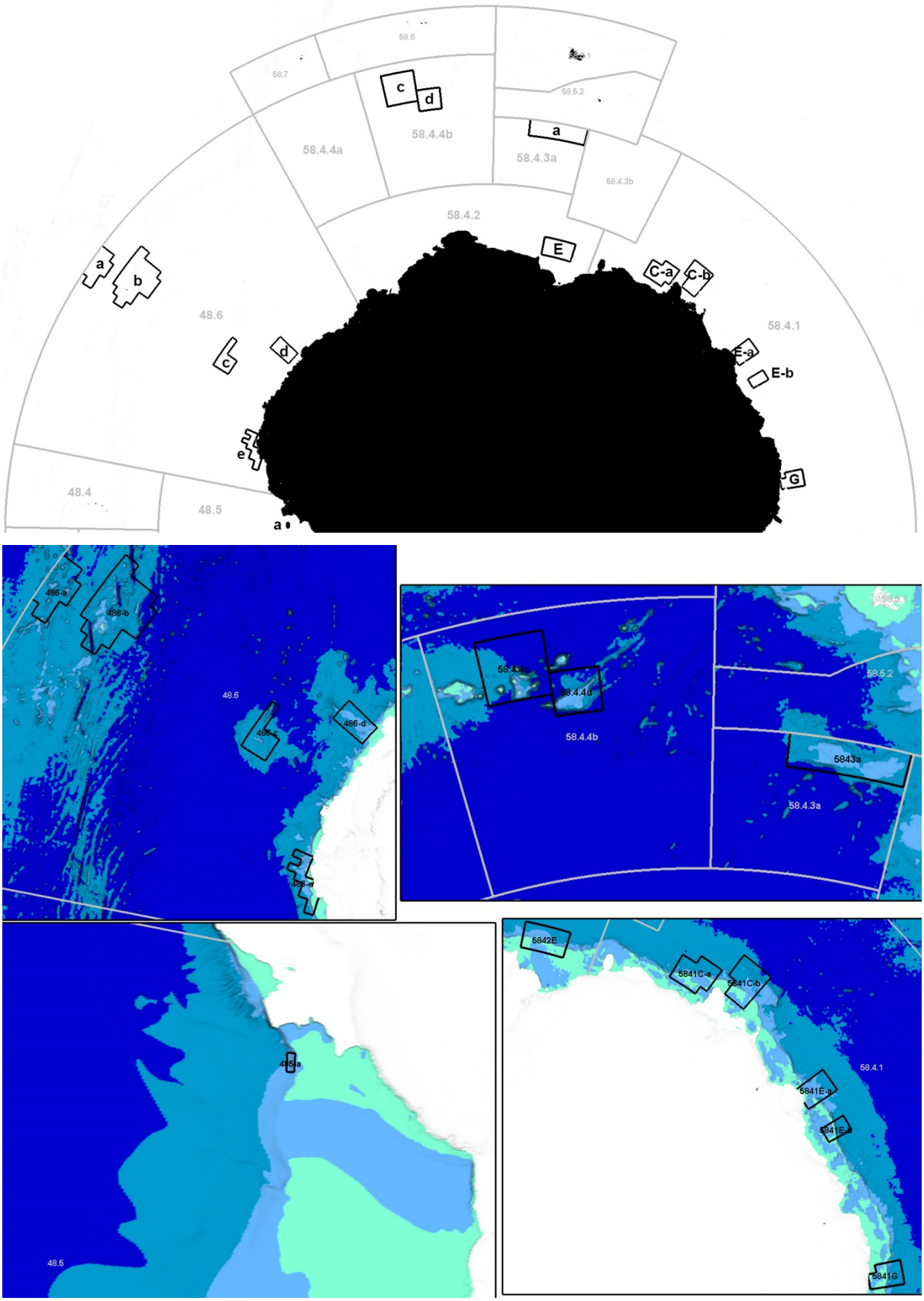


Figure 11: Location of research blocks (top) and close-ups, including the Gebco bathymetry.

Appendix A

LIST OF PARTICIPANTS

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(Hobart, Australia, 7 to 18 October 2013)

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Publications Assistant	Sarah Mackey
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French Translator	Bénédicte Graham
French Translator	Floride Pavlovic
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Russian Translator	Blair Denholm
Russian Translator	Vasily Smirnov
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Spanish Translator	Jesús Martínez García
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Print Production (temporary position)	Tristan Long
Information Technology	
IT Manager	Tim Jones
Systems Analyst	Ian Meredith

Appendix B

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 18 October 2013)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

    2.1 Organisation of the meeting
    2.2 Subgroup organisation and coordination

3. Review of available information

    3.1 Data requirements

4. Preparation for assessments and assessment timetable

    4.1 Report from the Working Group on Statistics, Assessments and Modelling (WG-SAM)
    4.2 Review of preliminary assessments
    4.3 Assessments and management advice
    4.4 Update Fishery Reports for established fisheries

5. New and exploratory fisheries

    5.1 Exploratory fisheries in 2012/13
    5.2 New and exploratory fisheries notified for 2013/14
    5.3 Update Fishery Reports for new and exploratory fisheries

6. Research to inform current or future assessments

    6.1 Review of proposals for research fishing in 2013/14
    6.2 Assessment and management advice for depleted and recovering stocks

7. Bottom fishing activities and vulnerable marine ecosystems (VMEs)

    7.1 Review of fishery and research-based VME notifications for 2012/13
    7.2 Report on Bottom Fisheries and Vulnerable Marine Ecosystems

8. Scheme of International Scientific Observation

9. Non-target catch in CCAMLR Fisheries

    9.1 Fish and invertebrate by-catch
    9.2 Marine mammal and seabird by-catch

10. Biology, ecology and interactions in fish-based ecosystems

11. Future work

    11.1 Organisation of intersessional activities in subgroups
    11.2 Intersessional meetings
    11.3 Notification of scientific research

12. Other business

13. Advice to Scientific Committee

14. Adoption of the report and close of the meeting.

Appendix C

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 18 October 2013)

WG-FSA-13/01	An analysis of within-season recaptures of tagged toothfish Secretariat
WG-FSA-13/02	Vacant
WG-FSA-13/03	Vacant
WG-FSA-13/04	A proposal for a research plan for the exploratory longline fishery for *Dissostichus* spp. in 2013/14 in Division 58.4.3a A. Rélot-Stirnemann (France)
WG-FSA-13/05	Preliminary stock assessment of Patagonian toothfish (*Dissostichus eleginoides*) in the vicinity of Crozet Islands (part of Subarea 58.6). R. Sinegre and G. Duhamel (France)
WG-FSA-13/06	Assessment of incidental catches of seabirds in the French EEZ included in Division 58.5.1 and Subarea 58.6 C. Marteau (France)
WG-FSA-13/07	Low genetic diversity and temporal stability in the Antarctic toothfish (*Dissostichus mawsoni*) from near-continental seas of the Antarctica N.S. Mugue, A.F. Petrov, D.A. Zelenina, I.I. Gordeev and A.A. Sergeev (Russia)
WG-FSA-13/08	Guidelines to whale photo-identification from fishing boats derived from experience in Kerguelen (ASD 58.5.1) and Crozet (ASD 58.6). N. Gasco, P. Tixier and C. Guinet (France)
WG-FSA-13/09	Plan of research program of the Russian Federation in Subarea 48.5 (Weddell Sea) in season 2013/14 A.F. Petrov, I.I. Gordeev and K.V. Shust (Russia)
WG-FSA-13/10	Research plan to investigate finfish distribution and abundance in Subareas 48.1 and 48.2 Delegation of Chile

WG-FSA-13/11	Results of research program of the Russian Federation in Subarea 48.5 (Weddell Sea) in season 2012/13 A.F. Petrov, I.I. Gordeev and E.F. Uryupova (Russia)
WG-FSA-13/12	Proposal of the Russian Federation to open Subarea 88.3 for exploratory fishery of *Dissostichus* spp. Delegation of the Russian Federation
WG-FSA-13/13	Proposal of the Russian Federation to open SSRU 882A for exploratory fishery of *Dissostichus* spp. Delegation of the Russian Federation
WG-FSA-13/14	Review of *Dissostichus* spp. fishery in the adjacent seas of three Antarctic sectors in 2003–2010 A.F. Petrov (Russia)
WG-FSA-13/15	Research plan for the Spanish exploratory longline fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2: Update of stage 2 (2013/14 season) and preliminary results of stage 1 (2012/13 season) according to WG-SAM advice R. Sarralde, L.J López Abellán and S. Barreiro (Spain)
WG-FSA-13/16	Size-age composition and growth of Antarctic toothfish *Dissostichus mawsoni* in the Weddell Sea E.N. Kyznetsova, A.F. Petrov and I.I. Gordeev (Russia)
WG-FSA-13/17	Report of the 2013 UK South Georgia Groundfish Survey (CCAMLR Subarea 48.3) M. Belchier, S. Gregory, K. Brigden, D. Johnston, N. Fallon and L. Featherstone (United Kingdom)
WG-FSA-13/18	On accidental catch of *Champsocephalus gunnari* while fishing of the Antarctic krill off the South Orkney Islands (Subarea 48.2) in 2013 L. Pshenichnov (Ukraine)
WG-FSA-13/19	Proposal to extend fishing season in the Patagonian toothfish longline fishery in CCAMLR Statistical Division 58.5.2 J. Barrington and B. Baker (Australia)
WG-FSA-13/20	Proposal to extend trial of daytime setting of longlines between 15 and 30 April in the Patagonian toothfish longline fishery in CCAMLR Statistical Division 58.5.2 J. Barrington and B. Baker (Australia)

WG-FSA-13/21	The 2013 annual random stratified trawl survey to estimate the abundance of *Dissostichus eleginoides* and *Champsocephalus gunnari* in the waters of Heard Island (Division 58.5.2). G.B. Nowara, T.D. Lamb and D.C. Welsford (Australia)
WG-FSA-13/22	Skate tagging in the Heard Island and McDonald Island (Division 58.5.2) toothfish fishery up to 2013 G.B. Nowara, T.D. Lamb and D.C. Welsford (Australia)
WG-FSA-13/23	A preliminary assessment of mackerel icefish (*Champsocephalus gunnari*) in Division 58.5.2, based on results from the 2013 random stratified trawl survey D.C. Welsford (Australia)
WG-FSA-13/24	Integrated stock assessment for the Heard Island and the McDonald Islands Patagonian toothfish (*Dissostichus eleginoides*) fishery (Division 58.5.2) P. Ziegler, S. Candy and D. Welsford (Australia)
WG-FSA-13/25	Analytical data on determination of reproductive potential of Antarctic toothfish *D. mawsoni* in the Pacific (SSRUs 88.1, 88.2, 88.3), Indian Ocean (SSRUs 58.4.1 and 58.4.2) and Atlantic (SSRU 48.6) Antarctic areas S.V. Piyanova and A.F. Petrov (Russia)
WG-FSA-13/26	Decadal trends in the South Georgia demersal fish assemblage M. Belchier (United Kingdom)
WG-FSA-13/27	Preliminary assessment of Subarea 48.3 mackerel icefish, *Champsocephalus gunnari*, based on the January 2013 survey C. Darby and T. Earl (United Kingdom)
WG-FSA-13/28	An overview of the elasmobranch fish of the Southern Ocean J.R. Ellis, S.R. McCully, V.V. Laptikhovsky and R. Scott (United Kingdom)
WG-FSA-13/29	A brief characterisation of Patagonian toothfish tag survival and tag detection in CCAMLR Statistical Area 48.3 M. Soeffker and R. Scott (United Kingdom)
WG-FSA-13/30	Preliminary assessment of Patagonian toothfish in Subarea 48.3 R. Scott (United Kingdom)

WG-FSA-13/31	Preliminary assessment of Patagonian toothfish in Subarea 48.4 R. Scott and V. Laptikohvsky (United Kingdom)
WG-FSA-13/32	Review of the efficacy of the early season extension in the Patagonian toothfish fishery in Subarea 48.3 and proposal for further season extension M.A. Collins and K. Ross (United Kingdom)
WG-FSA-13/33	An overview of tagging skates (Rajiformes) and CCAMLR skate tagging data S.R. McCully, D. Goldsmith, G. Burt, R. Scott and J.R. Ellis (United Kingdom)
WG-FSA-13/34	Revised reports on abundance and biological information of toothfish in Division 58.4.4 a & b by *Shinsei Maru No. 3* in 2012/13 season K. Taki, T. Ichii, T. Iwami and M. Kiyota (Japan)
WG-FSA-13/35	Assessment models for Patagonian toothfish in Division 58.4.4, SRU C on Ob and Lena Banks for the years 1989/90 to 2012/13 K. Taki (Japan)
WG-FSA-13/36	Revised research plan for toothfish in Division 58.4.4 a & b by *Shinsei Maru No. 3* in 2013/14 Delegation of Japan
WG-FSA-13/37	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Subarea 48.6 Delegation of Japan
WG-FSA-13/38	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.1 Delegation of Japan
WG-FSA-13/39	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.2 Delegation of Japan
WG-FSA-13/40	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.3a Delegation of Japan
WG-FSA-13/41	The relative by-catches of taxa associated with vulnerable marine ecosystems by autolines and Spanish longlines T. Gerrodette and G.M. Watters (USA)

WG-FSA-13/42	Fatty acid and stable isotope analyses to identify diets of Antarctic toothfish caught in February–March 2013 in the southern Ross Sea (88.1.K) and the eastern Antarctic Sea (58.4.1.C) I. Yeon, Y.J. Kwon, S.G. Choi, D.W. Lee and C.-K. Kang (Republic of Korea)
WG-FSA-13/43	Revised diet composition and feeding strategy of Antarctic toothfish, *Dissostichus mawsoni* in SSRU 58.4.1.C-a for the 2012/2013 Korean exploratory longline fishery I. Yeon, Y.J. Kwon, S.G. Choi, K.J. Seok, D.W. Lee, J.M. Jeong, S.J. Ye, H.J. Kim and G.W. Baeck (Republic of Korea)
WG-FSA-13/44	Revised research plan for the exploratory longline fishery for *Dissostichus* spp. in SSRUs C and E in Division 58.4.1 in 2013/2014 Delegation of the Republic of Korea
WG-FSA-13/45	Revised reproductive analysis of *Dissostichus mawsoni* in SSRU 58.4.1 C for the Korean exploratory longline fishery in 2012/2013 I.J. Yeon, J.S. Lee, Y.J. Kwon, M.A. Jeon, S.K, Choi, K.J. Seok, D.W. Lee, K.Y. Ku and H.J. Kim (Republic of Korea)
WG-FSA-13/46	Plan of research program of the Ukraine in Subarea 48.2 in 2014 (rev. 2 after WG-SAM recommendations) Delegation of Ukraine
WG-FSA-13/47	Revised South African work plan for 2013/14 for the joint Japan/South Africa research on *Dissostichus* spp. in Subarea 48.6 R.W. Leslie and S. Somhlaba (South Africa)
WG-FSA-13/48	A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997–98 to 2012–13 S. Hanchet, S. Mormede and A. Dunn (New Zealand)
WG-FSA-13/49	Descriptive analysis of the toothfish (*Dissostichus* spp.) tagging programme in Subareas 88.1 & 88.2 for the years 2000–01 to 2012–13 S. Parker, A. Dunn, S. Mormede and S. Hanchet (New Zealand)
WG-FSA-13/50	Pairwise tag performance: testing the sensitivity of the tag detection index and the mortality of tagged fish index S. Mormede (New Zealand)

WG-FSA-13/51	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea for the years 1997–98 to 2010–13 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-13/52	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2 SSRUs 88.2C–H for the years 2002–03 to 2012–13 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-13/53	A spatially explicit population dynamics operating model for Antarctic toothfish in the habitable depths of the Ross Sea region S. Mormede, A. Dunn, S. Parker and S. Hanchet (New Zealand)
WG-FSA-13/54	Further review of CCAMLR tagging programmes S. Parker and J. Fenaughty (New Zealand)
WG-FSA-13/55	Priority research surveys to address uncertainties in the assessment of toothfish in Subareas 88.1 and 88.2 S. Hanchet, B. Sharp and S. Parker (New Zealand)
WG-FSA-13/56	Steps carried out to check the data inputs to the stock assessment of the Ross Sea region of Antarctica S. Mormede (New Zealand) and S. Thanassekos (CCAMLR Secretariat)
WG-FSA-13/57 Rev. 1	Comparison of catches for toothfish in 58.4.1, 58.4.2, and 48.6 from vessels with anomalous CPUE A. Dunn, B.R. Sharp (New Zealand), C. Darby (United Kingdom) and O.R. Godø (Norway)
WG-FSA-13/58	Report of vulnerable marine ecosystems in South Georgia Islands (CCAMLR Subarea 48.3) through research dredge sampling E. Gaitán, L. Schejter, D. Giberto, M. Escolar and C. Bremec (Argentina)
WG-FSA-13/59	Study on reproductive biology of *Champsocephalus gunnari*, *Chaenocephalus aceratus* and *Pseudochaenichthys georgianus* from South Georgias and Shag Rocks, Dr Eduardo Holmberg survey – May 2013 M.I. Militelli, G.J. Macchi and K.A. Rodrigues (Argentina)
WG-FSA-13/60	Diet components and trophic interactions in five demersal fish in CCAMLR Subarea 48.3 N.R. Marí and G.H. Troccoli (Argentina)

WG-FSA-13/61	Cruise report EH-2013/02 G. Álvarez Colombo, J. Bastida, F. Castro, Á. Cubiella, E. Gaitán, E. Marschoff, P. Martinez, L. Padovani, D. Palmerola, R. Reta, R. Silva, S. Vivequin, O. Wöhler and A. Zavatteri (Argentina)
WG-FSA-13/62	Report on Argentine CCAMLR Subarea 48.3 survey: fish A. Zavatteri and A. Giussi (Argentina)
WG-FSA-13/63	Re-analysis of CPUE in both species of toothfish in 48.6 area R. Wiff, J.C. Quiroz (Chile) and R. Scott (United Kingdom)
WG-FSA-13/64	Population assessment of Antarctic toothfish in Subarea 48.4 using tag-recapture method V. Laptikhovsky (United Kingdom)
WG-FSA-13/65	Comparison of *Champsocephalus gunnari* catches in Subarea 48.3 from1994–97 and 2013 cruises E. Marschoff and P. Martínez (Argentina)
WG-FSA-13/66	Vacant
WG-FSA-13/67	Has climate change promoted genetic fragmentation in the ice-dependent fish *Pleuragramma antarcticum*? C. Agostini, T. Patarnello (Italy), J. Ashford, J. Torres (USA) and L. Zane (Italy)
WG-FSA-13/68 Rev. 1	Summary of scientific observer data collected in the CAMLR Convention Area during 2013 Secretariat
Other documents	
WG-FSA-13/P01	Age validation of juvenile *Notothenia rossii* at Potter Cove, South Shetland Islands, using mark-recapture data E. Moreira, E. Barrera-Oro and M. La Mesa (*Polar Biol*., 2013, doi 10.1007/s00300-013-1392-7)
WG-FSA-13/P02	How precautionary is the policy governing the Ross Sea Antarctic toothfish (*Dissostichus mawsoni*) fishery? P.A. Abrams (*Ant. Sci*, accepted)
WG-FSA-13/P03	Influence of data quality and quantity from a multiyear tagging program on an integrated fish stock assessment P. Ziegler (*Can. J. Fish. Aquat. Sci*., 70 (2013): 1031–1045)

Annex 7

Glossary of acronyms and abbreviations used in SC-CAMLR reports

GLOSSARY OF ACRONYMS AND ABBREVIATIONS USED IN SC-CAMLR REPORTS

AAD	Australian Government Antarctic Division
ACAP	Agreement on the Conservation of Albatrosses and Petrels
ACAP BSWG	ACAP Breeding Sites Working Group (BSWG)
ACC	Antarctic Circumpolar Current
ACW	Antarctic Circumpolar Wave
ADCP	Acoustic Doppler Current Profiler (mounted on the hull)
ADL	Aerobic Dive Limit
AEM	Ageing Error Matrix
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AKES	Antarctic Krill and Ecosystem Studies
ALK	Age–length Key
AMD	Antarctic Master Directory
AMES	Antarctic Marine Ecosystem Studies
AMLR	Antarctic Marine Living Resources
AMSR-E	Advanced Microwave Scanning Radiometer – Earth Observing System
ANDEEP	Antarctic Benthic Deep-sea Biodiversity
APBSW	Bransfield Strait West (SSMU)
APDPE	Drake Passage East (SSMU)
APDPW	Drake Passage West (SSMU)
APE	Antarctic Peninsula East (SSMU)
APEC	Asia-Pacific Economic Cooperation
APECS	Association of Polar Early Career Scientists
APEI	Elephant Island (SSMU)

APEME Steering Committee	Steering Committee on Antarctic Plausible Ecosystem Modelling Efforts
APIS	Antarctic Pack-Ice Seals Program (SCAR-GSS)
APW	Antarctic Peninsula West (SSMU)
ASE	Assessment Strategy Evaluation
ASI	Antarctic Site Inventory
ASIP	Antarctic Site Inventory Project
ASMA	Antarctic Specially Managed Area
ASOC	Antarctic and Southern Ocean Coalition
ASPA	Antarctic Specially Protected Area
ASPM	Age-Structured Production Model
ATCM	Antarctic Treaty Consultative Meeting
ATCP	Antarctic Treaty Consultative Party
ATME	Antarctic Treaty Meeting of Experts on the Impacts of Climate Change for Management and Governance of the Antarctic region
ATS	Antarctic Treaty System
ATSCM	Antarctic Treaty Special Consultative Meeting
AVHRR	Advanced Very High Resolution Radiometry
BAS	British Antarctic Survey
BED	Bird Excluder Device
BICS	Benthic Impact Camera System
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks (SCAR/SCOR)
BROKE	Baseline Research on Oceanography, Krill and the Environment
BRT	Boosted Regression Trees
CAC	Comprehensive Assessment of Compliance
cADL	calculated Aerobic Dive Limit
CAF	Central Ageing Facility

CAML	Census of Antarctic Marine Life
CAMLR Convention	Convention on the Conservation of Antarctic Marine Living Resources
CAML SSC	CAML Scientific Steering Committee
CAR	Comprehensiveness, Adequacy, Representativeness
CASAL	C++ Algorithmic Stock Assessment Laboratory
CBD	Convention on Biodiversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCAMLR-2000 Survey	CCAMLR 2000 Krill Synoptic Survey of Area 48
CCAMLR-IPY-2008 Survey	CCAMLR-IPY 2008 Krill Synoptic Survey in the South Atlantic Region
CCAS	Convention on the Conservation of Antarctic Seals
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CCSBT-ERS WG	CCSBT Ecologically Related Species Working Group
CDS	Catch Documentation Scheme for *Dissostichus* spp.
CDW	Circumpolar Deep Water
CEMP	CCAMLR Ecosystem Monitoring Program
CEP	Committee for Environmental Protection
CF	Conversion Factor
CircAntCML	Circum-Antarctic Census of Antarctic Marine Life
CITES	Convention on International Trade in Endangered Species
CM	Conservation Measure
CMIX	CCAMLR's Mixture Analysis Program
CMP	Conservation Management Plan
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COFI	Committee on Fisheries (FAO)
COLTO	Coalition of Legal Toothfish Operators

CoML	Census of Marine Life
COMM CIRC	Commission Circular (CCAMLR)
COMNAP	Council of Managers of National Antarctic Programs (SCAR)
CON	CCAMLR Otolith Network
COTPAS	CCAMLR Observer Training Program Accreditation Scheme
CPD	Critical Period–Distance
CPPS	Permanent Commission on the South Pacific
CPR	Continuous Plankton Recorder
CPUE	Catch-per-unit-effort
CQFE	Center for Quantitative Fisheries Ecology (USA)
CS-EASIZ	Coastal Shelf Sector of the Ecology of the Antarctic Sea-Ice Zone (SCAR)
CSI	Combined Standardised Index
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CT	Computed Tomography
CTD	Conductivity Temperature Depth Probe
CV	Coefficient of Variation
C-VMS	Centralised Vessel Monitoring System
CVS	Concurrent Version System
CWP	Coordinating Working Party on Fishery Statistics (FAO)
DCD	*Dissostichus* Catch Document
DMSP	Defense Meteorological Satellite Program
DPM	Dynamic Production Model
DPOI	Drake Passage Oscillation Index
DVM	Diel vertical migration
DWBA	Distorted wave Born approximation model
EAF	Ecosystem Approaches to Fishing

EASIZ	Ecology of the Antarctic Sea-Ice Zone
E-CDS	Electronic Web-based Catch Documentation Scheme for *Dissostichus* spp.
ECOPATH	Software for construction and analysis of mass-balance models and feeding interactions or nutrient flow in ecosystems (see www.ecopath.org)
ECOSIM	Software for construction and analysis of mass-balance models and feeding interactions or nutrient flow in ecosystems (see www.ecopath.org)
EEZ	Exclusive Economic Zone
EG-BAMM	Expert Group on Birds and Marine Mammals (SCAR)
EIV	Ecologically Important Value
ENFA	Environmental Niche Factor Analysis
ENSO	El Niño Southern Oscillation
EOF/PC	Empirical Orthogonal Function/Principal Component
EoI	Expression of Intent (for activities in the IPY)
EPOC	Ecosystem, productivity, ocean, climate modelling framework
EPOS	European *Polarstern* Study
EPROM	Erasable Programmable Read-Only Memory
eSB	Electronic version of CCAMLR's *Statistical Bulletin*
ESS	Effective Sample Size(s)
FAO	Food and Agriculture Organization of the United Nations
FEMA	Workshop on Fisheries and Ecosystem Models in the Antarctic
FEMA2	Second Workshop on Fisheries and Ecosystem Models in the Antarctic
FFA	Forum Fisheries Agency
FFO	Foraging–Fishery Overlap
FIBEX	First International BIOMASS Experiment
FIGIS	Fisheries Global Information System (FAO)
FIRMS	Fishery Resources Monitoring System (FAO)

FMP	Fishery Management Plan
FOOSA	Krill–Predator–Fishery Model (previously KPFM2)
FPI	Fishing-to-Predation Index
FRAM	Fine Resolution Antarctic Model
FV	Fishing Vessel
GAM	Generalised Additive Model
GATT	General Agreement on Tariffs and Trade
GBIF	Global Biodiversity Information Facility
GBM	Generalised Boosted Model
GCMD	Global Change Master Directory
GDM	Generalised Dissimilarity Modelling
GEBCO	General Bathymetric Chart of the Oceans
GEOSS	Global Earth Observing System of Systems
GIS	Geographic Information System
GIWA	Global International Waters Assessment (SCAR)
GLM	Generalised Linear Model
GLMM	Generalised Linear Mixed Model
GLOBEC	Global Ocean Ecosystems Dynamics Research
GLOCHANT	Global Change in the Antarctic (SCAR)
GMT	Greenwich Mean Time
GOOS	Global Ocean Observing System (SCOR)
GOSEAC	Group of Specialists on Environmental Affairs and Conservation (SCAR)
GOSSOE	Group of Specialists on Southern Ocean Ecology (SCAR/SCOR)
GPS	Global Positioning System
GUI	Graphical User Interface
GRT	Gross Registered Tonnage

GTS	Greene et al., (1990) linear TS versus length relationship
GYM	Generalised Yield Model
HAC	A global standard being developed for the storage of hydroacoustic data
HCR	Harvest Control Rule
HIMI	Heard Island and McDonald Islands
IA	Impact Assessment
IAATO	International Association of Antarctica Tour Operators
IASOS	Institute for Antarctic and Southern Ocean Studies (Australia)
IASOS/CRC	IASOS Cooperative Research Centre for the Antarctic and Southern Ocean Environment
IATTC	Inter-American Tropical Tuna Commission
ICAIR	International Centre for Antarctic Information and Research
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICED	Integrating Climate and Ecosystem Dynamics in the Southern Ocean
ICES	International Council for the Exploration of the Sea
ICESCAPE	Integrating Count Effort by Seasonally Correcting Animal Population Estimates
ICES WGFAST	ICES Working Group on Fisheries Acoustics Science and Technology
ICFA	International Coalition of Fisheries Associations
ICSEAF	International Commission for the Southeast Atlantic Fisheries
ICSU	International Council for Science
IDCR	International Decade of Cetacean Research
IFF	International Fishers' Forum
IGBP	International Geosphere-Biosphere Programme
IGR	Instantaneous Growth Rate
IHO	International Hydrographic Organisation
IKMT	Isaacs-Kidd Midwater Trawl
IMAF	Incidental Mortality Associated with Fishing

IMALF	Incidental Mortality Arising from Longline Fishing
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research (IGBP)
IMO	International Maritime Organization
IMP	Inter-moult Period
IOC	Intergovernmental Oceanographic Commission
IOCSOC	IOC Regional Committee for the Southern Ocean
IOFC	Indian Ocean Fisheries Commission
IOTC	Indian Ocean Tuna Commission
IPHC	International Pacific Halibut Commission
IPOA	International Plan of Action
IPOA-Seabirds	FAO International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries
IPY	International Polar Year
IRCS	International Radio Call Sign
ISO	International Organization for Standardization
ISR	Integrated Study Region
ITLOS	International Tribunal for the Law of the Sea
IUCN	International Union for the Conservation of Nature and Natural Resources – the World Conservation Union
IUU	Illegal, Unreported and Unregulated
IW	Integrated Weight
IWC	International Whaling Commission
IWC-IDCR	IWC International Decade of Cetacean Research
IWL	Integrated Weighted Line
IYGPT	International Young Gadoids Pelagic Trawl
JAG	Joint Assessment Group
JARPA	Japanese Whale Research Program under special permit in the Antarctic
JGOFS	Joint Global Ocean Flux Studies (SCOR/IGBP)

KPFM	Krill–Predatory–Fishery Model (used in 2005)
KPFM2	Krill–Predatory–Fishery Model (used in 2006) – renamed FOOSA
KYM	Krill Yield Model
LADCP	Lowered Acoustic Doppler Current Profiler (lowered through the water column)
LAKRIS	Lazarev Sea Krill Study
LBRS	Length-bin Random Sampling
LMM	Linear Mixed Model
LMR	Living Marine Resources Module (GOOS)
LSSS	Large-Scale Server System
LTER	Long-term Ecological Research (USA)
M	Natural Mortality
MARPOL Convention	International Convention for the Prevention of Pollution from Ships
MARS	Multivariate Adaptive Regression Splines
MAXENT	Maximum Entropy modelling
MBAL	Minimum Biologically Acceptable Limits
MCMC	Markov Chain Monte Carlo
MCS	Monitoring Control and Surveillance
MDS	Mitigation Development Strategy
MEA	Multilateral Environmental Agreement
MEOW	Marine Ecoregions of the World
MFTS	Multiple-Frequency Method for in situ TS Measurements
MIA	Marginal Increment Analysis
MIZ	Marginal Ice Zone
MLD	Mixed-layer Depth
MODIS	Moderate Resolution Imaging Spectroradiometer
MoU	Memorandum of Understanding

MP	Management Procedure
MPA	Marine Protected Area
MPD	Maximum of the Posterior Density
MRAG	Marine Resources Assessment Group (UK)
MRM	Minimum Realistic Model
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
MV	Merchant Vessel
MVBS	Mean Volume Backscattering Strength
MVP	Minimum Viable Populations
MVUE	Minimum Variance Unbiased Estimate
NAFO	Northwest Atlantic Fisheries Organization
NASA	National Aeronautical and Space Administration (USA)
NASC	Nautical Area Scattering Coefficient
NCAR	National Center for Atmospheric Research (USA)
NEAFC	North East Atlantic Fisheries Commission
NI	Nearest Integer
NIWA	National Institute of Water and Atmospheric Research (New Zealand)
nMDS	non-Metric Multidimensional Scaling
NMFS	National Marine Fisheries Service (USA)
NMML	National Marine Mammal Laboratory (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
NPOA	National Plan of Action
NPOA-Seabirds	FAO National Plans of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries
NRT	Net Registered Tonnage
NSF	National Science Foundation (USA)

NSIDC	National Snow and Ice Data Center (USA)
OBIS	Ocean Biogeographic Information System
OCCAM Project	Ocean Circulation Climate Advanced Modelling Project
OCTS	Ocean Colour and Temperature Scanner
OECD	Organisation for Economic Cooperation and Development
OM	Operating Model
PaCSWG	Population and Conservation Status Working Group (ACAP)
PAR	Photosynthetically Active Radiation
PBR	Permitted Biological Removal
PCA	Principal Component Analysis
PCR	Per Capita Recruitment
pdf	Portable Document Format
PF	Polar Front
PFZ	Polar Frontal Zone
PIT	Passive Integrated Transponder
PRP	CCAMLR Performance Review Panel
PS	Paired Streamer Line
PTT	Platform Terminal Transmitter
RES	Relative Environmental Suitability
RFB	Regional Fishery Body
RFMO	Regional Fishery Management Organisation
RMT	Research Midwater Trawl
ROV	Remotely-Operated Vehicle
RPO	Realised Potential Overlap
RTMP	Real-Time Monitoring Program
RV	Research Vessel
RVA	Register of Vulnerable Areas

SACCB	Southern Antarctic Circumpolar Current Boundary
SACCF	Southern Antarctic Circumpolar Current Front
SAER	State of the Antarctic Environment Report
SAF	Sub-Antarctic Front
SBDY	Southern Boundary of the ACC
SBWG	Seabird Bycatch Working Group (ACAP)
SCAF	Standing Committee on Administration and Finance (CCAMLR)
SCAR	Scientific Committee on Antarctic Research
SCAR-ASPECT	Antarctic Sea-Ice Processes, Ecosystems and Climate (SCAR Program)
SCAR-BBS	SCAR Bird Biology Subcommittee
SCAR-CPRAG	Action Group on Continuous Plankton Recorder Research
SCAR-EASIZ	Ecology of the Antarctic Sea-Ice Zone (SCAR Program)
SCAR-EBA	Evolution and Biodiversity in Antarctica (SCAR Program)
SCAR-EGBAMM	Expert Group on Birds And Marine Mammals
SCAR-GEB	SCAR Group of Experts on Birds
SCAR-GOSEAC	SCAR Group of Specialists on Environmental Affairs and Conservation
SCAR-GSS	SCAR Group of Specialists on Seals
SCAR-MarBIN	SCAR Marine Biodiversity Information Network
SCAR/SCOR-GOSSOE	SCAR/SCOR Group of Specialists on Southern Ocean Ecology
SCAR WG-Biology	SCAR Working Group on Biology
SC-CAMLR	Scientific Committee for the Conservation of Antarctic Marine Living Resources
SC CIRC	Scientific Committee Circular (CCAMLR)
SC-CMS	Scientific Committee for CMS
SCIC	Standing Committee on Implementation and Compliance (CCAMLR)
SC-IWC	Scientific Committee for IWC

SCOI	Standing Committee on Observation and Inspection (CCAMLR)
SCOR	Scientific Committee on Oceanic Research
SCP	Systematic Conservation planning
SD	Standard Deviation
SDWBA	Stochastic Distorted-wave Born Approximation
SEAFO	South East Atlantic Fisheries Organisation
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SG-ASAM	Subgroup on Acoustic Survey and Analysis Methods
SGE	South Georgia East
SGSR	South Georgia–Shag Rocks
SGW	South Georgia West (SSMU)
SIBEX	Second International BIOMASS Experiment
SIC	Scientist-in-Charge
SIOFA	Southern Indian Ocean Fisheries Agreement
SIR Algorithm	Sampling/Importance Resampling Algorithm
SMOM	Spatial Multispecies Operating Model
SNP	Single Nucleotide Polymorphism
SO-CPR	Southern Ocean CPR
SO GLOBEC	Southern Ocean GLOBEC
SOI	Southern Oscillation Index
SO JGOFS	Southern Ocean JGOFS
SOMBASE	Southern Ocean Molluscan Database
SONE	South Orkney North East (SSMU)
SOOS	Southern Ocean Observing System
SOPA	South Orkney Pelagic Area (SSMU)
SOS Workshop	Southern Ocean Sentinel Workshop
SOW	South Orkney West (SSMU)

SOWER	Southern Ocean Whale Ecology Research Cruises
SPA	Specially Protected Area
SPC	Secretariat of the Pacific Community
SPGANT	Ocean Colour Chlorophyll-*a* algorithm for the Southern Ocean
SPM	Spatial Population Model
SSB	Spawning Stock Biomass
SSG-LS	The Standing Scientific Group on Life Sciences (SCAR)
SSM/I	Special Sensor Microwave Imager
SSMU	Small-scale Management Unit
SSMU Workshop	Workshop on Small-scale Management Units, such as Predator Units
SSRU	Small-scale Research Unit
SSSI	Site of Special Scientific Interest
SST	Sea-Surface Temperature
STC	Subtropical Convergence
SWIOFC	Southwest Indian Ocean Fisheries Commission
TASO	ad hoc Technical Group for At-Sea Operations (CCAMLR)
TDR	Time Depth Recorder
TEWG	Transitional Environmental Working Group
TIRIS	Texas Instruments Radio Identification System
TISVPA	Triple Instantaneous Separable VPA (previously TSVPA)
ToR	Term of Reference
TrawlCI	Estimation of Abundance from Trawl Surveys
TS	Target Strength
TVG	Time Varied Gain
UBC	University of British Columbia (Canada)
UCDW	Upper Circumpolar Deep Water
UN	United Nations

UNCED	UN Conference on Environment and Development
UNCLOS	UN Convention on the Law of the Sea
UNEP	UN Environment Programme
UNEP-WCMC	UNEP World Conservation Monitoring Centre
UNFSA	the United Nations Fish Stock Agreement is the 1995 United Nations Agreement for the Implementation of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
UNGA	United Nations General Assembly
UPGMA	Unweighted Pair Group Method with Arithmetic Mean
US AMLR	United States Antarctic Marine Living Resources Program
US LTER	United States Long-term Ecological Research
UV	Ultra-Violet
UW	Unweighted
UWL	Unweighted Longline
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring System
VOGON	Value Outside the Generally Observed Norm
VPA	Virtual Population Analysis
WAMI	Workshop on Assessment Methods for Icefish (CCAMLR)
WC	Weddell Circulation
WCO	World Customs Organization
WFC	World Fisheries Congress
WCPFC	Western and Central Pacific Fisheries Convention
WG-CEMP	Working Group for the CCAMLR Ecosystem Monitoring Program (CCAMLR)
WG-EMM	Working Group on Ecosystem Monitoring and Management (CCAMLR)

WG-EMM-STAPP	Subgroup on Status and Trend Assessment of Predator Populations
WG-FSA	Working Group on Fish Stock Assessment (CCAMLR)
WG-FSA-SAM	Subgroup on Assessment Methods
WG-FSA-SFA	Subgroup on Fisheries Acoustics
WG-IMAF	Working Group on Incidental Mortality Associated with Fishing (CCAMLR)
WG-IMALF	ad hoc Working Group on Incidental Mortality Arising from Longline Fishing (CCAMLR)
WG-Krill	Working Group on Krill (CCAMLR)
WG-SAM	Working Group on Statistics, Assessments and Modelling
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment
WSC	Weddell–Scotia Confluence
WS-Flux	Workshop on Evaluating Krill Flux Factors (CCAMLR)
WS-MAD	Workshop on Methods for the Assessment of *D. eleginoides* (CCAMLR)
WSSD	World Summit on Sustainable Development
WS-VME	Workshop on Vulnerable Marine Ecosystems
WTO	World Trade Organization
WWD	West Wind Drift
WWW	World Wide Web
XBT	Expendable Bathythermograph
XML	Extensible Mark-up Language
Y2K	Year 2000
YCS	Year-class Strength(s)